Bureau of Energy Efficiency
Government of India, Ministry of Power

STATE ENERGY EFFICIENCY ACTION PLAN

GUJARAT

Prepared by
Confederation of Indian Industry

Supported by
Gujarat Energy Development Agency

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सत्यमेव जयते

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) is involved in numerous efforts aimed at developing and implementing energy efficiency programmes. As part of this initiative, BEE has proposed the above assignment, which aims to provide technical assistance for the identification of focus sectors for the "**State Energy Efficiency Action Plan**" in various states/UTs, to ensure that resources are allocated in accordance with state/UT requirements, and to estimate the potential of energy conservation in sectors that are prevalent in the region. The "State Energy Efficiency Action Plan" is sought in two parts: a 5-year short-term strategy and a long-term plan aimed at high-impact energy efficiency by 2031.

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

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 Gujarat.

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 and 2 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 inputs.

CII is grateful to the proactive management of the Gujarat Energy Development Agency (GEDA) 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 Ms. Mamta Verma, IAS, Principal Secretary, Energy & Petrochemicals Department, Mr. Sanjeev Kumar, Principal Secretary Climate Change Department, Mr. Ajay Prakash, IAS, Director, Gujarat Energy Development Agency (GEDA), Mr. S. J. Haider, IAS, Additional Chief Secretary, Industries and Mines Department, Mr. D. J. Jadeja, Chief Town Planning officer, Town Planning and Valuation Department, Mr. Harpal Dave, Additional, Chief Town Planning officer, Town Planning and Valuation Department, Mr. Rajesh Manjhu, IAS, Transport Commissioner, Mr. Dhaval R Gadhvi, IMV (License & EV Policy), Transport Commissioner office, Ms Nita Shukla, Assistant Director of Fisheries, Ms. Amita Pandya, Sr. Project executive, GEDA, Professor Amit Garg, IIM Ahmedabad and PAT cell GEDA who helped to complete the study in a timely manner.

The 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 Gujarat, 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. Gujarat Energy Development Agency (GEDA), with inputs & suggestions from various government departments and sector experts. The primary objective of the State Energy Efficiency Action Plan for Gujarat is to formulate sector-specific strategies in short-term 2025 and long-term 2030 goals for enhancing energy efficiency in the state.

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GLOSSARY

AgDSM	Agriculture Demand side management
ATF	Aviation Turbine Fuel
BEE	Bureau of energy efficiency
BPL	Below Poverty Line
CAGR	Compound annual growth rate
CEA	Central Electricity Authority
DDUGJY	Deendayal Upadhyaya Gram Jyoti Yojana
DISCOM	Distribution company
DSM	Demand side management
ECBC	Energy Conservation Building Codes
EE	Energy Efficiency
ESCO	Energy Service Company
FAME	Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India
FEEED	Framework for Energy Efficient Economic Development
FO	Furnace Oil
GHG	Green House Gases
HHS	Hot Heavy Stock
KMT	Kilo Metric Tonnes
KUSUM	Kisan Urja Suraksha Evam Utthaan Mahabhiyan
LDO	Light Diesel Oil
LPG	Liquefied Natural Gas
LSHS	Low Sulphur Heavy Stock
MNRE	Ministry of New and Renewable Energy
MoP	Ministry of Power
MoPNG	Ministry of Petroleum and Natural Gas

MoU	Memorandum of Understanding
MSME	Micro, Small and Medium Enterprises
MTOE	Million tonnes of Oil Equivalent
MWh	Megawatt Hour
MW	Mega Watt
NITI Aayog	National Institution for Transforming India
NMEEE	National Mission on Enhanced Energy Efficiency
PAT	Perform, Achieve and Trade
PAF	Plant availability factor
RES	Renewable Energy Sources (Includes Electric Generation due to (a) Wind (b) Biomass Power (c) Solar Power (d) Urban & Industrial Wastes & (e) Small Hydro Power Projects of capacity less than or equal to 25 MW.
SDA	State designated agencies
SKO	Superior Kerosene Oil
TFEC	Total Final Energy Consumption
ULB	Urban Local Bodies
UTILITIES	Utility means the electric lines or electrical plant, and includes all lands, buildings, works & materials attached thereto belonging to any person acting as a generating company or licensee under the provisions of the Electricity Act,2003.

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1 Introduction

1.1 Background of the study

India is a diverse country with diverse energy consumption patterns in different states/UTs. Broadly, energy consumption is divided in six major sectors i.e., **Buildings, Transportation, Municipalities, DISCOMs, Agriculture and Industries**. A need for a focused 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, the Industry sector has a significant primary energy demand in India; 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 provisions 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.

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

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

1.2 India's Nationally Determined Contribution (NDC) including LIFE

The ambitious NDC from India makes a substantial contribution to fulfilling the objectives of the Paris Agreement. Efforts to reduce carbon emissions and preserve the environment are the foundation of all of India's major economic sectors. India reiterates its support for the Paris Agreement on Climate Change and the UNFCCC. India submitted its Intended Nationally Determined Contribution (NDC) to the United Nations Framework Convention on Climate Change (UNFCCC) on October 2, 2015[1], in accordance with resolution 1/CP.20. India's existing NDC is a step forward towards long term goal of reaching net-zero by 2070.

Accordingly, India has updated its first NDC submitted earlier on October 2, 2015, for the period up to 2030, in conformity with the a fore mentioned provision of the Paris Agreement read with pertinent decisions, as follows:

- "India will put forward and propagate a healthy and sustainable way of living based on its traditions and the values of conservation and moderation, including through a mass movement for LIFE, as a key to combating climate change." Energy used, water saved, single use plastic reduced, sustainable food system adopted, waste reduced, healthy life style adopted, and E-waste reduced, are the 7 action fall under the Mission Life 2022-2023.
- To adopt a climate friendly and a cleaner path than the one followed hitherto by others at corresponding level of economic development.
- To reduce Emissions Intensity of its GDP by 45 percent by 2030, from 2005 level.
- To achieve about 50 percent cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030, with the help of transfer of technology and low-cost international finance including from Green Climate Fund (GCF).
- To create an additional carbon sink of 2.5 to 3 billion tonnes of CO2 equivalent through additional forest and tree cover by 2030.
- To better adapt to climate change by enhancing investments in development programmes in sectors vulnerable to climate change, particularly agriculture, water resources, Himalayan region, coastal regions, health and disaster management.
- To mobilize domestic and new & additional funds from developed countries to implement the above mitigation and adaptation actions in view of the resource required and the resource gap.
- To build capacities, create domestic framework and international architecture for quick diffusion of cutting-edge climate technology in India and for joint collaborative R&D for such future technologies.

1.3 About SEEAP

[1] https://unfccc.int/sites/default/files/NDC/2022-08/India%20Updated%20First%20Nationally%20Determined%20Contrib.pdf

1.3.1 Objectives of the study

This assignment aims to provide technical assistance for the identification of focus sectors for the State Energy Efficiency Action Plan for **Gujarat** 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 2031.

The above said objective will be achieved by completion of four tasks as given in Figure 1

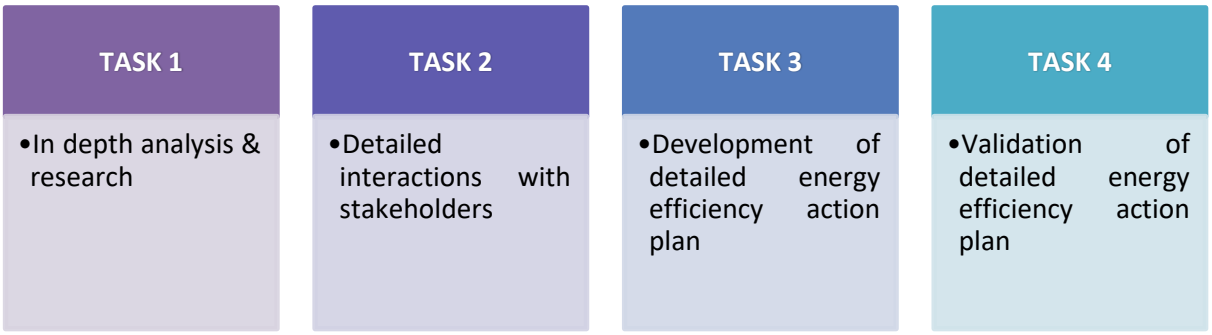


Figure 1 Key Tasks in state energy efficiency action plan

1.3.2 Task and outcome of the study

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

TASK-1	Task 1 includes secondary research, policy mapping at national and state level, stakeholder consultation which will give entire overview of state's energy intensity, policy framework and challenges. Task will be completed by submission of inception report.
TASK-2	Identification of policy gap analysis based on primary as well as secondary research. Detailed structure of State Energy Efficiency Action Plan with stake holder consultation.
TASK-3	Detailed draft State Energy Efficiency Action Plan for a tenure of 5 years and up to 2031 for the state. State Level Stakeholder consultation workshop, one at the beginning of Task and one at conclusion of Task.
TASK-4	State wise energy efficiency action plan-5 year and up to 2031. White paper on suggested policies & programme along with financial implication, methodology to achieve the said road map and benefits expected.

Figure 2 Task wise expected outcome of the study

1.3.3 Energy efficiency drivers of the state

Gujarat which ranked seventh in its group in energy efficiency Index 2020[2], worked on various areas to upscale energy efficiency.

Gujarat has developed various programs such as energy efficiency in street lighting, electric mobility, charging infrastructure, water pumping, sewage treatment and a smart grid program. The above intervention is driven by key drivers as illustrated in Figure 3

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

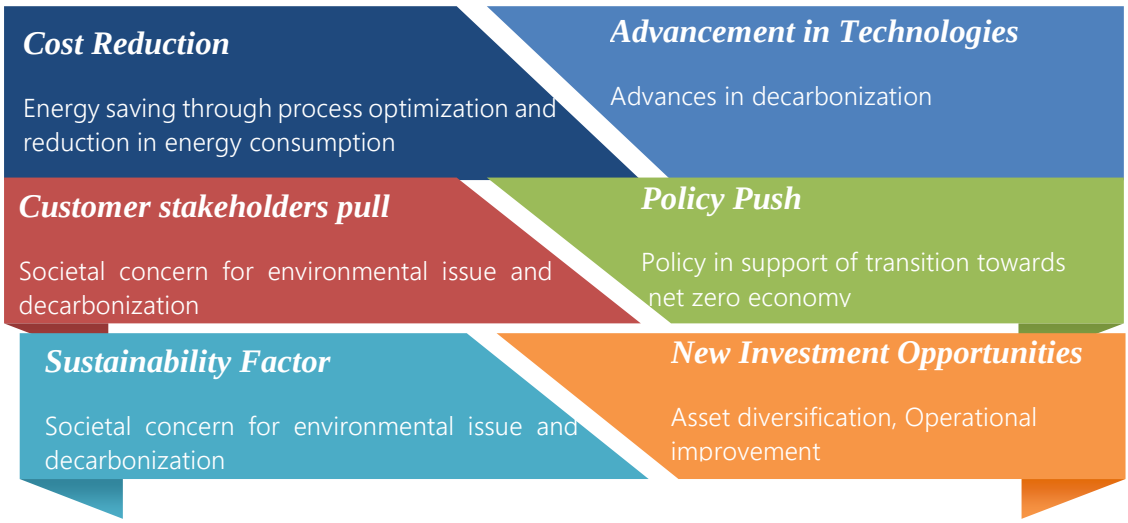


Figure 3 Energy efficiency drivers of the state

The above are the key drivers and other drivers for energy efficiency are;

Climate change, Interest of multiple stakeholders, Investment in hydrogen projects, cluster level (MSMEs) awareness for energy saving etc.

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

1.4 State Profile

Figure 4 State brief profile[3]

The Indian state of Gujarat is located on the country's western coast, along the Arabian Sea. It encompasses the entire Kathiawar Peninsula as well as the surrounding area on the mainland. The state is bounded by Pakistan to the northwest and by the Indian states of Rajasthan to the north, Madhya Pradesh to the east and Maharashtra to the southeast. The coastline of Gujarat spans 1,596 km and no part of the state is more than 160 km from the sea. The capital is Gandhinagar, located on the outskirts of the north-central city of Ahmedabad. The largest city in the state and former capital of Gujarat, Ahmedabad is one of the most important textile centres in India.

At current prices, Gujarat's Gross State Domestic Product (GSDP) stood at ~Rs. 16.59 trillion (US$ 267.40 billion) from 2020 to 2021. Gujarat has achieved the distinction of being one of the most industrially developed states. Accounting for 5% of the total Indian population, Gujarat contributes about a quarter to India's goods exports. Gujarat has successfully developed world class infrastructure. There are 42 ports, 18 domestic airports & one international airport. The state also has an extensive road & rail network. A 2,200 km gas grid supplies gas to the industrial areas.[4]

[3] Gujarat Budget 2019-20: Socio Economic Review
[4] https://www.ibef.org/download/Gujarat-March-2021.pdf

1.5 State Energy Scenario

Energy consumption is directly linked to economic growth and development, human needs and activities, with an ever-increasing population, increase in living standards, and the industrialisation of developing countries. However, rising energy consumption has resulted in increased greenhouse gas emissions and has sparked severe environmental worries.

As an emerging economy, Gujarat has a huge opportunity to meet its development goals in minimal energy consumption by adopting and choosing most energy efficient equipment and measures. Energy efficiency will be critical in choosing the best energy portfolio for Gujarat.

Gujarat has been at the forefront of clean energy development in India, particularly in the areas of solar and wind power. The state government has implemented various policies and initiatives to promote renewable energy and attract investments in clean energy projects. Gujarat has immense potential for energy efficiency and harnessing the energy efficiency potential in Gujarat can yield significant benefits in terms of cost savings, environmental sustainability, and energy security.

Energy efficiency is gradually becoming a critical element of India's energy transformation strategy. Implementing comprehensive energy efficiency initiatives results in reduced air pollution, decarbonisation, improved energy access, better resource utilisation, and increased energy security. If energy efficiency measures are implemented, the transition to renewable energy will be expedite and less expensive. For preparing energy efficiency action plan it is important to study the entire energy sector of the state which is discussed in subsequent section.

- **Installed Capacity**

India's overall installed power capacity is 3,70,106 MW and Gujarat state's Installed electricity capacity is 46,483 MW as of 31st March 2020[5] which is 12.56% of India's overall installed power capacity. State's overall capacity grew by approx. 4.72% CAGR over last five years from 2015 to 2020.

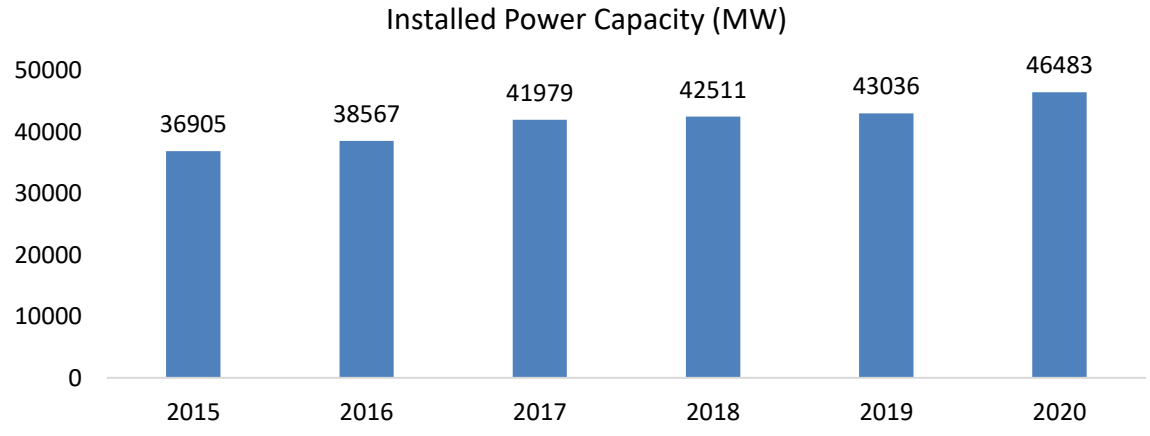


Figure 5 Installed power capacity of Gujarat from FY2015 to FY 2020

[5] NITI Ayog edm Dashboard

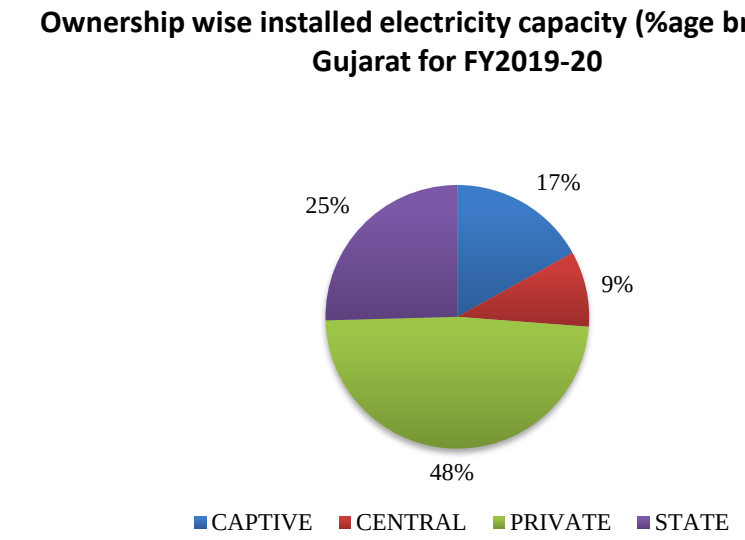


Figure 6: Ownership wise installed electricity capacity (%age breakup) in Gujarat for FY2019-20

The above installed capacity of the state is contributed by Captive unit, Central, Private and State where 48% is share of Private followed by state[6], captive and central as shown in Figure 6. Source wise installed capacity of the state is shown in Figure 7

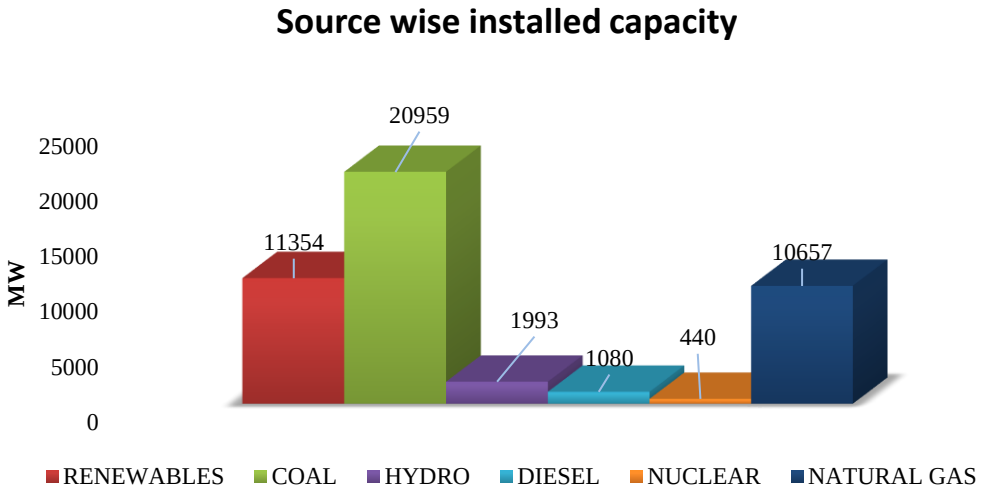


Figure 7 Source wise installed capacity

1.5.1 Primary energy Consumption

- **Coal Consumption:**

Total coal consumption in Gujarat is 81.46 Mn tonnes in FY 2019-20, which was 73.95 Mn tonnes in FY 2014-15, Coal consumption has gradually come down due to increased share of renewable energy in the state. Year wise coal consumption[7] is presented in below table;

[6] NITI Ayog edm Dashboard

[7] Coal domestic- Industry-Domestic offtake, Coal Captive-Coal controller Power-Utility-CEA general review report 20221

Table 1 year wise overall coal consumption in the state

Coal (Million Tonnes)	2015	2016	2017	2018	2019	2020
Total	73.95	65.01	69.23	77.70	78.30	81.46

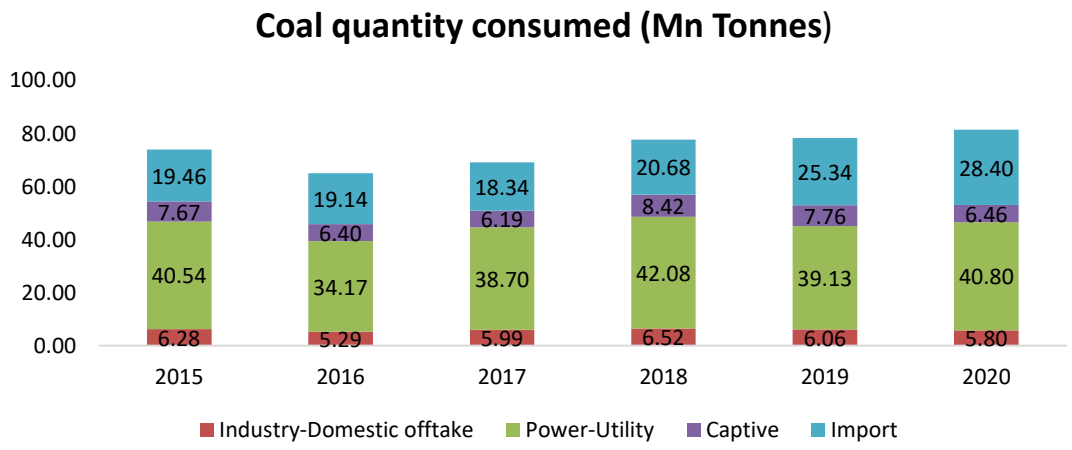


Figure 8 Coal quantity consumption (Mn Tonnes) year wise

As shown in below figure, coal consumption is distributed in four type of coal, Industry-domestic coal consumption, Captive power generation, non-power coal and import. Electricity generation alone accounts for almost 58% of the total coal consumption in power generation in FY 2019-20.

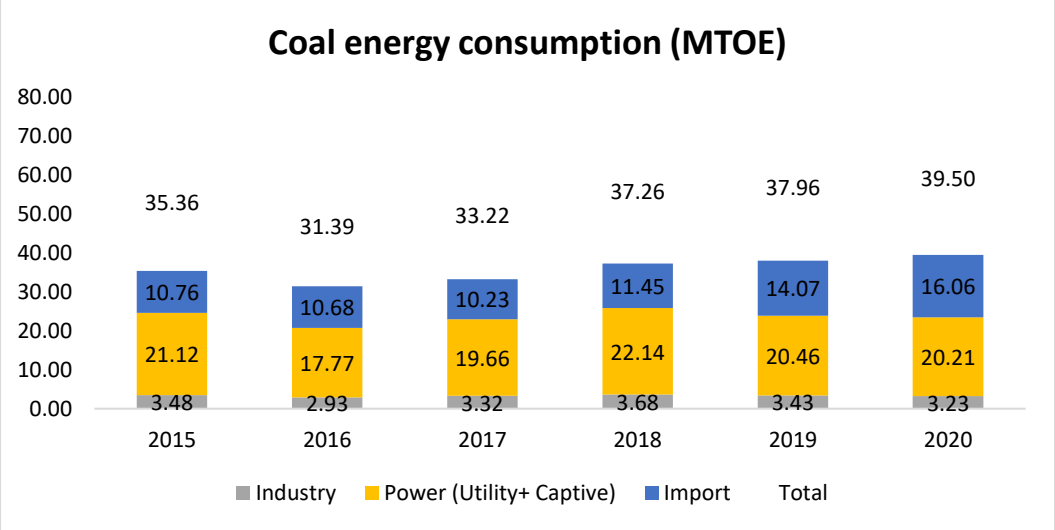


Figure 9 Coal energy consumption year wise

Import-CII estimates

- **Oil Consumption:**

✓ **Figure 10**, shows the energy supplied by oil from FY 2015-16 to FY2019-20 in Gujarat. LPG, petrol, diesel, and furnace oil show an increasing CAGR growth over a period of five years. However, SKO and coal show a negative growth rate (CAGR).

✓ Kerosene consumption in the state for the public distribution system has been declining over the years. The Ujjwala Yojana, which provides LPG connections to BPL households, has contributed towards decreasing rate of kerosene consumption.

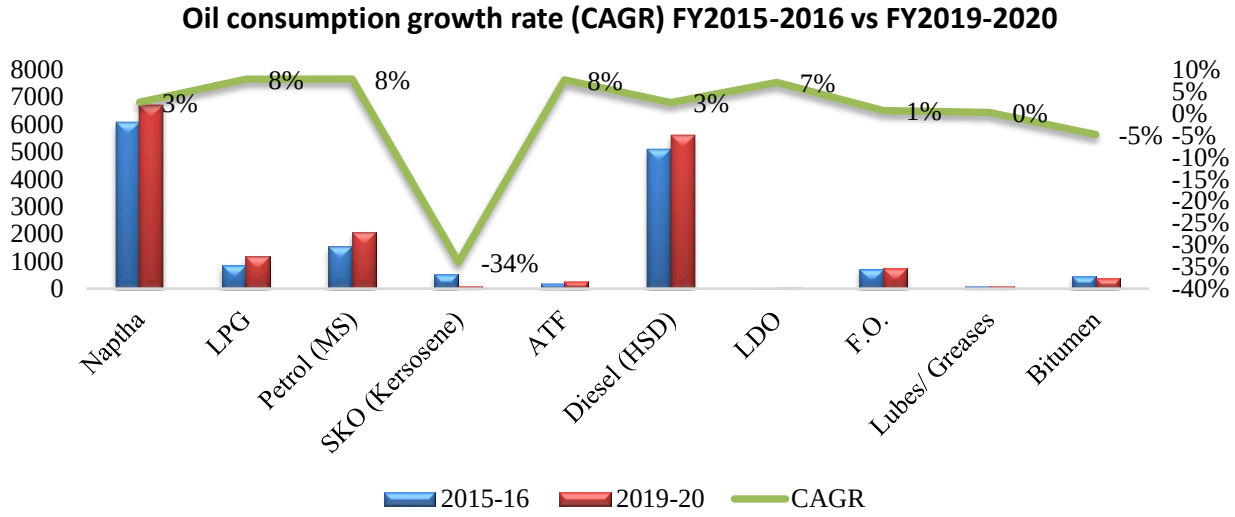


Figure 10 Oil consumption growth rate (CAGR) FY2015-2016 vs FY2019-2020[8]

- **Gas Consumption:**

Total gas consumption in India is shown in shown in below table and as per the information from Gujarat Infrastructure Development Board Gujarat accounts for approximately 32% gas consumption in the country[9].

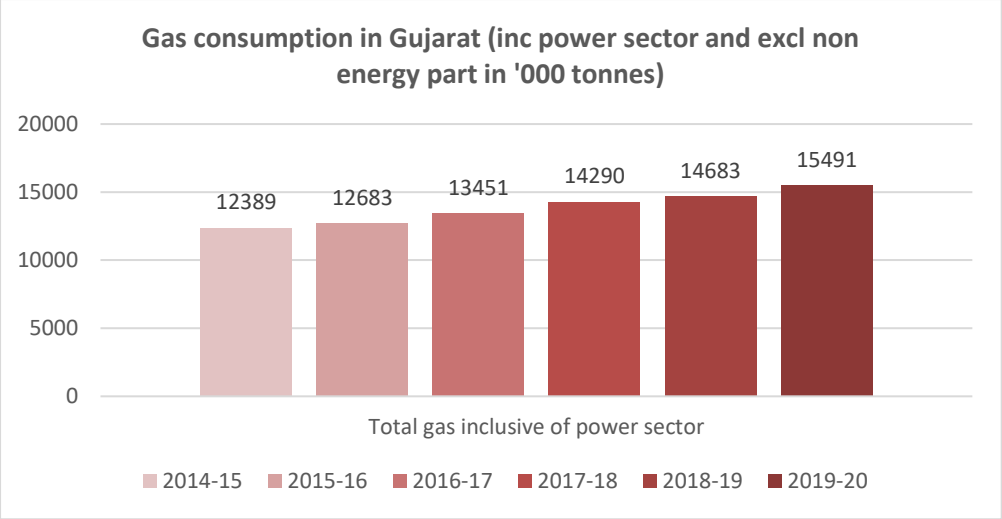
Table 2 Total gas consumption in India

Financial Year (MMSCM)	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
Net Production	46453	39753	34574	32693	31129	30848	31731	32056	30257	27784	33131
LNG import	17997	17614	17801	18607	21388	24849	27439	28740	33887	33031	30776
Total Consumption (Net Production + LNG import)	64451	57367	52375	51300	52517	55697	59170	60796	64144	60815	63907

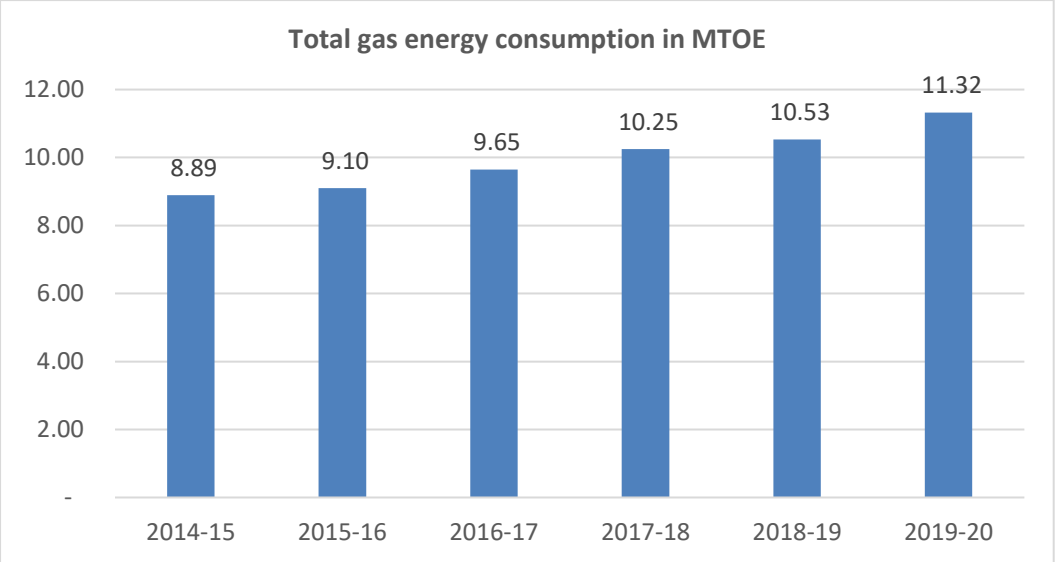
[8] https://mopng.gov.in/en/petroleum-statistics/indian-png-statistics from 2016 to 2020

[9] https://www.gidb.org/gas-current-scenario

Excluding the, power non energy part of the gas fuel consumption, total gas consumption in Gujarat is as given below;



Gas consumption in MTOE is as given below;



Excluding the non-energy part natural gas consumption is shown in below figure; Total natural gas energy consumption in FY 19-20 is 9.26 MTOE, increased at CAGR of 4.06% over the last five years.

1.5.2 Electricity consumption subsector wise

Gujarat's current electricity mix is dominated by thermal power sources. Due to the lack of material in-state 'black' coal mining capacity, more than 90% of Gujarat's coal-fired power plants use either expensive imported seaborne thermal coal or domestic coal hauled via railways from mines located at a distance of more than 1,200km in eastern Indian states of Odisha, Jharkhand or West Bengal.

Being one of the most industrial states in India, Gujarat's electricity demand has grown rapidly at a CAGR of 3% from FY2015-16 to FY2020.

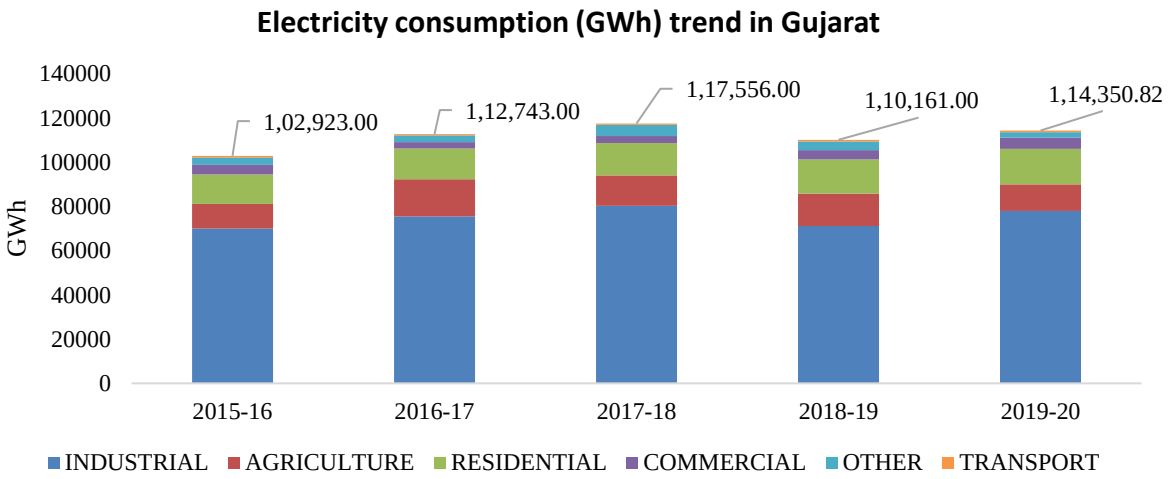


Figure 11 Electricity consumption (GWh) trend in Gujarat

Figure 11 shows the growth rate (CAGR) trend of electricity consumption, sector wise over the period FY2015-16 to FY2019-20. It can be observed that almost all the sectors signify an increasing growth in terms of energy consumption. Total electrical energy consumption is as given below;

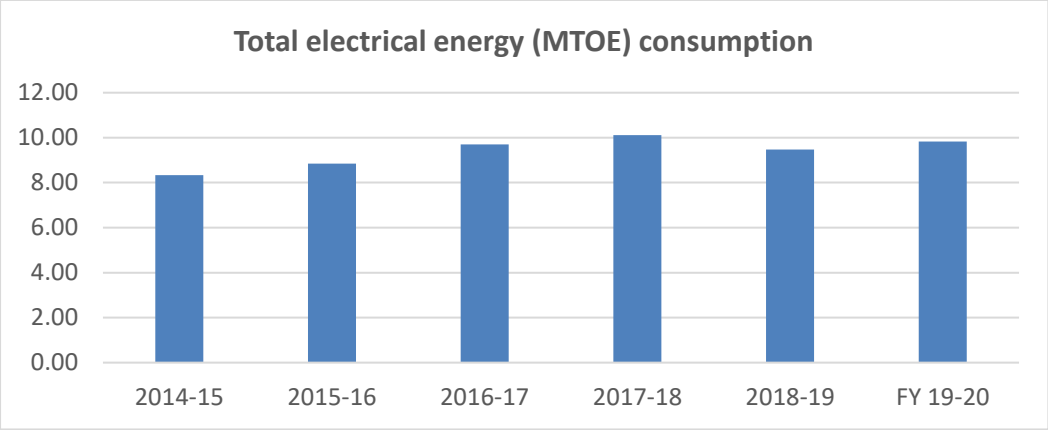


Figure 12 Electrical energy consumption year wise (MTOE)

1.5.3 Renewable energy scenario

Gujarat is rich in renewable energy resources – 300 days of sunshine, Rann of Kachchh where the land is endless and the sun's heat relentless, good winds along its 1600 km long coastline, scope of energy plantation in its vast wetlands, waste-to-energy options that harness bio, agro and industrial-waste.

However, Gujarat traditionally has a coal dominated power system, and is now witnessing rapid increase in the share of renewables. As of FY 2019- 20, the total installed capacity of 46.48 GW includes 20.96 GW coal, 10.66 GW gas, 1.99 GW of large hydro and, the rest of about 11.35 GW

comprises of renewable energy sources including solar, wind and small hydro. Source wise renewable energy and is given in **Table 3**[10].

Table 3 Sector-wise renewable energy

Renewables in Gujarat	2020 (as on 30/11/2020) (MW)
Solar (excluding rooftop)	2772
Rooftop solar	866
Onshore wind	8042
Offshore wind	0
Other renewables (excluding large hydro)	144
Kutch hybrid park (for export to other states)	0

State has also prepared the roadmap for renewable energy capacity till 2030. Stat's targeted capacity is 72290 MW till 2030. As per the information received from GUVNL, state's road map for renewable energy is given below;

Table 4 Renewable energy capacity till 2030 in MW

Tentative RE Roadmap of GUVNL/Gujarat by 2030				
RE source(incl. Hydr)	Present installed capacity (As on 31.08.2022)		Cumulative Capacity (expected by 2030)	
	GUVNL	Gujarat*	GUVNL	Gujarat*
Wind (Onshore)	4280	9712	8280	10280
Wind (Onshore)	NA	NA	2000	4000 (#)
Solar (incl. Rooftop)	3976	8000.15	15906	27706 ($)
Other (Biomass, Bagasse, WTE, mini-hydel	59	199	178	325
Hydro	779	779	2279	2279
Khavda	NA	NA	10000	27700
Total RE	9094	18690	38643	72290

* inclu. Captive/merchant capacity

Assuming 2000MW captive & 2000 MW Offshore wind (outside sale)

$ 4000 MW Dholera - SECI & 2000 MW captive

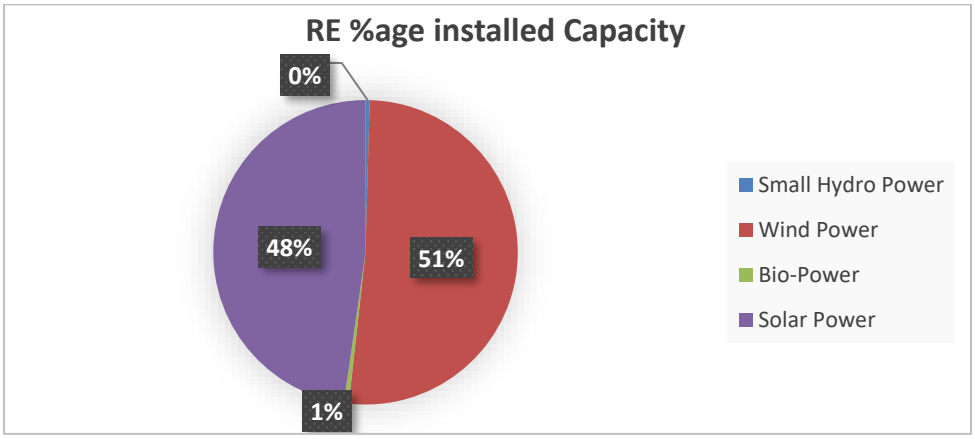
$ 600MW per year rooftop addition estimated & 1000 MW distributed generation

Renewable Energy Installed capacity installed capacity including Off-grid as on 30.06.2023:

[10] https://iea.blob.core.windows.net/assets/d74c1484-1b7c-491e-b2cf-598064e98809/IEANACER-GujaratPSTWorkshopReportfinal.pdf

The state RE installed capacity as of 30 June 2023 is given in below table.

State	Small Hydro Power	Wind Power	Bio-Power					Solar Power					Total Capacity
			BM Power/Bag	BM Cogen. (Non-	Waste to	Waste to Energy (Off-	Bio Power Total	Ground Mounted Solar	Rooftop Solar	Hybrid Solar Comp.	Off-grid Solar/ KUSUM	Solar Power Total	
	(MW)	(MW)	(MW)	(MW)	(MW)	(MW)	(MW)	(MW)	(MW)	(MW)	(MW)	(MW)	(MW)
Gujarat	91.64	10899.92	65.30	12.00	7.50	27.43	112.23	6758.46	2752.16	568.75	54.30	10133.67	21237.46



The above pi-chart shows that 51% of installed RE capacity is in wind and 48% if capacity is for solar energy[11].

1.6 Final energy consumption scenario

The Total Final Energy Consumption (TFEC), also known as gross final energy consumption, is the sum of all thermal energy and electrical energy consumption. TFEC is an indicator to measure overall energy consumption of the state and carbon emission intensity. It also aids in the analysis of the energy-saving target, which will lower the intensity of GHG emissions, and it can be reached by improving energy efficiency and reducing the uses of fossil fuels. The essence of progress towards a long-term sustainable economy is to benefit both people and the environment. To achieve economic growth and long-term development, we must drastically reduce our environmental carbon footprint by altering how we create and use commodities and resources.

The Total final energy consumption (TFEC) reached 60.60 MTOE (million tonnes of oil equivalent) as of FY 19-20, increased by CAGR 4.74% over the last five years from 48.08 MTOE in FY 2014-15.

[11] https://mnre.gov.in/img/documents/uploads/file_s-1689077131891.pdf

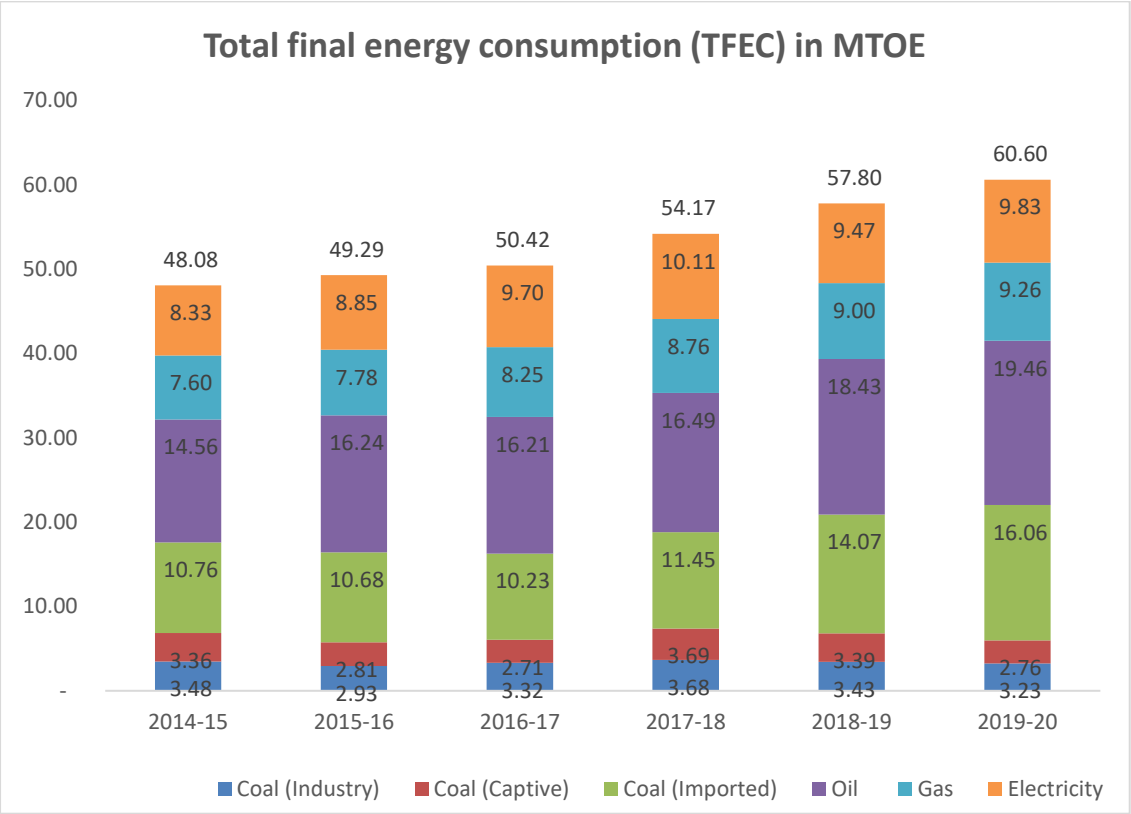


Figure 13 Total final energy consumption (TFEC) in MTOE

The distribution of energy source for the state for FY2020 is shown below. In FY 2019-20, coal, oil gas and electricity consumption of 36%, 32%, 15% and 16% respectively.

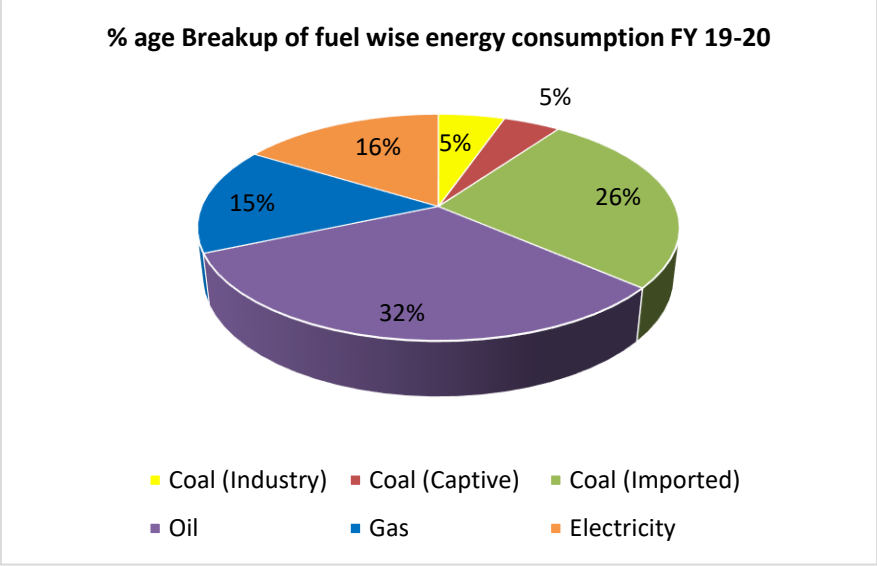


Figure 14 Breakup of fuel wise energy consumption FY 2019-20

1.7 Institutional Framework & Stakeholders mapping

Institutional framework of Gujarat power sector is shown in Figure 15. The Gujarat Energy Development Agency (GEDA) is an autonomous body established by the Government of Gujarat, exclusively to undertake all programmes in the field of non-conventional and renewable energy sources. Apart from this, GEDA is also the Nodal Agency, which interacts with the Ministry of New and Renewable Energy (MNRE), Government of India, New Delhi, to implement the centrally funded and sponsored schemes, in the relevant field.

GEDA is registered as a Society under the Societies Registration Act 1860, having a Governing Body headed by the Chief Secretary of the State. The Agency became operational in April 1996.

Series of reforms in the 1990s and the EA 2003 has moved the power sector towards its vision of a competitive market with multiple buyers, sellers supported by regulatory, and oversight bodies. In context to this, organizations have been formed both at the central and state Government levels to facilitate development of the power sector.

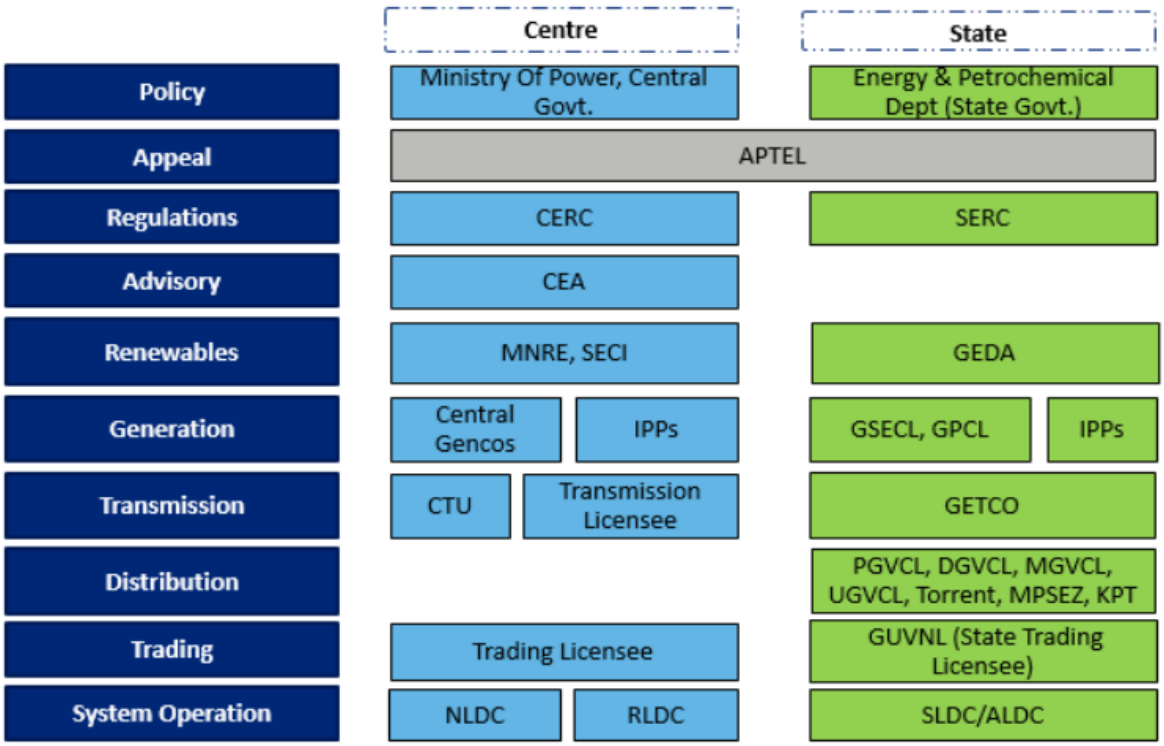


Figure 15 Institutional framework of power sector[12]

The state's electricity board structure and brief are given in Figure 16 and Table 5 respectively.

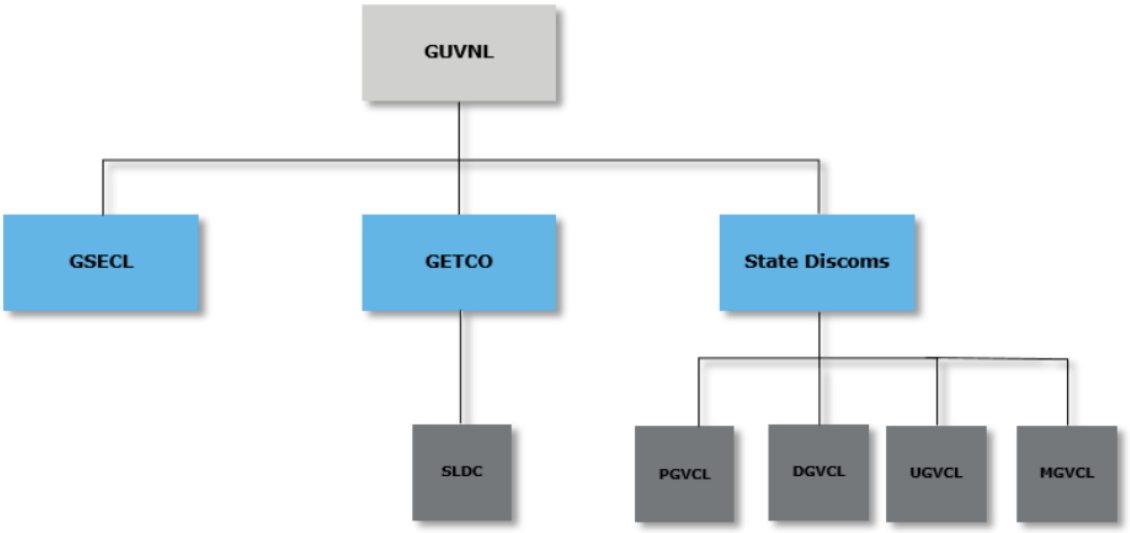


Figure 16 Gujarat State Electricity Board structure[13]

Table 5 Description of the power sector[9]

Gujarat Electricity Regulatory Commission (GERC)	GERC, constituted in November 1998 is responsible to regulate & determine tariff, issue licenses, specify the Grid Code, specify and enforce standard for quality & reliability, etc. at intra-state level, promote cogeneration and generation of electricity from renewable sources of energy and Adjudicate upon the disputes between the licensees, and generating companies and to refer any dispute for arbitration.
Gujarat Urja Vikas Nigam ltd (GUVNL)	GUVNL was incorporated as a Govt. of Gujarat Company. GUVNL is engaged in the business of bulk purchase and sale of electricity, Supervision, Co-ordination and facilitation of the activities of its six subsidiary companies. It is the single bulk buyer of power in the state as well as the bulk supplier to distribution companies.
Gujarat State Electricity Corporation Limited (GSECL)	Post Electricity Act 2003, GEB was unbundled in 2005 & GSECL was given responsibility of electricity generation & to undertake new power projects in the state. It currently accounts for 31% (6132 MW) of the total installed conventional capacity of the state and has achieved highest ever PAF of around 83.65%.
Gujarat Energy Transmission	GETCO setup in 1999 builds, operate & maintains state transmission network, company has made significant progress in network capacity addition, transmission asset management, state grid operation, smart

[12] https://www.guvnl.com/img/home/Research%20_Report_on_Energy_Sector_in_Gujarat.pdf
[13] https://www.guvnl.com/img/home/Research%20_Report_on_Energy_Sector_in_Gujarat.pdf

Corporation Ltd (GETCO)	grid solutions and human resource development. Currently it has transmission network of about 55,468 ckm and 1,671 substations with transformation capacity of around 91,544 MVA.
Distribution Licensees in Gujarat	Undertake the electricity distribution and retail supply in the State of Gujarat. There are four DISCOMs in Gujarat-Dakshin Gujarat Vij Company Ltd (DGVCL), Madhya Gujarat Vij Company Ltd (MGVCL), Paschim Gujarat Vij Company Ltd (PGVCL), and Uttar Gujarat Vij Company Ltd (UGVCL)

- **Stakeholders mapping:**

List of the stakeholder are mentioned below and key stakeholder's were consulted for preparing the state's energy efficiency action plan;

Table 6 Stakeholder mapping

Sector	Government departments
Power And Discoms	○ Gujarat Urja Vikas Nigam Limited ○ Gujarat State Electricity Corporation Limited ○ Gujarat Power Corporation Limited ○ Gujarat Energy Transmission Corporation Limited ○ Dakshin Gujarat Vij Company Ltd ○ Madhya Gujarat Vij Company Ltd ○ Paschim Gujarat Vij Company Ltd ○ Uttar Gujarat Vij Company Ltd ○ Torrent Power Ahmedabad ○ Torrent Power Surat
Industries	○ Gujarat Industrial Development Corporation Limited ○ Industries Commissionerate ○ MSME Department Gujarat
Building	○ Road & Building Department ○ Urban Development & Urban Housing Department ○ Town Planning Department

Transport	○ Gujarat State Road Transport Corporation ○ Ports & Transport Department ○ Commissioner of Transport ○ Gujarat Maritime Board ○ Public Works Department, Government of Gujarat
Agriculture	○ Agriculture, Farmers Welfare and Co-operation Department ○ Directorate of Agriculture ○ Gujarat Agro Industries Corporation
Municipalities	○ Municipalities administration Urban Development and Urban Housing Department
Other Key Department	○ Energy and petrochemical Department ○ Climate Change Department (Think Tank of Gujarat Govt.) ○ Gujarat Energy Development Agency (Nodal agency)

2 Identification of Focus Sector

Energy consumption indicators and situation assessment have been used to define target focus sectors and specific industries. The following sectors should be focused for the implementation of "State Energy Efficiency Action Plan" for Gujarat

The industry sector is the most significant consumer of energy. Energy consumption in this sector is primarily used for powering machinery, heating, cooling, and other industrial processes. The types of energy sources used vary depending on the region and the availability of resources. Common energy sources in the industry sector include electricity, natural gas, coal, oil, and renewable energy. Transport sector is second largest major consumer of energy, primarily in the form of petroleum-based fuels like gasoline and diesel. The building sector is third energy consuming sector primarily in the form of petroleum-based fuels like gasoline and diesel. The agriculture sector is a significant consumer of energy, utilizing various energy sources for different purposes. Energy is consumed in agriculture for activities such as plowing, planting, irrigation, harvesting, and transportation. The main sources of energy used in agriculture include diesel for tractors and other machinery, electricity for irrigation and processing facilities, and other energy inputs like fertilizers and pesticides. The fisheries sector also consumes energy for various activities, primarily in fishing

vessels, fish processing plants, and cold storage facilities. Energy is used to power fishing boats, refrigeration equipment, and processing machinery. Like agriculture, the energy consumption in the fisheries sector can vary based on the level of mechanization and the scale of fishing operations.

Energy efficiency measures are becoming increasingly significant in these sectors, based not just on overall energy use but also on the potential for cost-effective improvements. In subsequent section sector wise energy efficiency potential has been discussed

3 Projection and Forecasting methodology

The forecasting of energy consumption and CO2 emission is based on energy intensity forecast in the state. Energy intensity and forecasting is based on KAYA Identity equation.

The Kaya identity is a useful equation for calculating the total amount of carbon dioxide (CO2) emissions from human sources. 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 in order 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[14] 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.

[14] Kaya (1990); Impact of Carbon Dioxide Emission Control on GNP Growth: Interpretation of Proposed Scenarios. Paper presented to the IPCC Energy and Industry Subgroup, Response Strategies Working Group, Paris (mimeo)

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[15]. 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.

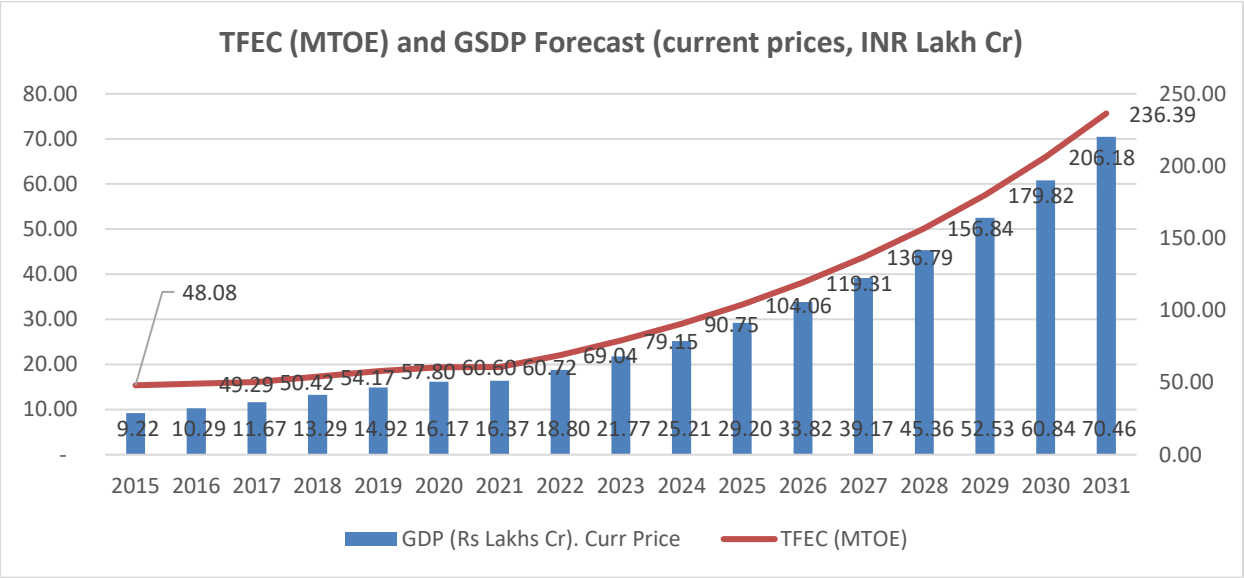
Carbon Intensity – is driven by the prevailing form of energy generation. Measured on a total life cycle basis, renewable energy sources have a lower Carbon Intensity than fossil fuels.

The forecasting of TFEC is done based on the growth in state's gross domestic product. Gujarat has ambitious targets for renewable energy for 2030 and energy intensity is expected to decrease significantly due to growth in GDP. Gujarat has projected GDP as USD 500 billion (INR 39,16,66,667 Lakh) by 2026-27 which means economy will grow at the rate of 15.81% in five years. Considering the same growth rate of 15.81%, Gujarat economy is expected to reach INR 70,46,21,320 Lakh by 2031. Energy intensity of FY 2019-20 is 3.75 MTOE per INR Lakh Cr GDP compared to energy intensity of 5.22 INR Lakh Cr GDP in 2014-15.

Considering the historical energy intensity of the state, the average 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 2031 is 236.39 MTOE for the state of Gujarat from the TFEC of 60.60 MTOE in FY2015.

[15] IPCC (2000); IPCC Special Report on Emissions Scenarios



4 Focus sector 1: Industry

4.1 Current Industry Scenario

Industries in Gujarat, contributing 16.85% of the country's total industrial output, the highest percentage among all other Indian states.

Gujarat state's heavy industries are spread across various sectors such as; Cement, Chlor-Alkali, Fertilizer, Iron and Steel, Pulp and Paper, Petrochemical and Textile. No. of industries sector wise from Gujarat state included in PAT cycle from PAT-1 to PAT-6[16] is given below table;

Table 7 Sector wise No of Designated consumers (DCs) in various PAT Cycles

Sector	PAT-1	PAT-2	PAT-3	PAT-4	PAT-5	PAT-6
	2012-15	2016-19	2017-20	2018-21	2019-22	2020-22
Cement	7	9			1	9
Chlor-Alkali	8	10			1	10
Fertilizer	4	6				
Iron and Steel	4	5			2	5
Pulp and Paper	2	2		1		2
Petrochemical				3		
Textile	11	12	9	3	11	10
Grand Total	36	44	9	7	15	36

[16] BEE-PAT Gazetted notification

Gujarat has spread of 106 clusters and few key clusters are ceramics cluster in Thangadh &Morbi, the brass parts cluster in Jamnagar, Foundry in Ahmedabad, Chemical in Ankleshwar, and the power looms cluster in Ahmedabad. Together, the 13 largest industry groups in Gujarat's industrial economy account for about 82.05% of all factories, 95.85% of all fixed capital investments, 90.09% of production value, and 93.21% of value addition. Gujarat's major industries are chemicals, petrochemicals, dairy, medications, pharmaceuticals, cement, ceramics, gems, jewellery, textiles, and engineering. About 3,851,000 people are employed by the 603,000 micro, small, and medium-sized businesses that make up the state's industrial sector[17].

Micro, Small and Medium Enterprises (MSMEs) is the most important sector of the Gujarat economy and there are approximately 633.88 lakh MSMEs in India as per MSME Annual report 20-21, and Gujarat contributes to 5% (33.16 Lakhs) share in total no of MSMEs in India (refer below table)

Table 8 Top 10 state by no of MSMEs[18]

Sr. No.	State/UT	Estimated Number of MSME	
		Number in Lakh	Share in %
1	Uttar Pradesh	89.99	14%
2	West Bengal	88.67	14%
3	Tamil Nadu	49.48	8%
4	Maharashtra	47.78	8%
5	Karnataka	38.34	6%
6	Bihar	34.46	5%
7	Andhra Pradesh	33.87	5%
8	Gujarat	33.16	5%
9	Rajasthan	26.87	4%
10	Madhya Pradesh	26.74	4%
	Total of above 10 states	469.36	74%
	Other state/UTs	164.52	26%
	All	633.88	100%

[17] https://www.ibef.org/download/Gujarat-March-2021.pdf
[18] Pg 29: https://msme.gov.in/sites/default/files/MSMEENGLISHANNUALREPORT2021-22.pdf

4.2 Energy efficiency Strategies in Industry sector

4.2.1 Startegy-1 PAT Deepening & Widening Strategy

1. PAT Deepening strategy:

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. Gujarat, 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 Gujarat achieving its energy efficiency and emission reduction targets by incentivizing industries to adopt energy-efficient practices and technologies.

By increasing the coverage of industries under the PAT scheme, state can further unlock its potential for energy savings and emission reductions. This will 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 the state. The implementation strategy of PAT deepening is discussed below.

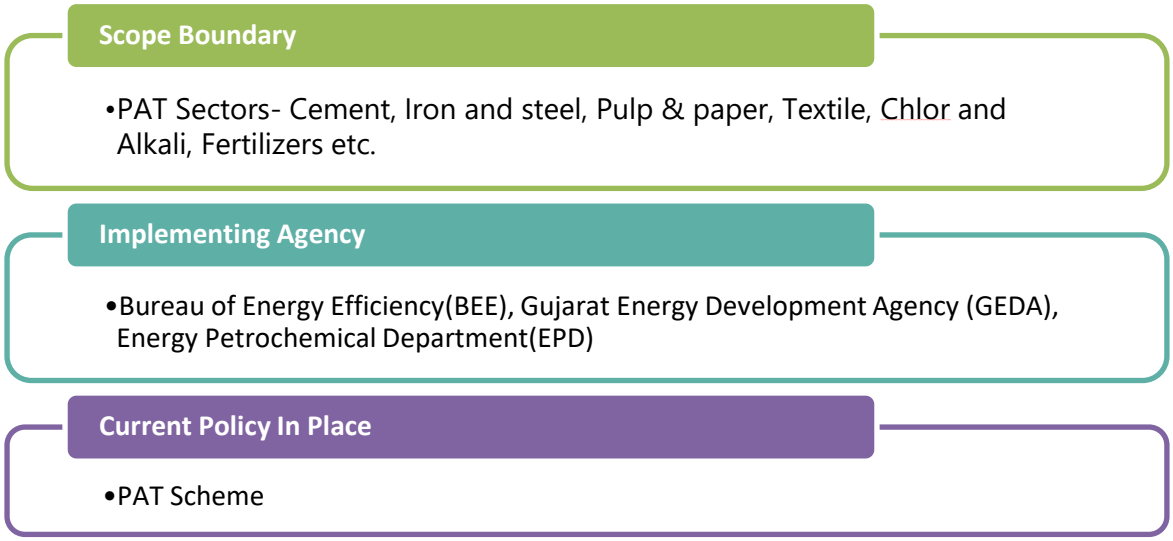


Figure 17 PAT Deeping implementation-scope, policy and Implementing agency

Saving Potential

Energy saving potential is based on Specific energy consumption (SEC) of the sector and its projected production[19]. Baseline and projected production for Iron and steel, Chlor& Alkali, Cement and Textile is shown in below figure.

[19] CII study

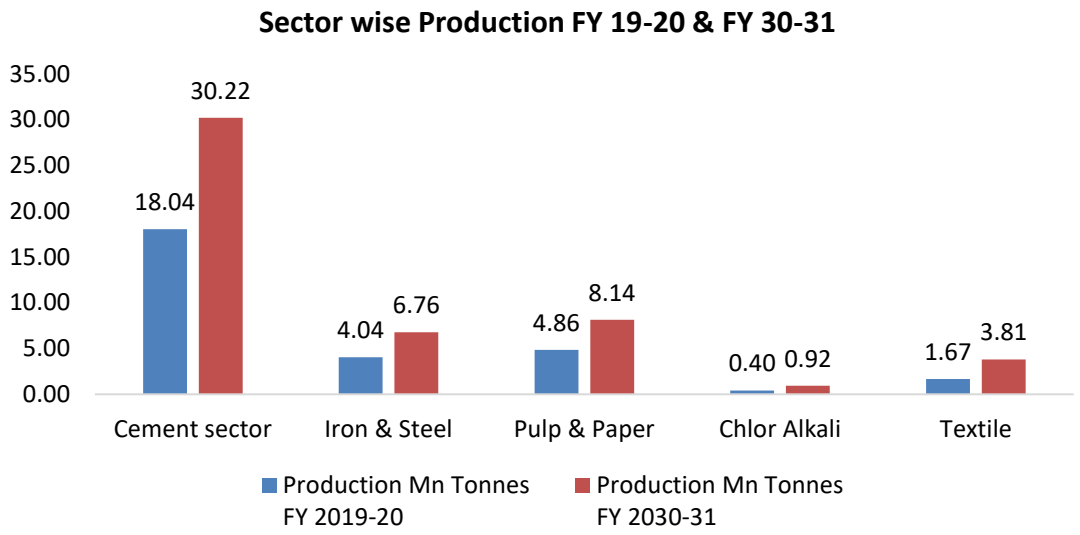
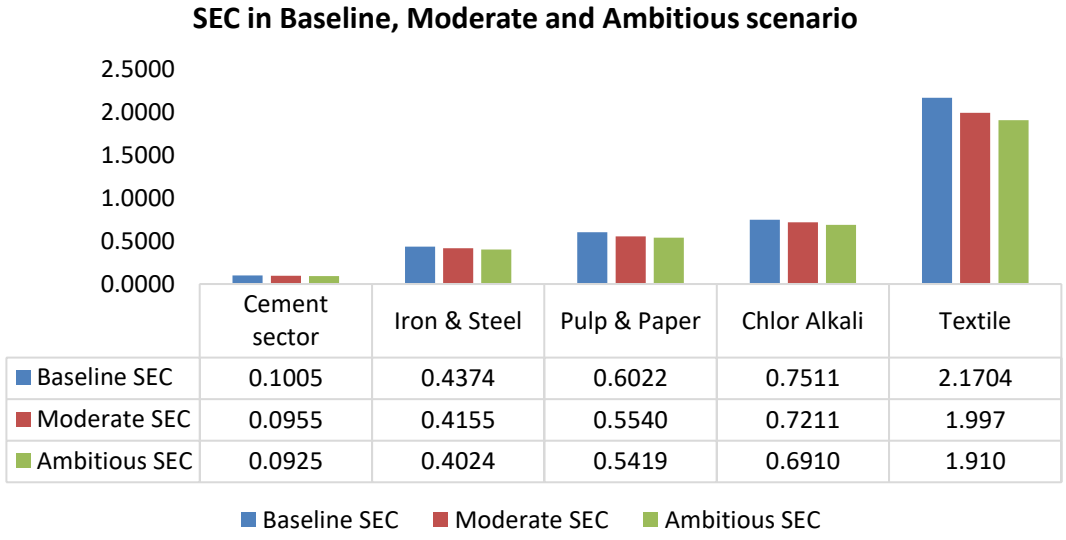


Figure 18 Sector wise energy production FY 19-20 and Projected production in FY 30-31

Sector wise SEC for Iron and steel, Chlor & Alkali, Cement and Textile is shown in below figure. Sector wise SEC in moderate and ambitious scenario is based on energy saving potential in that particular state and technology interventions.



	Cement sector	Iron & Steel	Pulp & Paper	Chlor Alkali	Textile
Baseline SEC	0.1005	0.4374	0.6022	0.7511	2.1704
Moderate SEC	0.0955	0.4155	0.5540	0.7211	1.997
Ambitious SEC	0.0925	0.4024	0.5419	0.6910	1.910

Figure 19 Sector wise SEC in baseline, moderate and ambitious scenario

- **Energy saving potential estimate for PAT Deepening Strategy**

Table 9 Cement sector energy saving potential in PAT Deepening strategy

Items	Values
Average SEC (toe / ton)	0.1005
Non PAT Production (million ton)	18.04
Baseline Energy Consumption (toe)	1813483.057

Items	Values
Moderate SEC (toe/ton)[20]	0.0955
Ambitious SEC (toe/ton)	0.0925
Production in 2031 (million ton)[21]	30.22
Energy consumption in BAU scenario (toe)	3037299.45
Energy consumption in moderate scenario (toe)	2961366.96
Energy consumption in ambitious scenario (toe)	2915807.47
Energy Savings in Moderate Scenario (Mtoe) 2031	**0.076**
Energy Savings in Ambitious Scenario (Mtoe) 2031	**0.121**

Table 10 Iron and Steel sector energy saving potential in PAT Deepening strategy

Items	Values
Average SEC (toe / ton)	0.4374
Non PAT Production (million ton)	4.04
Baseline Energy Consumption (toe)	1766436.401
Moderate SEC (toe/ton)	0.4155
Ambitious SEC (toe/ton)	0.4024
Production in 2031 (million ton)	6.76
Energy consumption in BAU scenario (toe)	2958503.69
Energy consumption in moderate scenario (toe)	2884541.09
Energy consumption in ambitious scenario (toe)	2840163.54
Energy Savings in Moderate Scenario (Mtoe) 2031	**0.074**
Energy Savings in Ambitious Scenario (Mtoe) 2031	**0.118**

Table 11 Pulp and Paper Sector energy saving potential in PAT Deepening strategy

Items	Values
Average SEC (toe / ton)	0.6022
Non PAT Production (million ton)	4.86
Baseline Energy Consumption (toe)	2928015.794
Moderate SEC (toe/ton)	0.5540
Ambitious SEC (toe/ton)	0.5419
Production in 2031 (million ton)	8.14
Energy consumption in BAU scenario (toe)	4903966.83
Energy consumption in moderate scenario (toe)	4707808.16
Energy consumption in ambitious scenario (toe)	4658768.49
Energy Savings in Moderate Scenario (Mtoe) 2031	**0.196**
Energy Savings in Ambitious Scenario (Mtoe) 2031	**0.245**

[20] https://shaktifoundation.in/wp-content/uploads/2017/06/A-study-of-EE-in-the-cement-industry.pdf
[21] https://ibm.gov.in/writereaddata/files/12102021174214Cement_2020.pdf

Table 12 Chlor and Alkali energy saving potential in PAT Deepening strategy

Items	Values
Average SEC (toe / ton)	0.7511
Non PAT Production (million ton)	0.40
Baseline Energy Consumption (toe)	303655.8564
Moderate SEC (toe/ton)	0.7211
Ambitious SEC (toe/ton)	0.6910
Production in 2031 (million ton)[22]	0.92
Energy consumption in BAU scenario (toe)	693726.09
Energy consumption in moderate scenario (toe)	679851.57
Energy consumption in ambitious scenario (toe)	665977.05
Energy Savings in Moderate Scenario (Mtoe) 2031	**0.014**
Energy Savings in Ambitious Scenario (Mtoe) 2031	**0.028**

Table 13 Textile sector energy saving potential in PAT Deepening strategy

Items	Values
Average SEC (toe / ton)	2.1704
Non PAT Production (million ton)	1.67
Baseline Energy Consumption (toe)	3618540.108
Moderate SEC (toe/ton)	1.9968
Ambitious SEC (toe/ton)	1.9100
Production in 2031 (million ton)	3.81
Energy consumption in BAU scenario (toe)	8266844.34
Energy consumption in moderate scenario (toe)	8068440.07
Energy consumption in ambitious scenario (toe)	7969237.94
Energy Savings in Moderate Scenario (Mtoe) 2031	**0.198**
Energy Savings in Ambitious Scenario (Mtoe) 2031	**0.298**

- **Energy saving potential in PAT Deepening strategy**

Table 14 Total energy saving through PAT Deepening Strategy

Particulars	Moderate Scenario for 2031	Ambitious Scenario for 2031
Energy Saving Potential (MTOE)	0.558	0.810
GHG Emission Reduction Potential ($MtCO_2$)	1.75	2.54

[22] https://ama-india.org/wp-content/uploads/2020/10/Chlor-alkali-industry-in-India-status.pdf

Action Plans

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

Table 15 Action plan PAT-Deepening strategy

Policy/Scheme	Action Plan	Timeline
Awareness & Capacity Building	• Capacity Building of Energy Managers and Energy Auditors in PAT sector. • Identification of new DCs in existing sector & Study to check possibility to reduce existing sectoral threshold energy consumption	Short Term
Energy mapping	• Benchmarking study and data collection study at frequent interval of time	Long Term
Technology Intervention	• Encouraging industries for adoption of energy efficient technologies through demonstration projects. List of such energy efficient technologies are given at BEE's facilitation centre on ADEETIE portal[23](Assistance in Deploying Energy Efficient Technologies in Industries and Establishment)	

- **PAT Widening Strategy**

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. The implementation strategy is as given below;

[23] https://www.adeetie.beeindia.gov.in/list-of-energy-efficient-technologies

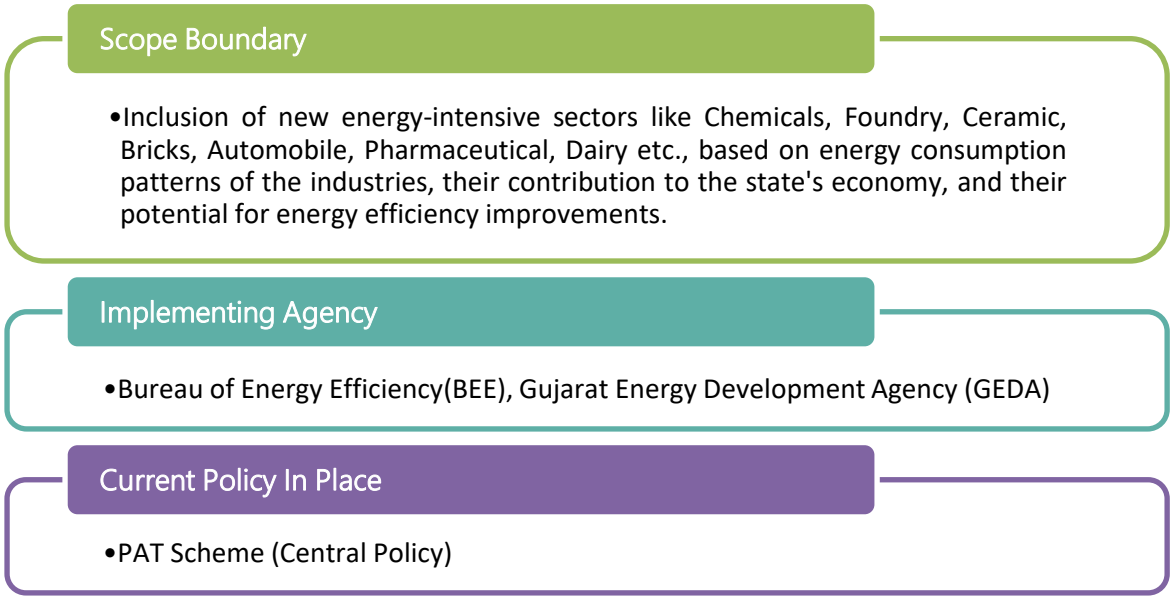


Figure 20 PAT Deeping implementation-scope, policy and Implementing agency

Similar to the PAT deepening scheme, PAT widening scheme's energy saving potential calculation is based on specific energy consumption and production. Baseline production of Dairy, Ceramic, Chemical, Brick and Foundry sector is given in below table;

Table 16 Sector wise production in FY 19-20 and projected production FY 30-31

Sector	Production Mn Tonnes FY 2019-20	Production Mn Tonnes FY 2030-31
Dairy	15.29	39.46
Ceramic	0.03	0.07
Foundry	0.53	1.85
Chemical	0.004	0.01
Brick	13.90	19.64

SEC (in toe/ton) of all sector under widening scheme is given in below figure;

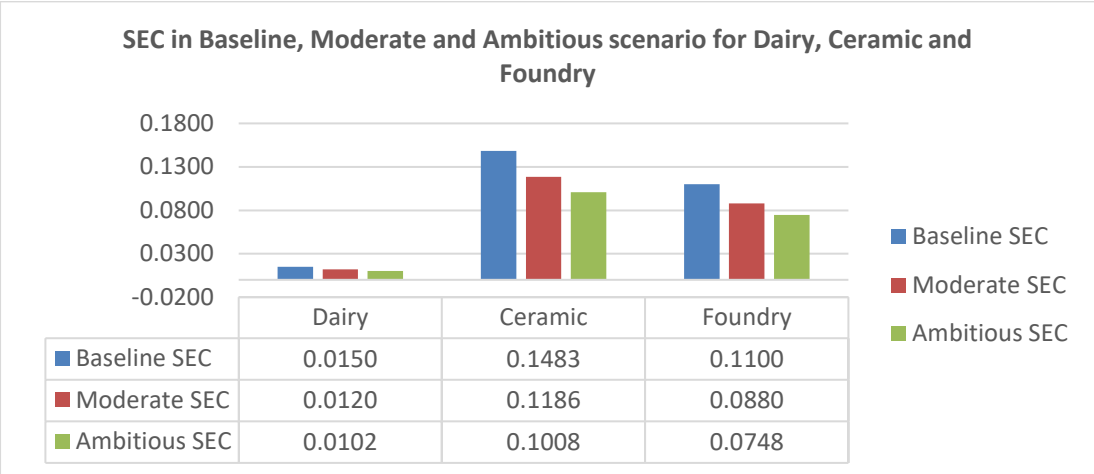


Figure 21 SEC in Baseline, Moderate and Ambitious scenario for Dairy, Ceramic and Foundry

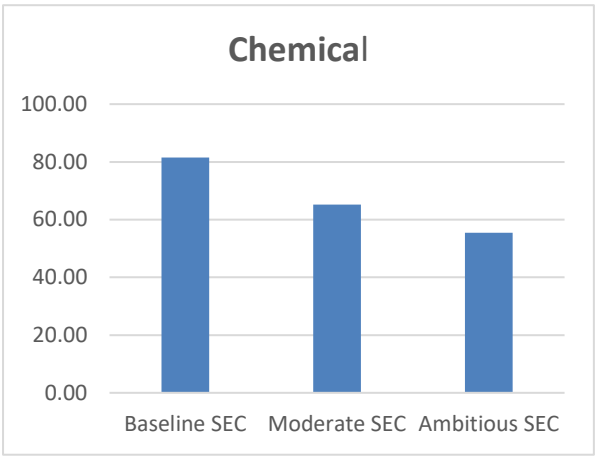


Figure 22 SEC (toe/ton) Chemical Sector

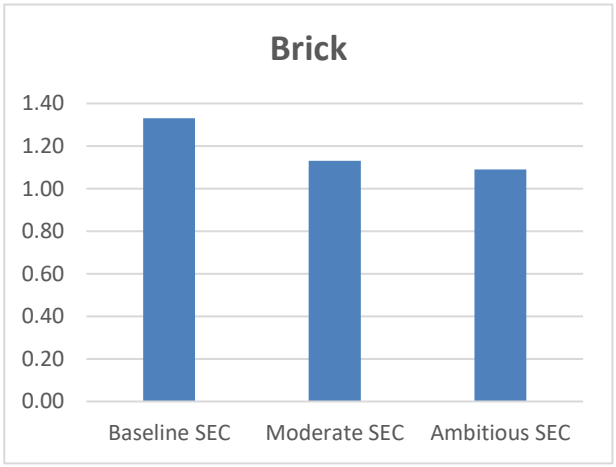


Figure 23 SEC (MJ /kg fired brick)-Brick Sector

- **Energy saving potential estimate for PAT Widening strategy;**

Energy saving calculation of various PAT widening strategy has been discussed below;

Table 17 Energy saving potential in Dairy sector by 2031

Items	Values
Average SEC (toe / ton)	0.0150
Non PAT Production (million ton)	15.29
Baseline Energy Consumption (toe)	229380
Moderate SEC (toe/ton)	0.0120
Ambitious SEC (toe/ton)	0.0102
Production in 2031 (million ton)	39.46
Energy consumption in BAU scenario (toe)	591898.21
Energy consumption in moderate scenario (toe)	532708.39
Energy consumption in ambitious scenario (toe)	497194.50
Energy Savings in Moderate Scenario (Mtoe) 2031	**0.059**
Energy Savings in Ambitious Scenario (Mtoe) 2031	**0.095**

Table 18 Energy saving potential in ceramic sector

Items	Values
Average SEC (toe / ton)	0.1483
Non PAT Production (million ton)	0.03
Baseline Energy Consumption (toe)	4086
Moderate SEC (toe/ton)	0.1186
Ambitious SEC (toe/ton)	0.1008
Production in 2031 (million ton)	0.07
Energy consumption in BAU scenario (toe)	10543.62
Energy consumption in moderate scenario (toe)	9489.26
Energy consumption in ambitious scenario (toe)	8856.64
Energy Savings in Moderate Scenario (Mtoe) 2031	**0.001**
Energy Savings in Ambitious Scenario (Mtoe) 2031	**0.002**

Table 19 Energy saving potential in Foundry sector by 2031

Items	Values
Average SEC (toe / ton)	0.1100
Non PAT Production (million ton)	0.53
Baseline Energy Consumption (toe)	58435.04717
Moderate SEC (toe/ton)	0.0880
Ambitious SEC (toe/ton)	0.0748
Production in 2031 (million ton)	1.85
Energy consumption in BAU scenario (toe)	203269.23
Energy consumption in moderate scenario (toe)	182942.31
Energy consumption in ambitious scenario (toe)	170746.16
Energy Savings in Moderate Scenario (Mtoe) 2031	**0.020**
Energy Savings in Ambitious Scenario (Mtoe) 2031	**0.033**

Table 20 Energy saving potential in chemical sector

Items	Values
Average SEC (toe / ton)	81.4710
Non PAT Production (million ton)	0.00
Baseline Energy Consumption (toe)	340683.6257
Moderate SEC (toe/ton)	65.1768
Ambitious SEC (toe/ton)	55.4003
Production in 2031 (million ton)	0.01
Energy consumption in BAU scenario (toe)	906093.56
Energy consumption in moderate scenario (toe)	815484.20
Energy consumption in ambitious scenario (toe)	761118.59
Energy Savings in Moderate Scenario (Mtoe) 2031	**0.091**
Energy Savings in Ambitious Scenario (Mtoe) 2031	**0.145**

Table 21 Energy saving potential in Brick Sector by 2031

Items	Values
Average SEC (MJ /kg fired brick)	1.3300
Non PAT Production (No Lakhs)	42000.00
Avg. weight per Brick (Kg)	3.31
Baseline Energy Consumption (MJ /kg fired brick)	4409604.375
Moderate SEC (MJ /kg fired brick)	1.1305
Ambitious SEC (MJ /kg fired brick)	1.0906
Production in 2031 (Lakh bricks)	59342.73
Energy consumption in BAU scenario (toe)	6230427.71
Energy consumption in moderate scenario (toe)	5295863.56
Energy consumption in ambitious scenario (toe)	5108950.73
Energy Savings in Moderate Scenario (Mtoe) 2031	**0.93**
Energy Savings in Ambitious Scenario (Mtoe) 2031	**1.12**

Table 22: PAT-Widening scheme: Energy Saving Potential

Particulars	Moderate Scenario for 2031	Ambitious Scenario for 2031
Energy Saving Potential (MTOE)	1.05	1.30
GHG Emission Reduction Potential ($MtCO_2$)	3.28	4.07

Action Plans for PAT Deepening and Widening strategy:

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

Table 23 Action plan PAT-Widening strategy

Policy/Scheme	Action Plan	Timeline
Awareness & Capacity Building	Capacity Building of Energy Managers and Energy Auditors in Non-PAT Sectors. Feasibility Study of new probable sectors (Dairy, Bricks, Ceramic, Foundry etc.) to be included in PAT scheme Benchmarking study and data collection at cluster level	Short Term
Technology Intervention	implementation of pilot projects, digitization, automation and use of energy efficient technology. List of such energy efficient technologies are given at BEE's facilitation centre on ADEETIE portal[24](Assistance in Deploying Energy Efficient Technologies in Industries and Establishment)	Long Term

[24] https://www.adeetie.beeindia.gov.in/list-of-energy-efficient-technologies

Scheme	Promotion and implementation of Perform Achieve Earn Scheme (PAE, Central Scheme-BEE)	Short Term

Case Study: PAE guidelines by BEE

Objective

Perform Achieve Earn (PAE) scheme is the new scheme that BEE is envisaging to unlock PAT like schemes for MSME which will help in improving SEC of energy-intensive industries and help in cost saving making industries more competitive. In the long-term BEE may also explore synergizing the emission Savings / Reduction by MSMEs to Evolving National Carbon market.

Key Features:-

Key features include the following:

Particulars	Key features of scheme
Participation	Voluntary for MSMEs.
Compliance	No penalization, MSMEs will earn ESCerts on overachievement of targets.
ESCerts	Government will buy from MSME at levelized price of fuel.
Fund	BEE will form the corpus to support the programme and ensure the purchase of ESCerts.
Benefits	MSME generally use conventional technologies that offer several opportunities for improving efficiencies. Thus, lower investment can yield higher savings. Energy saving will help MSME to become more competitive and healthier work environment.

Benefits to MSMEs:

- MSMEs will receive comprehensive hand-holding support throughout the scheme's implementation, including guidance on identifying and adopting efficient technologies and measures, as well as collecting, analyzing, and reporting energy statistics.
- MSMEs will have the opportunity to monetize the ESCerts earned during the scheme, providing an additional financial incentive on top of the energy savings achieved. This mechanism encourages MSMEs to actively pursue energy efficiency measures.
- The scheme will generate a substantial amount of first-hand, measured, and verified data on industrial energy consumption. This will promote the adoption of Energy Management Systems (EMS) and ISO 50001 certification, leading to improved efficiency, productivity, and profitability for MSMEs.

- Overall Energy saving and Monitoring Mechanism

Table 24 Overall energy saving and emission reduction potential in PAT-Deepening and widening strategy

Sr. No	Strategy	Sector Targeted	Energy Saving Potential (MTOE) 2031		CO2 Saving Potential (Mn Tonnes of CO2)-20231	
			Moderate	Ambitious	Moderate	Ambitious
1	Deepening of PAT Audit sectors	Iron and steel, Fertilizers, Pulp and Paper, Chlor Alkali, Food processing, Metals, Pharmaceuticals	0.56	0.81	1.75	2.54
2	Widening of PAT Audit sectors	Brass (Jamnagar), Ceramic (Thangarh, Morbi), Foundry (Ahmedabad), Dairy (Gujarat),Chemical (Ankleshwar), Textile (Surat), Dyes and Chemical (Vapi)	1.05	1.30	3.28	4.07
		Total energy saving	1.60	2.11	5.02	6.61

Energy saving target of the industry sector is 1.60 MTOE and 2.11 MTOE for moderate and ambitious scenarios respectively as of as of FY 2030-31 as seen from **Table 24**

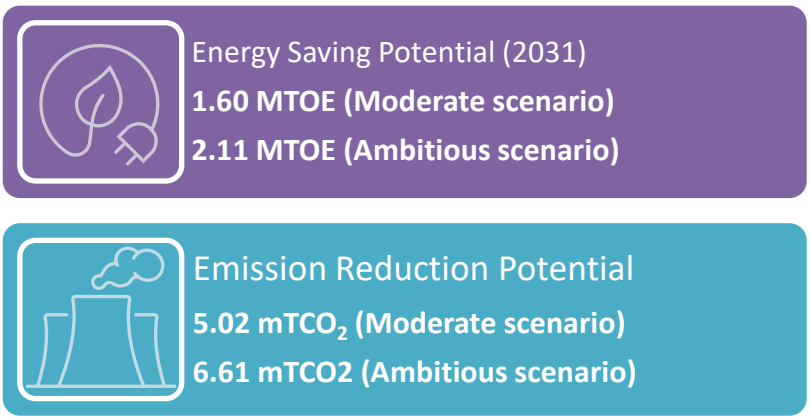


Figure 24 Summary of energy saving from the strategies FY 2031

4.2.2 Strategy-2 Promotion of Green Rating of Industries

Company Rating System advocates a performance based approach and 360 degree view of performance of the company. The rating system evaluates green features of companies against the following performance parameters: Energy Efficiency, Water conservation, Renewable Energy, GHG

Mitigation, Waste Management, Material conservation & Recycling and Recyclability, Green Supply chain, Product stewardship, Life Cycle assessment and Green Building feature and biodiversity. Current status of green rated companies in Gujarat as of Dec 2022 is shown below;

Table 25 Sector wise Green rated industries by GreenCo as of Oct 2023

Sector	Count of Rating Level
Automobile	3
Cement	2
Chemical	5
Engineering	4
FMCG	1
Gems & Jewellergy	1
Petrochemical	2
Petroleum Marketing	18
Railways	3
Grand Total	**39**

Table 26 Certification level of Green rated industries by GreenCo as of Oct 2023

Certification Level	Count of Rating Level
Bronze	3
Certified	1
Gold	13
Platinum	5
Platinum Plus	1
Silver	16
Grand Total	**39**

List of Green rated companies by Green Co in Gujarat as of May 2023 is given in Annexure- of this report

Implementation strategy is as follows;

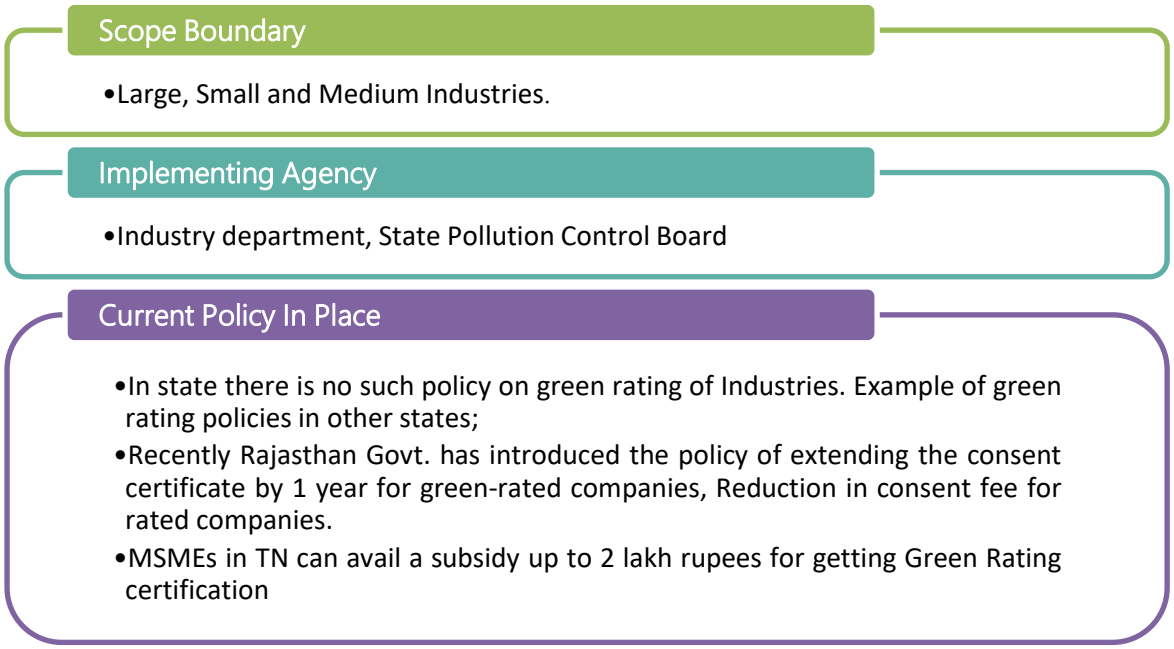


Figure 25 Promotion of green rating of Industries-scope, policy and Implementing agency

Rajasthan State Pollution Control Board has launched a system for Green Rating of Industries based on their environmental performance which may be evaluated based on their compliance of the prescribed format and their efforts to perform better than prescribed standard (No F14 (185) Corres/RSPCB/Plg/511-548, dated 27/7/21)[25]. To ensure maximum participation of industries in the scheme and to provide financial and other benefits of the green rated industries, Rajasthan State Pollution Control Board has decided to provide the following incentives and recognition to the Green Rated Industrial units;

A) Reduction in consent fee will be provided as per the below table;

Sr. No	Green Rating Category	Reduction in Consent Fee
1	Bronze	5%
2	Silver	10%
3	Gold	25%
4	Platinum	50%

[25] https://www.greenco.in/doc/Greenrating-Officeorder.pdf

B) Extension in consent period: Extension in consent period for 1 year beyond the prescribed period of industries securing rating in Bronze, Silver, Gold and Platinum categories will be provided subject to the condition that no non-compliance is reported within the consent period.

The Karnataka State Pollution Control Board (KSPCB):

Karnataka State Pollution Control Board (KSPCB) will promote green industries in Karnataka through the use of GreenCo Rating, a voluntary tool for enhancing the environmental performance of industries in the state. The programme is aimed at creating a green industry landscape in Karnataka where industries voluntarily have started to realize that both business and the environment can benefit together. Taking forward, the Karnataka State Pollution Control Board (KSPCB) envisages industries, service sector companies, and also government entities to be evaluated based on environmental performance as well as resource consumption and efficiency parameters. This will create an environmental management landscape where industries can improve their environmental performance voluntarily, set higher goals for improvement, and be rewarded for better results. perform better than the prescribed regulatory norms, set higher goals for improvement, and get suitably rewarded and motivated for better results.

Special Fee for KSPCB:

As a special case, discount of 10% will be provided to all the applicants enrolling for Green Rating through the KSPCB program

Incentives by KSPCB:

Implementation of the Green rating will facilitate industries to achieve multiple benefits in saving natural resources, reduce pollution and achieve cost benefits. It will also provide industries a credible recognition for enhanced green performance. KSPCB, in the process of encouraging the industries participating in the Green rating system and will provide incentive and recognition to the Green rated industries

1. One time Incentive for Green certified Industries[26];

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

[26] https://kspcb.karnataka.gov.in/sites/default/files/inline-files/KSPCB%20CII-Program_26%2003%2023%20Sp_19.05.2023_0.pdf

Note:

i. Capital Investment (CI) shall be as defined in Rule 32 of Karnataka Water Rules and Size of the industry shall be as per KSPCB norms.
ii. The Green rating incentive scheme is operational from the financial year 2023-24.
iii. The procedure and guidelines for availing the incentives will be published by the Board separately.

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

Tamil Nadu MSME Department supports Green Rating: MSME Department guides and supports Industries towards sustainability. Department of Industries and Commerce has approved the Q-Cert scheme incentive for all MSMEs for Green rating via RC No-33808/LC3/2022-2 dated 22.12.2022.

Energy Saving Potential and Monitoring Mechanism

As per the Green Co rating mechanism, Green rating have following parameters and also the points given for each parameters[27] have been given in below table;

No	Parameter	Points	%age Contribution of each points
1	Energy Efficiency	150	15%
2	Water Conservation	100	10%
3	Renewable Energy	100	10%
4	GHG Emission Reduction	100	10%
5	Waste Management	100	10%
6	Material conservation, Recycling & Recyclability	100	10%
7	Green Supply Chain	100	10%
8	Product Stewardship & Life cycle aspects	125	13%
9	Innovation for Environment	50	5%
10	Green infrastructure & Ecology	75	8%
	Total points	1000	100%

Energy saving through GreenCo rating

Particular	Unit	Value
No of companies rated till Sep 2022	Nos	450
Electrical saving	MTOE	0.033
Thermal savings	MTOE	33.75
Total saving	MTOE	33.783
Saving per unit	MTOE/Unit/year	0.008
Contribution of energy efficiency in Saving	%	15%

[27] https://www.greenco.in/

Particular	Unit	Value
Energy saving through energy efficiency measures	MTOE/UNIT/year	0.0011
Investment made by 450 companies	INR Cr	3093
Investment per unit	INR Cr/unit	6.87
CO2 reduction	Million Tonnes CO2	3.03
CO2 reduction/MTOE	Million Tonnes CO2/MTOE	0.090

Cumulative energy saving through GreenCo rating till date (within span of 10 years) is 33.783 MTOE which means average annual saving per unit per year is approximately 0.008 MTOE and weightage of energy efficiency is 15%. Energy efficiency per unit per year with one parameter i.e. energy efficiency is approximately 0.0011 MTOE. There are 33.16 Lakh MSMEs in Gujarat as per Gujarat Economic Survey[28]. Out of these MSMEs if 1% is considered for small and medium then there are 33,160 small and medium industries in Gujarat. An assumption is made that by 2031 in moderate and ambitious business scenario, 537 and 810 small and medium would be part of green rated industries if state provides incentives and encourages industries to adopt green rating.

Table 27 Promotion of Green Rating of Industries-Overall energy saving and emission reduction

Particulars	Moderate Scenario for 2031	Ambitious Scenario for 2031
Energy Saving Potential (MTOE)	0.33	0.50
GHG Emission Reduction Potential ($MtCO_2$)	1.02	1.56

Action Plans for promotion of green rating of Industries

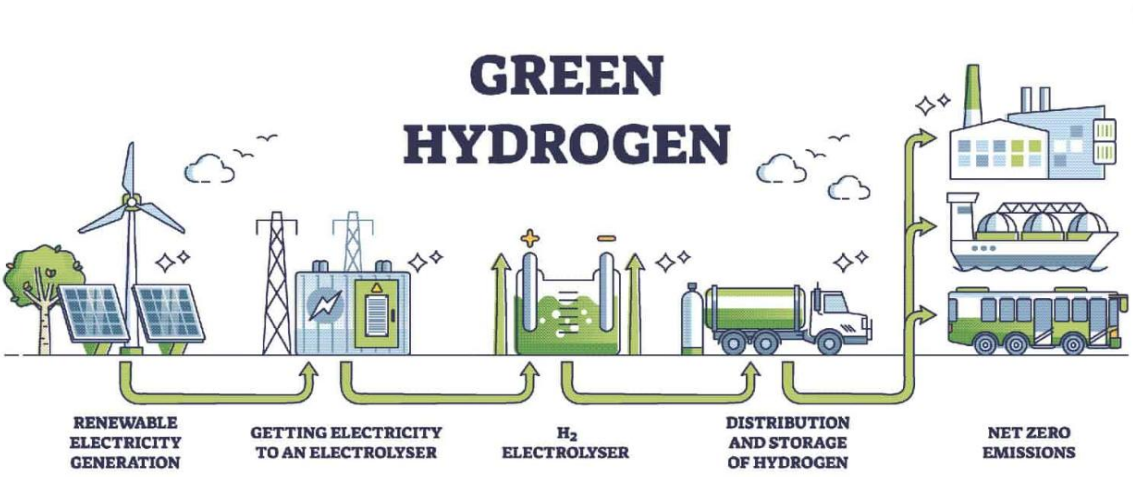
This section describes several action plans that can be implemented across the industry sector for this strategy. For each of the strategies, a short-term, medium-term, and long-term period has been taken into consideration for actionable instruments.

Table 28 Action Plans for Promotion of green rating of Industries

Policy Type/Scheme	Action Plan	Timeline
Capacity building and awareness	Capacity Building of MSMEs Industrial awareness Support from pollution control Board	Short Term
subsidy	Incentive for Industries to go for green rating	Short Term

28

4.2.3 Startegy-3 Green Hydrogen for DCs



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. Gujarat have major refineries, fertilizer capacity, and major steel capacity, where hydrogen can be used as a fuel and help in decarbonization. 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[29] as shown in below figure;

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

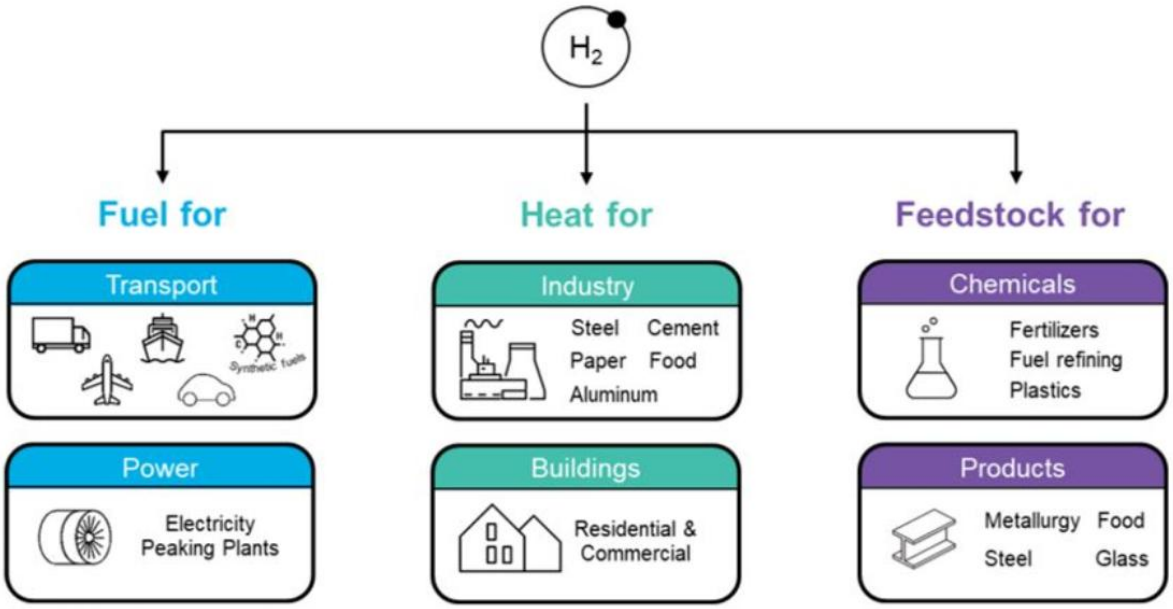


Figure 26 End use of H2

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[30], the following mechanism as shown in below figure;

[30] 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).

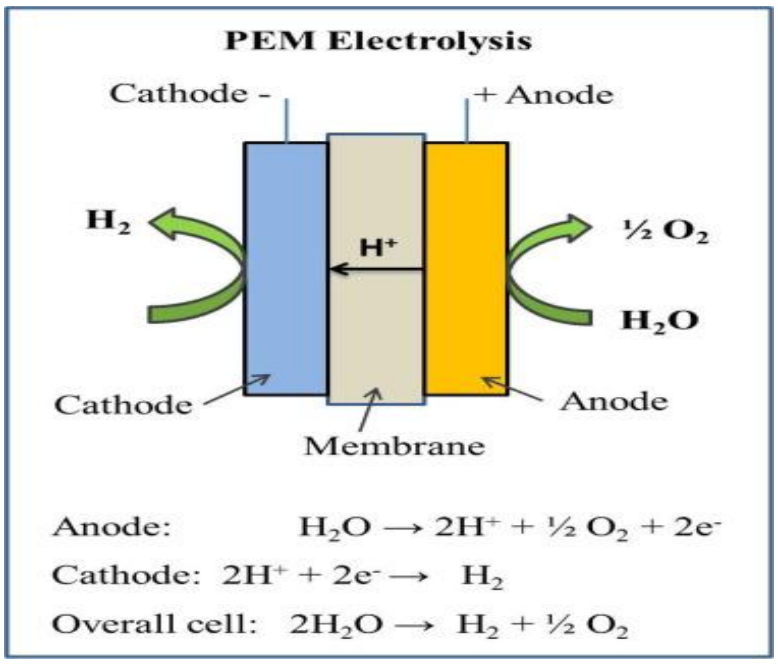


Figure 27 Schematic illustration of PEM water electrolysis

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;

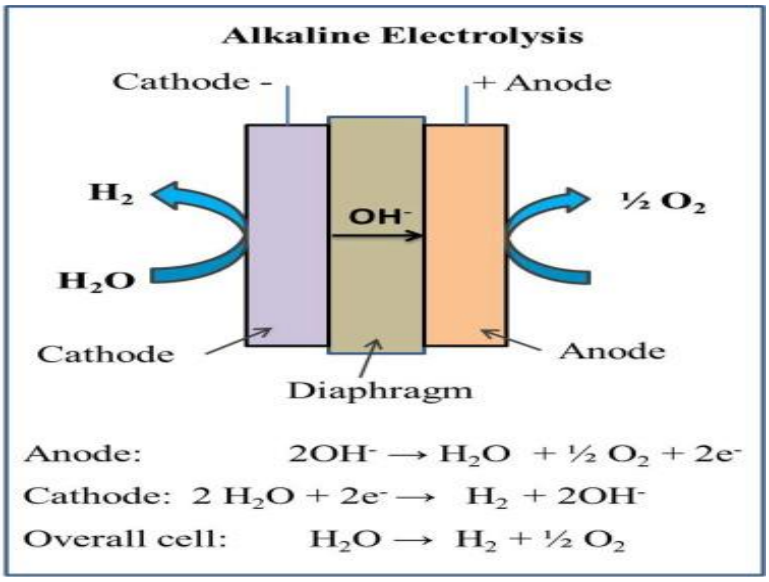


Figure 28 Schematic illustration of alkaline water electrolysis

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 Gujarat is also at the forefront of the production of green hydrogen.

In April 2023, Gujarat cabinet approved the draft land allocation policy- "Policy-2023 for leasing the government fallow land for green hydrogen production using non-conventional energy sources such as solar, wind, wind solar hybrid energy" for green H2 Projects. Land parcels of 1.99 Lakh hectare have been earmarked for five key players in private entities. The Key players, which have received in-principal approval for land parcels in Kutch, Banaskantha district from the state government, include Reliance New Energy Limited, Adani New Industries Limited, Torrent Power Limited, Arcelor Nippon Steel India Limited and Welspun Group[31].

Table 29 Land allocation for Green H2 production in State

Companies	Land allocation (Hectare)
Reliance Energy Limited	74750
Adani New Industries Ltd	84486
Torrent Power	18000
Arcelor Mittal	14393
Welspun Group	8000
Total	199629

Cabinet approved 1.99 Lakh hectare of land against demand of 3.26 Lakh hectare in company proposals. Land is allocated at the rate of Rs 15,000 per hectare on 40 years lease basis. For the production of green hydrogen to start quickly, the development of the associated renewable energy plant will have to be completed within 8 years after handing over the possession of the land. Under this, 50% power capacity and green hydrogen generation capacity in the next 3 years and 100% electricity capacity in 3 years and green hydrogen production will have to be started in the next 3 years[32].

Water supply for industrial purposes in the district can be obtained from three main sources, viz Gujarat Water Supply and Sewerage Board (GSSWB), Irrigation Canal and Sardar Sarovar Narmada Nigam Limited[33].

The Sardar Sarovar Dam is the main source of water supply for all the industries in the regions of Kutch and Saurashtra. Industries in these regions are taking water amounting to 844.85 million litres against their allocation of 675.88 million litres[34]. Water availability can be a challenge in Kutch, Banaskantha.

Hydrogen Projects in Gujrat

As per current scenario many projects are running at pilot level or H2 production is at started for their captive consumption. Example: In August 2022, Larsen & Toubro announced the

[31] https://timesofindia.indiatimes.com/city/ahmedabad/gujarat-clears-1-99-lakh-hectare-land-for-green-hydrogen-projects/articleshow/99827306.cms?frmapp=yes&from=mdr
[32] Government of Gujarat Revenue Department Resolution No. JAMAN/3923/197/A.1 Sachivalaya, Gandhinagar. Date: 08-05-2023
[33] http://www.globalgujarat.com/images/banas-kantha-district-profile.pdf
[34] https://thefederal.com/states/west/gujarat/kutch-saurashtra-thirsting-for-water-71-years-after-launch-of-narmada-canal/

commissioning of a green hydrogen facility at its AM Naik Heavy Engineering Complex in Hazira, Gujarat. The facility is expected to produce 45 kg of green hydrogen daily, for its captive consumption at its Hazira manufacturing complex.

As per the Indo German energy forum information of H2 projects in Gujarat[35] is given in below table;

Green H2 Production	Status	End Use	Project Capacity (Tonnes H2 per Annum)
GIPCL - 10+5 MW Green Hydrogen Project	Announced	Chemical Production	2354.20
NTPC - City Gas at NTPC Kawas	Commissioned	Blending with Natural Gas	0.700
NTPC and GACL - Green Methanol and Ammonia	Announced	Chemical Production	
Adani and Total Energies - Green Hydrogen Ecosystem	Announced	NA	
L &T - Green Hydrogen Plant	Commissioned	Heavy Industry	16.4
Total			2371.3

Approximate capacity of H2 based on disclosed information in public domain can be approximately 2371.3 tonnes. Recently, to give policy push for H2 production at commercial level, Govt has allocated land to 5 key players.

1. **Green Hydrogen plant at L&T in Surat:**

Larsen & Toubro (L&T) has commissioned a green hydrogen plant at its AM Naik Heavy Engineering Complex in Hazira, Gujarat. The production of green hydrogen based on an alkaline electrolysis process has begun. The plant estimated to produce 45 kg of green hydrogen daily, which will be used for captive consumption in the company's Hazira manufacturing complex. The green hydrogen plant is designed for an electrolyser capacity of 800 kW comprising both Alkaline (380 kW) and PEM (420 kW) technologies and will be powered by a rooftop solar plant of 990 kW peak DC capacity and a 500 kWh Battery Energy Storage System (BESS).

As part of Phase-I of the project 380 kW Alkaline electrolyser has been installed, while the 420 kW PEM electrolyser along with solar plant capacity augmentation to 1.6 MW peak DC, will be part of future expansion.

2. **Hydrogen blending solutions for the pilot project by NTPC & Gujrat Gas**

35 https://www.energyforum.in/fileadmin/user_upload/india/media_elements/Presentations/20230320_GH2_Project_list_India/20230320_GH2_Projects_India.pdf

Green Hydrogen will be produced at NTPC Kanwas through solar power supplied by its 1MW project. NTPC will start the green hydrogen blending with a mere 5% but a can be increased further. The Hazira gas pipeline network run by Gujarat Gas will be extended to NTPC township of Kawas and thereafter the blending will take place in a predetermined proportion. The blended gas will be supplied to the households for cooking purposes.

3. Reliance Industry Limited

Reliance have set an ambitious target of achieving net-zero carbon by 2035 and are investing over USD 10 billion (Rs 75,000 crore) in building the most comprehensive ecosystem for New Energy and New Materials in India to secure the promise of a sustainable future for generations to come. Jamnagar, the cradle of RIL old energy business, is also the cradle of RIL New Energy business.

Reliance constructing the Dhirubhai Ambani Green Energy Giga Complex over 5,000 acres in Jamnagar. This will be among the largest such integrated renewable energy manufacturing facilities in the world.

Reliance investing Rs 60,000 crores to construct world-scale, state-of-the-art facilities to manufacture and integrate critical components of the New Energy ecosystem:

- Fully integrated solar photovoltaic manufacturing complex
- Advanced Energy Storage systems for integrated cells, battery packs, control manufacturing
- **Electrolyser manufacturing facility**
- Mobility solutions and development for EV and FCEV
- Power electronics and semiconductor development
- Basic raw material and auxiliary materials manufacturing
- Research and Development facilities for all New Energy Technologies

Reliance also investing Rs 15,000 crores in value-chain, partnerships, and future technologies, including upstream and downstream industries, to create a fully integrated, end-to-end renewable energy ecosystem.

4. Adani Green Energy

Adani, India's diversified business portfolio, and energy supermajor Total Energies of France, have entered into a partnership to jointly create the world's largest green hydrogen ecosystem. Under the venture Adani New Energy Ltd. (ANEL), Adani aims to invest over USD 50 billion over the next 10 years in green hydrogen and associated ecosystem. In the initial phase, ANEL will develop green hydrogen production capacity of 1 million ton per annum before 2030.

Green H2 Potential in Gujarat:

Future production of H2 is estimated in below table;

Table 30 Estimate for the production of H2 by 2031

Particular	Unit	Value
Electricity required for producing 1 Kg of H2	kWh	50
Land Required for 1 MW of Solar energy	Acre	5

Land Required for 1 MW of Solar energy	Hectare/MW	2.023
Land available from Govt of Gujarat	Hectare	199629
Land for renewable energy	%	80%
Land for RE	Hectare	159703.2
No of Days for RE energy	Days	300
No of units generated per day	Units/Day/kWp	4
Solar capacity for H2 with available land	MW	98680
Units generated	Lakh kWh	1184156.204
H2 generated	Lakh Tonnes	23.7
H2 generated	Mn Tonnes	2.37
Water required for 1 Kg of H2	Liters	10
Water required for land allocated to 5 companies in state for H2 Production annually	Mn Lit	23683

		FY 2031	
Particular	**Unit**	**Moderate**	**Ambitious**
H2 Generation Potential	Mn Tonnes/Annum	0.36	0.47
H2 Calorific Value	kCal/Kg	33,889	33,889
H2 Energy	Mn TOE	1.20	1.61
CO2 Saving factor	Mn TOC2/MTOE	3.13	3.13
CO2 Avoidance	Mn TCO2	3.77	5.02

H2 Production is estimated in Moderate and Ambitious scenarios. H2 production is estimated as 30% of the full potential based on land allocation in moderate scenario, i.e., 0.36 Mn tonnes annually. In Ambitious scenario, H2 potential is estimated as 0.47 Mn tonnes in ambitious scenario.

As per India's Green H2 mission, hydrogen production capacity is targeted at least 5 MMT (Million Metric Tonne) per annum with an associated renewable energy capacity addition of about 125 GW in the country[36] by 2030. Gujarat has potential to contribute 2.37 MMT production of H2 if all the 5 key players whom land has been allocated start production at full capacity.

The strategy and its implementation are explained below.

[36] https://pib.gov.in/PressReleasePage.aspx?PRID=1888547

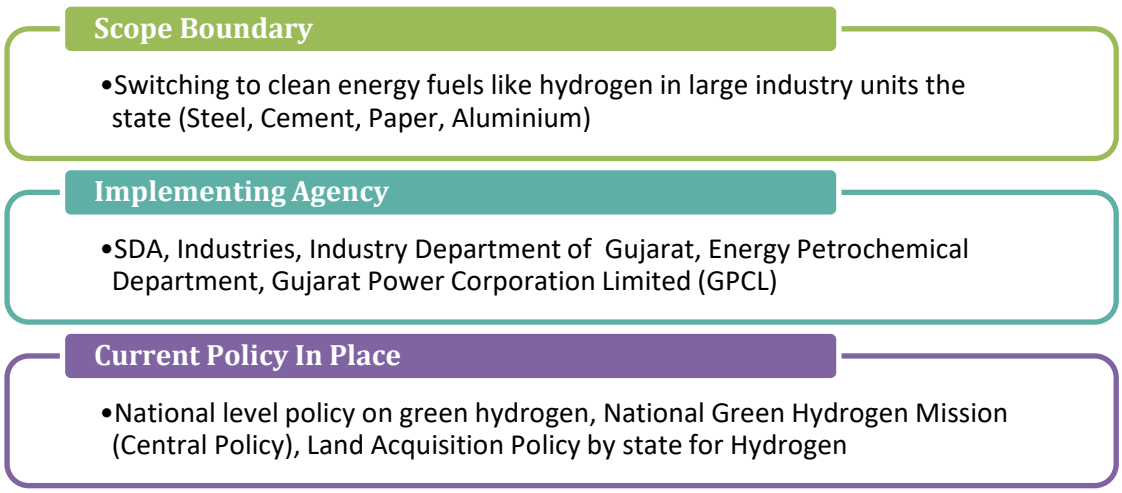


Figure 29 Green Hydrogen Projects: Scope Boundary, Implementing agency and policy

Saving Potential

Assuming in Renewable energy used for generation of Green H2 in moderate and ambitious scenario are 5.87 GW and 7.67 GW. The energy saving potential through deployment of GreenH2 project is as given below;

Table 31: Energy Saving Potential

Particulars	Moderate Scenario for 2031	Ambitious Scenario for 2031
Energy Saving Potential (MTOE)	1.20	1.61
GHG Emission Reduction Potential ($MtCO_2$)	3.77	5.02

Action Plans for Green H2

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

Table 32 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	Short Term

	research, cost optimization and increasing technical capability of industries	
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 33 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%.

4.2.4 Startegy-4 Carbon Capture Storage and Utilization

The role of Carbon Capture, Utilisation, and Storage (CCUS) in climate change mitigation has been a topic of discussion for over two decades. The Intergovernmental Panel on Climate Change's (IPCC) Special Report on Global Warming of 1.5°C and the recent series of announcements made by nations on net proponents of this technology, given the potential zero have enthused the technology can play in reducing emissions.

How to deal with unavoidable emissions has been a central question in the race to achieve climate goals. Certain industries such as concrete and cement simply have no alternative to their methods. In fact, cement production alone, which emits large amounts of carbon dioxide (CO2) into the atmosphere from the chemical reaction that turns limestone into cement, is responsible for 8

percent of all CO2 emissions. This means innovative new approaches are urgently needed – chief among them: carbon capture, utilization and storage, or CCUS, which can trap and use the CO2 released from fuel combustion or industrial activities.

ONGC-IOCL Project in Gujarat state

Oil and Natural Gas Corporation (ONGC) and Indian Oil Corporation Limited (IOCL) have joined forces to implement a carbon capture utilization and storage project (CCUS project) in India with an aim to reduce carbon emissions and enhance oil recovery.

In this regard, the two Indian state-owned conglomerates have signed a memorandum of understanding (MOU) for starting a CO2 based enhanced oil recovery (EOR) programme by capturing CO2 from IOCL's Koyali Refinery in the western Indian state of Gujarat.

The MOU's aim is to improve hydrocarbon production from domestic fields and to reduce the country's carbon emission targets as defined in COP21.

The collaboration will also focus on developing a business model, boosting domestic oil production through CO2-EOR at the Gandhar oil field in Gujarat. The partners will also work on inclusion of the CCUS project as part of national emission curtailment measure, which is aimed at supporting the low-carbon development goals of India.

Dastur International, Inc. and Dastur Energy (Dastur) announced the successful completion of the Techno-Economic Feasibility of the Indian Oil Corporation Limited's (IOCL) Carbon Capture and Utilization Project at the 13.7 MTPA Koyali refinery in Gujarat, India[37]. The project was funded by a grant from the United States Trade and Development Agency (USTDA).

Refineries in Gujrat[38]

No.	Refinery	Oil company	Sector	State	Location	Capacity (MTPA)
1	Jamnagar Refinery (for exports)	Reliance Industries Limited	Private	Gujarat	Jamnagar (SEZ)	35.4
2	Jamnagar Refinery (for domestic market)	Reliance Industries Limited	Private	Gujarat	Jamnagar	33
3	Vadinar Refinery	Nayara Energy Limited	Private	Gujarat	Vadinar	20
4	Gujarat Refinery	Indian Oil Corporation Limited	Public	Gujarat	Koyali/Vadodara	13.7 (capacity expanding to 18)
					Total	106.4

[37] https://www.businesswire.com/news/home/20220414005333/en/Dastur-Successfully-Completes-Techno-Economic-Feasibility-of-India%E2%80%99s-Largest-Carbon-Capture-and-Utilization-Project-at-the-IOCL-Koyali-Refinery

[38] https://en.wikipedia.org/wiki/List_of_oil_refineries_in_India#cite_note-RIL-3

As per the pilot project by IOCL at Koyali refinery, will capture 0.7mtpa of carbon dioxide from its steam methane reforming (SMR). The total capacity of Gujrat refineries is 106.4 MTPA. So as per the pilot project of IOCL, Gujrat has 5.74 MTPA CCUS potential in refineries alone.

The strategy and its implementation are explained below.

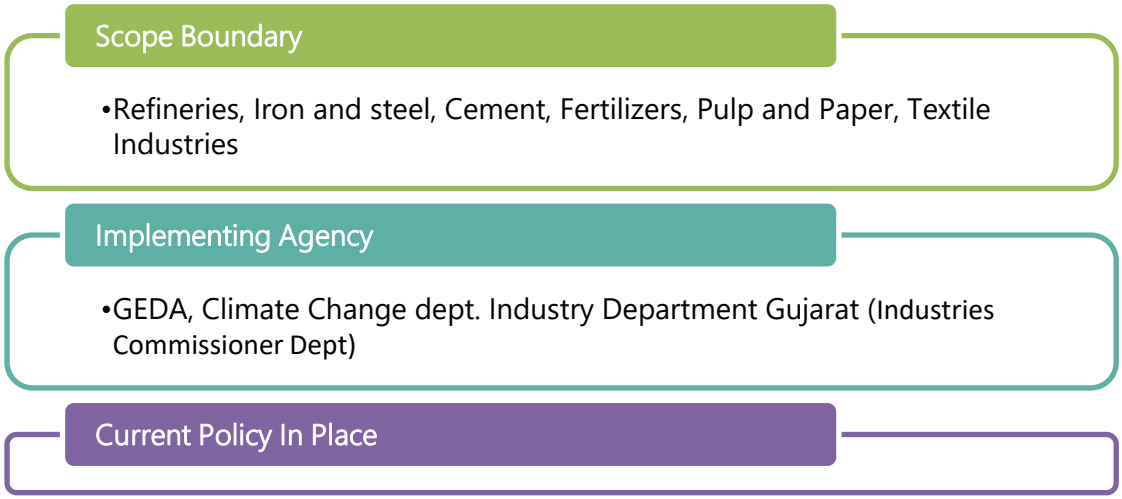


Figure 30 CCUS -Scope Boundary, Implementing agency and Policy

Saving Potential

CCUS are the storage and utilization of CO2 and CO2 saving potential in state till FY 31 is estimated as given below;

Table 34: CO2 Saving Potential

Particulars	Moderate Scenario for 2031	Ambitious Scenario for 2031
Energy Saving Potential (MTOE)		
GHG Emission Reduction Potential ($MtCO_2$)	3.44	5.74

Action Plans for CCUS projects implementation in the state

Carbon capture utilization and storage project is at very nascent stage in the state and following are the action plans;

Table 35 Action Plans for CCUS Project implementation

Policy Type	Action Plan	Timeline
Subsidy	4. Subsidy for pilot project implementation	Short Term
R& D support	5. CCUS technology is still evolving and not yet reached the economies of scale. Some initial support for R&D can help	Long Term

	research, cost optimization and increasing technical capability of industries	

4.3 Energy saving Potential & monitoring mechanism

The overall Energy saving potential in the Industry sector is the state is estimated as 3.13 MTOE in moderate scenario and 4.22 MTOE in ambitious scenario by 2031 as seen from **Table 36**

Table 36 Summary of energy saving from the strategies

Strategy	Energy Saving (Moderate)	Energy Saving (Ambitious)
1. Deepening of PAT	0.56	0.81
2. Widening of PAT	1.05	1.30
3. Promotion of Green rating of Industries	0.33	0.50
4. Green Hydrogen projects and blending with other fuels in Industries	1.20	1.61
5. Carbon Capture Storage and utilization		
Total	3.13	4.22

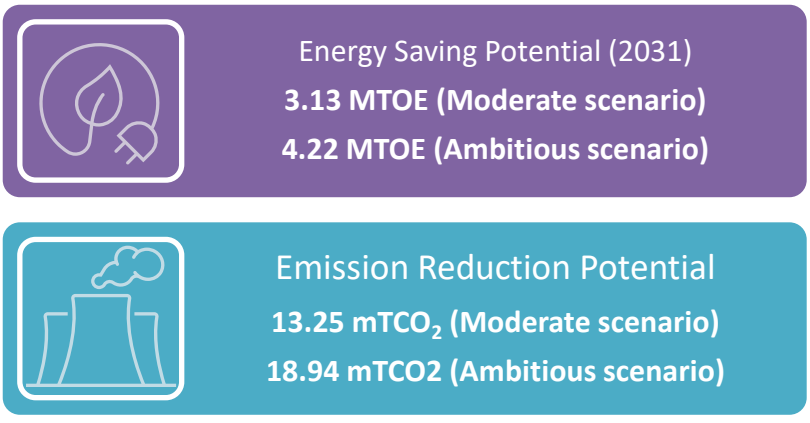


Figure 31 Overall energy saving and emission reduction potential by 2031 in Industry sector

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

Table 37 Monitoring Mechanism

Particular	Monitoring Mechanism
Industry associations	Industry associations can play a key role in monitoring energy consumption for their members.

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

5 Transportation Sector Energy Efficiency

The need to decarbonize our societies is critical in view of climate change. The transportation sector, and specifically the road transport sector within it, is unique. It's difficult because transportation demand is rising, leading to increase the uses of petrol and diesel finally adding greenhouse gases to atmosphere.

There are many solutions for sustainable transport system such as use of biofuels, e-fuels, and other low carbon fuels. However, none of them will be able to address this massive problem on their own, and renewable transportation fuels play a critical role in closing the carbon emissions gap.

Over the next 30 years, the transportation sector will have to undergo structural changes in order to achieve significant emission reductions. To fully engage in the transformation of the transportation sector, market actors need strong policy signals to support the market uptake of zero-emission vehicles, increased production and use of sustainable fuels, and a significant rollout of infrastructure for recharging batteries and refueling with alternative fuels. **Figure 32**, shows the

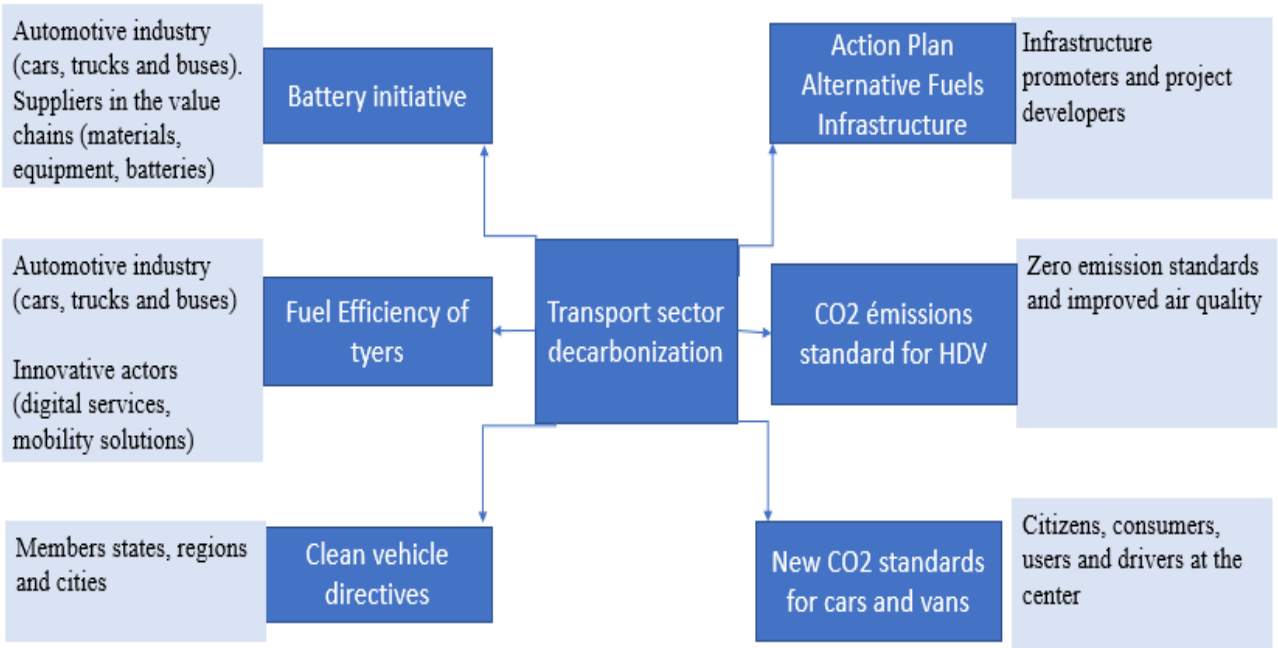


Figure 32 Integrated approach to Transport sector energy efficiency

integrated approach in transport sector for unlocking the potential of initiatives in the field of decarbonizing the transport sector.

For transport sector multidimensional energy efficiency strategy is required. Multidimension strategy includes, electrification of transport sector, fuel switching (Hydrogen, biofuels etc.) i.e look into the multiple aspects which can contribute to energy efficiency.

By 2050, a variety of technology approaches and fuels might result in a 90% reduction in transportation-related emissions. While predicting the technology and fuel mix that will prevail in the transportation sector in the long run is speculative and uncertain, one thing is certain: meeting this ambitious goal in a cost-effective manner cannot be achieved through a single fuel or technology, but rather through an effective mix of policies and technologies tailored to the specificities of different transportation markets. Different decarbonization strategies must be tailored to specific modes of transportation, travel habits, supply chains, and logistics. Transportation decarbonisation also entails the adoption of sustainable mobility solutions such as the promotion of public transportation, soft transport modes (cycling, e-scooters), changes in mobility behaviors/trip patterns (e.g. more teleworking), and modal shifts to less energy-intensive modes of transportation.

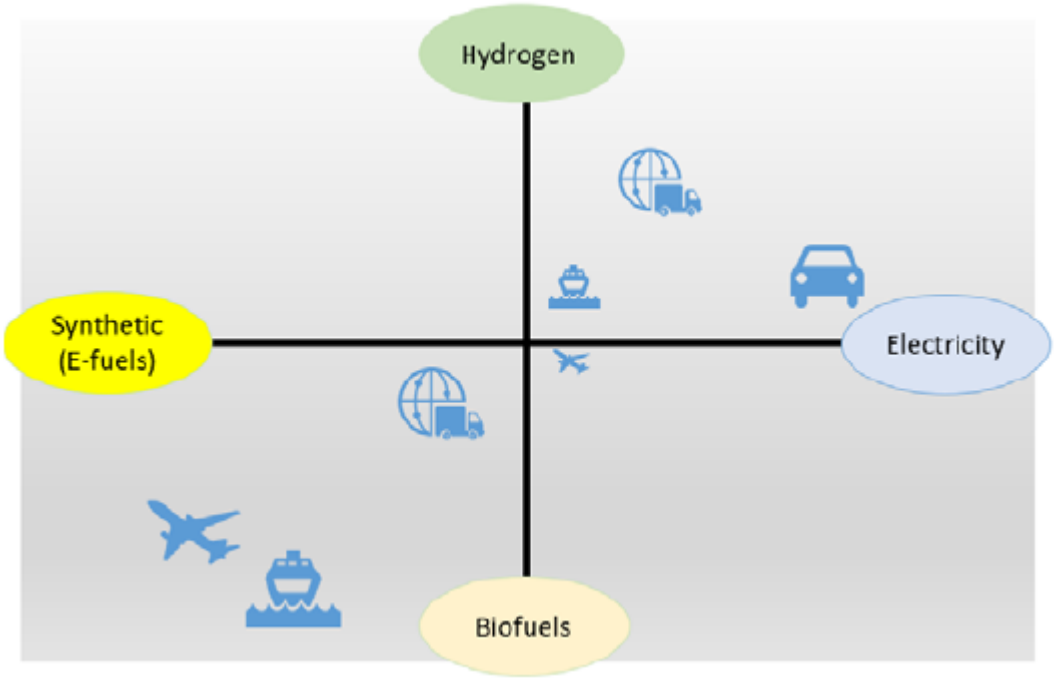


Figure 33 Multidimensions strategy for transport sector decarbonization

India has vowed to cut carbon emission intensity of GDP by 33 percent to 35 percent below 2005 levels by 2030 as part of its Nationally Determined Contributions (NDCs). The NDCs demonstrate a distinct preference for mass transport systems such as buses and metros over private/low occupancy modes. It also recognises the need to move away from the road sector and toward more energy-efficient forms of transportation like rail and water. The goal of a 45 percent rail share in land transport is a huge step in the right direction. Electric vehicles, fuel efficiency improvements, and biofuel mixing are all cited as ways to improve the road sector transportation.

- **Approach for Transport sector efficiency**

The benefits of applying the ASI strategy to develop a sustainable transportation system are illustrated in the Figure 34.
According to the NITI Aayog report, traffic congestion costs a lot of money in terms of lost productivity and wasted fuel. According to the survey, the cost of congestion in our top four metros is over USD 22 billion per year. By finding alternatives that result in lower energy costs and less imported fuel, the ASI strategy will improve energy security. It will have an impact on the country's economic development by increasing private investment and reducing congestion, which will save time, which is a valuable commodity in today's world.

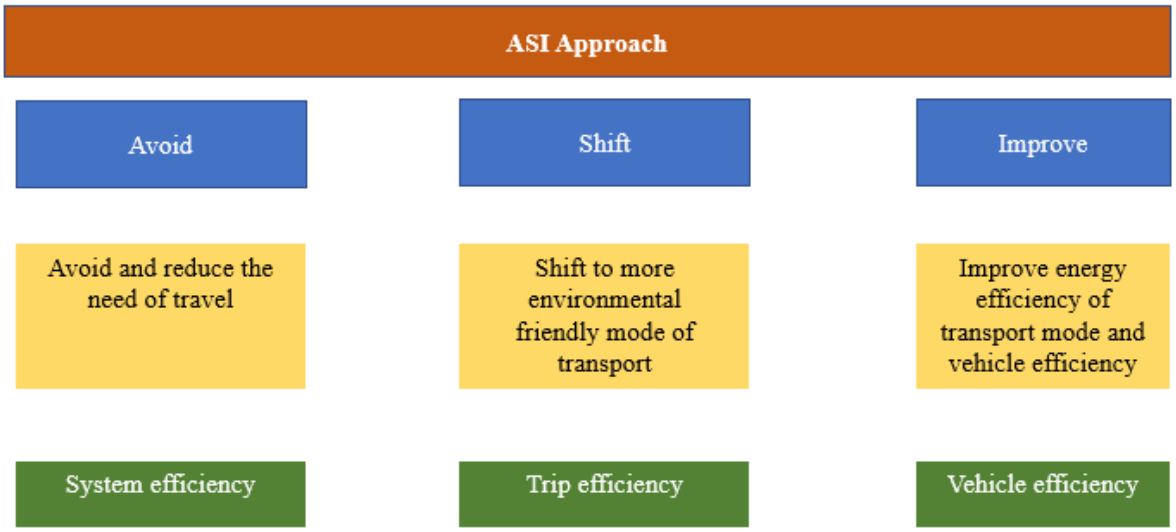


Figure 34 ASI Approach in transport sector energy efficiency

- **Policy framework for decarbonizing and energy efficiency in the transport sector:**

To reduce the gap between the India's climate goals and actual CO_2 emissions, a mix of technology and policy alternatives will be required. As new and improved technology are introduced to the market, as well as the demands for passenger and freight transportation, this balance is projected to change.

Below Figure depicts the portfolio of drivers and intervention options for the transition to a decarbonized future transportation system.

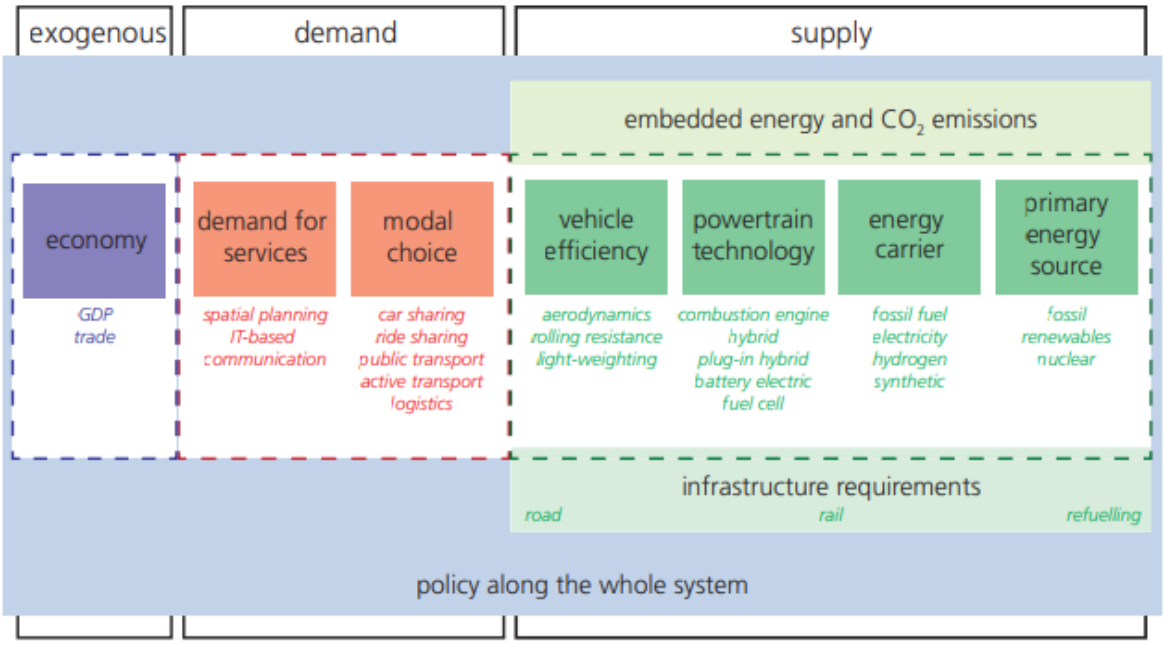


Figure 35 Policy framework for decarbonization of transport sector

Transport Demand

- Encourage people to change their behavior (e.g., by facilitating walking, cycling, teleworking, teleconferencing, web-streaming of events, more healthier lives, etc.) to reduce demand for passenger transportation services.
- change to modes of transportation that require fewer vehicle kilometers (kms) (e.g., shifting people and freight to vehicles with better specific load carrying capacity or boosting load factors of existing vehicles through sharing or pooling)

Transport Supply

- Enhance vehicle design (e.g., better aerodynamics, light-weighting to minimize vehicle energy demand, lower new vehicle fossil carbon footprint, etc.);
- Improve/deploy more efficient conventional powertrains as a transitional option, and maximise the potential of hybrid cars (hybridisation);
- Improve/deploy vehicles using alternative energy carriers (e.g. low-carbon electricity, hydrogen, and synthetic fuels) that are powered by primary energy sources as long-term sustainable solutions.

Fuel efficiency:

Emission standards have long been enforced in India. In 1991/92, the first set of standards for gasoline and diesel automobiles were implemented. The National Auto Fuel Policy outlined a timeline for implementing Bharat Stage emission requirements. These standards are focused on reducing air pollution, which necessitates overall improvements in vehicle performance.

In terms of fuel efficiency, the Corporate Average Fuel Economy (CAFÉ) standards, which were implemented in 2017, have yielded positive improvements for passenger cars. The weighted average CO_2 emission from a manufacturer's production line must be less than 130 gm/km until 2022, and less than 113 gm/km thereafter, according to these regulations. Fuel efficiency policy is also implemented in EU which have resulted in improved fuel efficiency in transport sector.

Example: EU Policy for decarbonization of transport sector and fuel efficiency

• Regulation (EU) 2019/631, which establishes CO_2 emission performance standards for new passenger vehicles and vans, went into effect on January 1, 2020. As per the policy, the target for 2020 -2024 is 95 g CO_2/km for cars and 147 g CO_2/km for vans.
• Since the new target was implemented in 2020, average CO_2 emissions from new passenger cars registered in Europe have declined by 12% year on year, and the share of electric cars has tripled.

• The EU policy also focusses on reducing CO_2 emissions from heavy-duty vehicles. The first-ever EU-wide CO_2 emission standards for heavy-duty vehicles, adopted in 2019, set targets for reducing the average emissions from new lorries for 2025 and 2030.
• The targets are expressed as a percentage reduction of emissions compared to EU average in the reference period (1 July 2019–30 June 2020):
- from 2025 onwards: 15% reduction
- from 2030 onwards: 30% reduction
As per the latest amendments in EC Act 2001, following norms have been included for vehicle and vessels;
If the manufacturer of a vehicle fails to comply with the fuel consumption norms, he shall also be liable to pay an additional penalty per unit of vehicles sold in the corresponding year, as follows, namely:-
(i) twenty-five thousand rupees per vehicle for non-compliance of norms up to 0.2 litres per 100 kms;
(ii) fifty thousand rupees per vehicle for non-compliance of norms above 0.2 litres per 100 kms.[39]

5.1 Energy efficiency Strategies in Transport sector

5.1.1 Strategy 1: Facilitating Electrification of Road Transport

Electric vehicles are significantly more efficient than their petrol or diesel counterparts. While electric vehicles can convert around 60% of the electrical energy from the grid to power the wheels, petrol or diesel cars can only convert 17%-21% of the energy stored in the fuel to the wheels, resulting in a wastage of around 80%. Thus, electrification of road transport is a good way to reduce energy consumption and emissions, particularly as the grid becomes greener with increased use of renewables. In Gujarat as of November 2022, total number of vehicles are 2,10,79,091 and 84.48% of vehicles out of total numbers of vehicles are petrol fuel type.

[39] Bill No. 177-C of 2022, THE ENERGY CONSERVATION (AMENDMENT) BILL, 2022

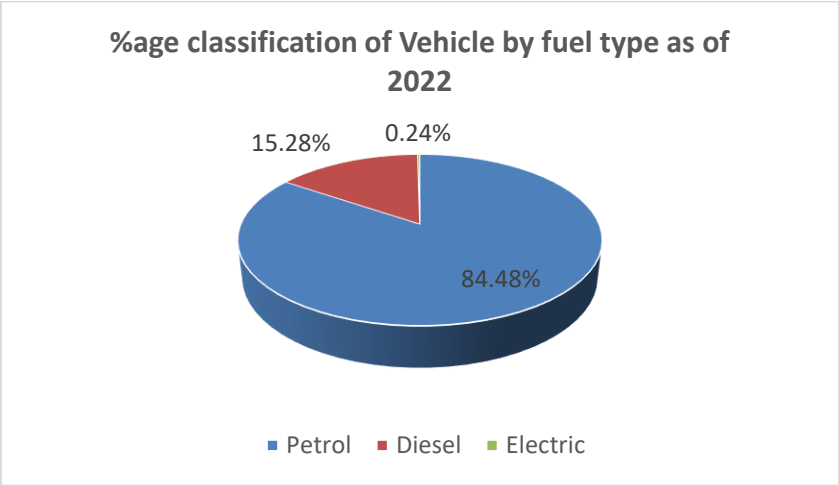


Figure 36 %age classification of vehicle by fuel type as of Dec 2022

Further vehicles are classified into various categories such as 2- Wheeler 3- Wheeler, 4- Wheeler, Goods vehicles, Heavy vehicles, Buses and total no is as given below;

Table 38 No of Vehicle category wise number of vehicles as of Dec 2022[40]

Vehicle Category	Total
2- Wheeler	14975445
3- Wheeler	792025
4- Wheeler	4393263
Goods vehicles	540642
Heavy vehicles	352237
Buses	25479
Total	21079091

%age breakup of total number of category wise vehicles is as given below;

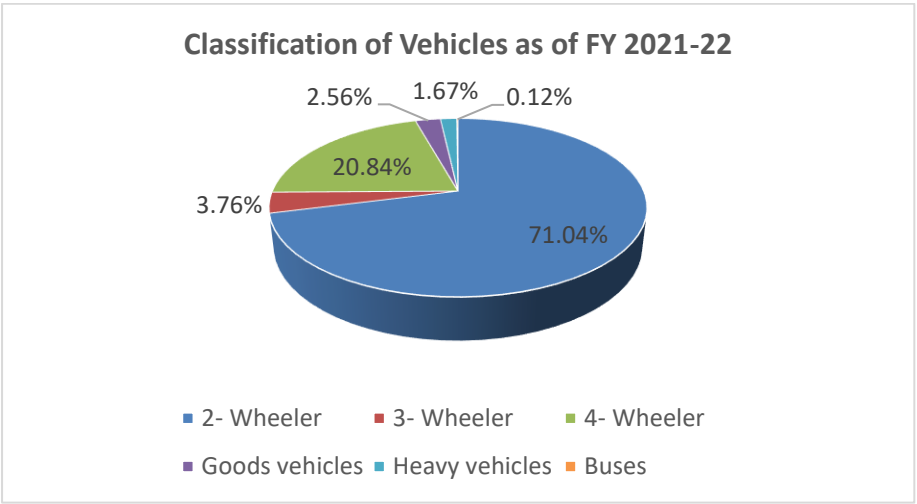


Figure 37 Classification of vehicle as vehicle type as on FY 2021-22

[40] https://vahan.parivahan.gov.in/vahan4dashboard/

Table 39 Fuel Wise Vehicle Categories as on FY2022

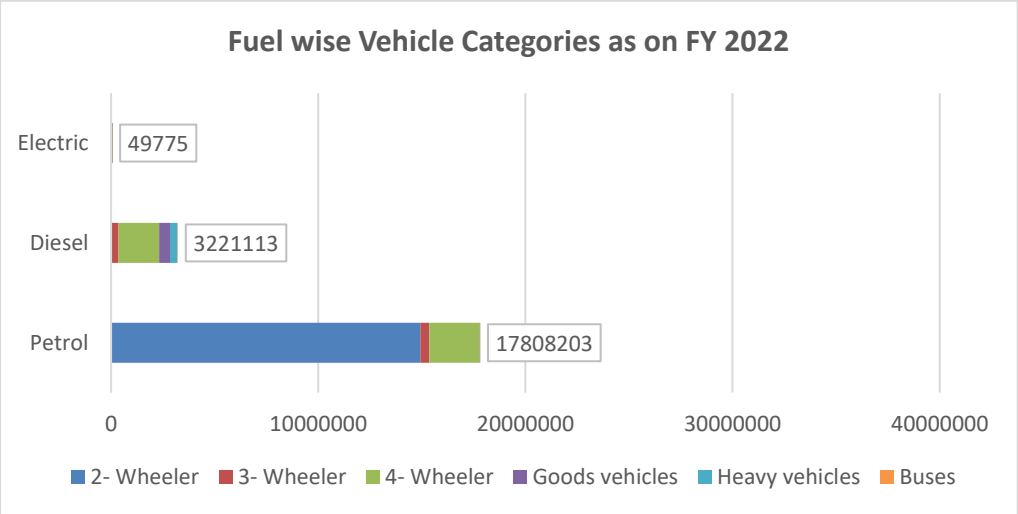


Figure 38 Fuel Wise Vehicle Categories as on FY2022

Despite being one of the fastest growing electric vehicle markets in India with favourable demand-side incentives through their EV policy and an established charging infrastructure, Gujarat state still has a long way to go to transition from ICE vehicles to electric vehicles, with only 0.36% of registered vehicles being electric.

Projected number of vehicles for FY2031 is given below.

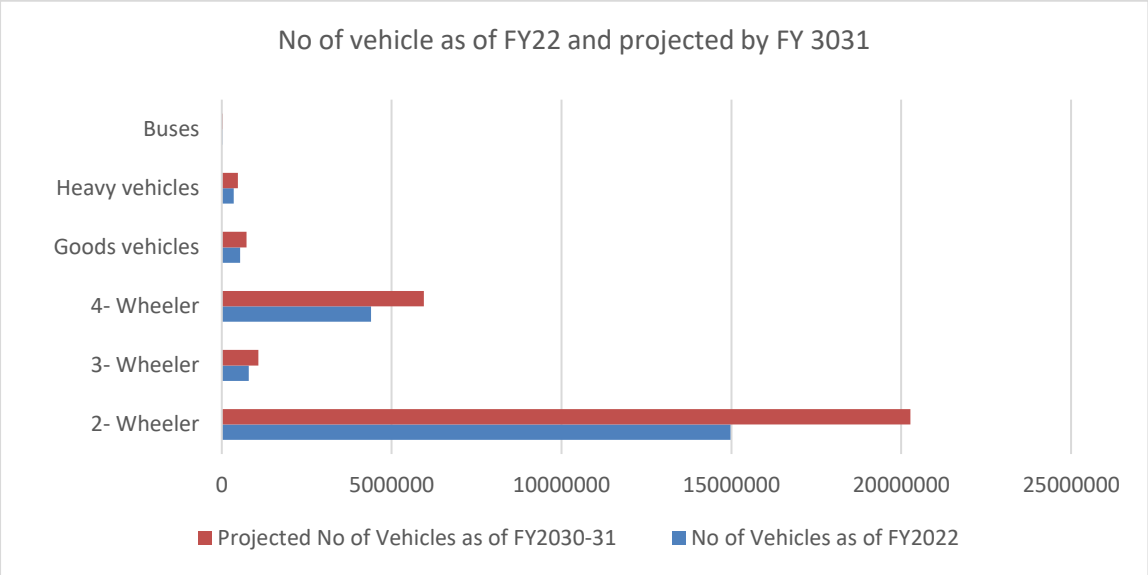


Figure 39 No of vehicle as of FY22 and projected by FY 3031

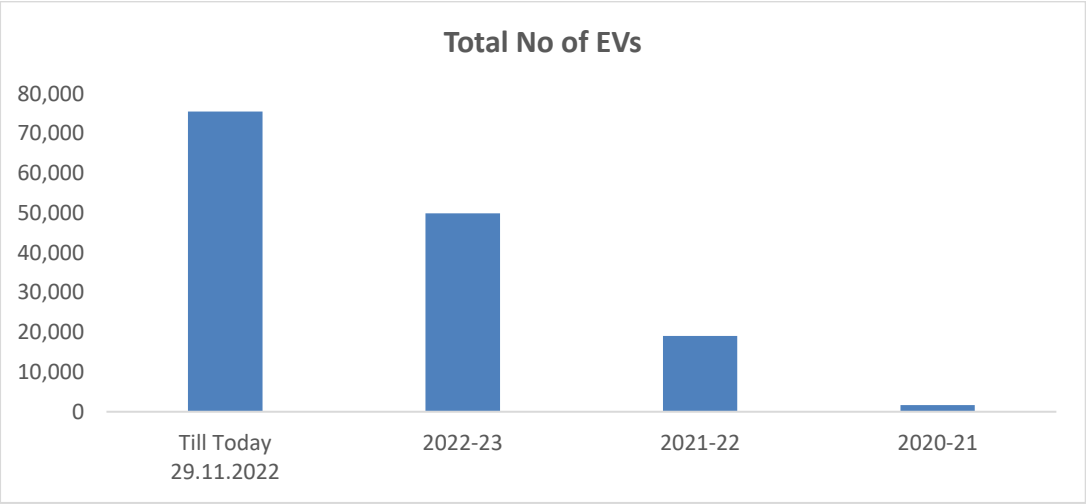
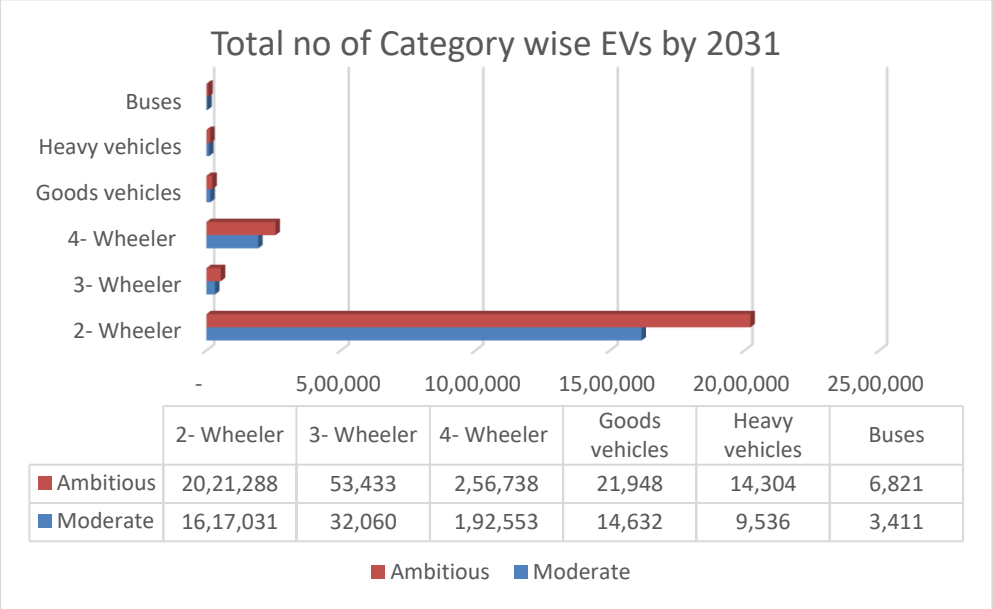


Figure 40 Total No of EVs

Total number of projected vehicle in the state as of FY 2031 is 2,85,34,429 and it is considered that by 2031, state has potential to convert existing fleet into EV by 7% in moderate scenario and 8% in ambitious scenario. In projection it is considered by 2031, total no of fleet converted to EV would be 18,69,223 in moderate scenario and 23,74,533 in ambitious scenario.

The category wise potential of EVs by 2031 in moderate and ambitious scenario is given below;



	2- Wheeler	3- Wheeler	4- Wheeler	Goods vehicles	Heavy vehicles	Buses
Ambitious	20,21,288	53,433	2,56,738	21,948	14,304	6,821
Moderate	16,17,031	32,060	1,92,553	14,632	9,536	3,411

For charging the above electric vehicles the approximate annual electricity requirement will be 945681571 kWh in moderate scenario and 1245875825 kWh in ambitious scenario. Considering the 60% of the electricity is procured through renewable sources, the renewable electricity required would be 473 MW to 623 MW in moderate and ambitious scenario respectively.

The strategy and its implementation are explained below.

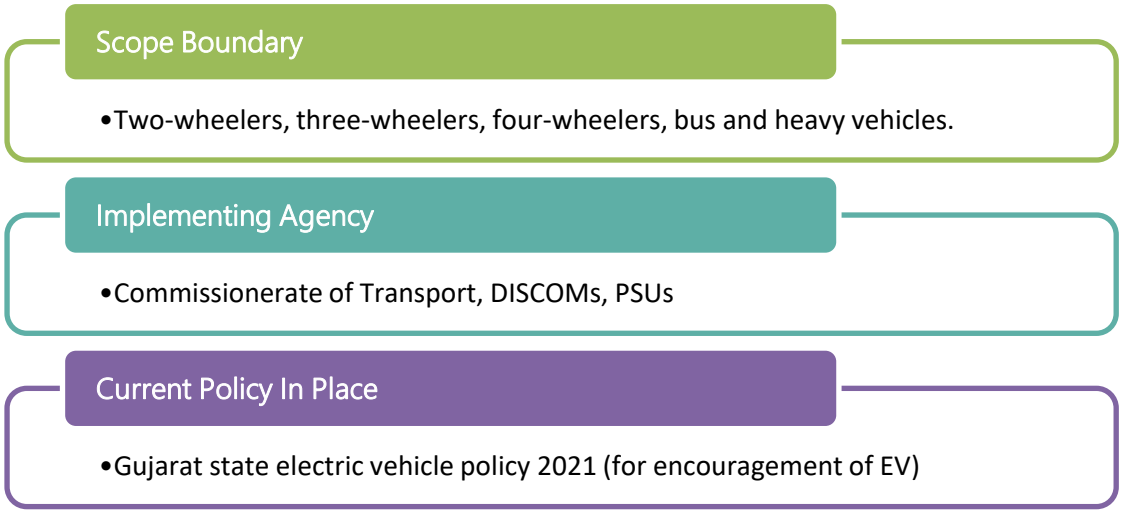


Figure 41 EV: Scope Boundary, Implementing agency and Policy

As per Commissionerate of Transport Gujarat, under the Gujarat EV policy 2021, No. of Applicants who are given subsidy: 40,794. Total Amount of subsidy (from start of policy, till 15-01-2023): ₹ 1,00,75,71,900.00[41]

Saving Potential

By increasing the share of EVs in the vehicle stock of Gujarat with 18.54 lakh EVs in moderate scenario and 23.55 Lakh EVs in ambitious scenario by 2031, additionally 56,622 chargers and battery swapping infrastructure by 2026 and 73,362 chargers and battery swapping infrastructure by 2031, with Level-1, Level-2 and Level-3 (DC) chargers across all cities will result into energy saving of 1.17 MTOE in moderate scenario and 1.60 MTOE in ambitious scenario by FY 2031.

Table 40: Energy Saving Potential

Particulars	Moderate Scenario for 2031	Ambitious Scenario for 2031
Energy Saving Potential (MTOE)	1.17	1.60
GHG Emission Reduction Potential ($MtCO_2$)	3.66	5.00

Action Plans for converting existing fleet to EVs

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.

[41] https://cot.gujarat.gov.in/

Table 41 Action plans for EVs

Policy Type/Schemes	Action Plan	Timeline
Awareness & Capacity Building	6. Awareness on Standard & Labelling Program for Tyres	Short Term
	7. Awareness on Energy Efficiency Program on High Energy Lithium-Ion Traction Battery Packs and Systems.	Short Term
Technological Intervention	8. Combined Charging Systems (CCS Standard)	Long Term
	9. Charging stations based on open access	Long Term
	10. Pilot projects on Hydrogen Fuel Cell Vehicles	Long Term
	11. Pilot projects on Battery Swapping stations in all 10 model cities	Long Term

5.1.2 Strategy 2: Adequate Public Transport

Gujarat has an extensive public transportation system that includes buses, trains, and auto-rickshaws. The state-owned Gujarat State Road Transport Corporation (GSRTC) operates buses that connect various cities and towns within the state, as well as neighbouring states. As of Nov 2022 total number of 25,196 heavy passenger vehicles are operated in the state.

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

The strategy and its implementation are explained below.

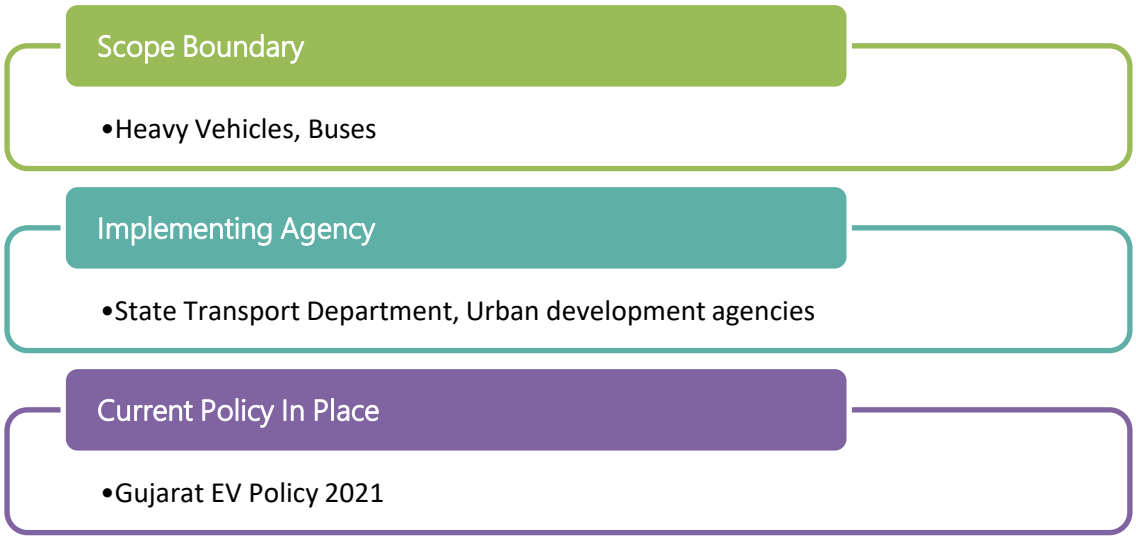


Figure 42 Adequate public transport- Scope Boundary, Implementing agency and Policy

Saving Potential

According to the Ministry of Urban Development report[42] on Public Transit, cars and two-wheelers consume less than 50% of the total fuel consumption by all modes, however the total emission produced by these two modes is more than 60%. This is due to high level of congestion in the cities resulting in slow speeds and thus higher emissions. The public transport system is the most effective way to reduce the number of vehicles as well as the total emissions on the road. This is also the only way to a more equitable allocation of road space with people, rather than vehicles.

The energy saving potential is estimated by categorizing districts of the state based on the population, thus arriving on total fuel consumption per day by vehicles with and without public transport per day.

			Fuel consumption (KL/day)		Savings Potential	
Sr No.	Population	No. of Urban Agglomerations	Without Adequate PT	With Adequate PT	KL/day	MTOE/year
1.	<5 Lakhs	25	18	17	25	0.01
2.	5-10 Lakhs	2	559	502	114	0.04
3.	10-20 Lakhs	1	2617	2112	505	0.17
4.	20-40 Lakhs	0	2802	2099	0	0.00
5.	40-80 Lakhs	2	38395	37163	2464	0.81
6.	>80 Lakhs	1	38395	37163	1232	0.40
						1.42

By using above information the saving potential is estimated as 1.42 MTOE and to take a conservative estimate in moderate and ambitious scenario of 75% and 90% of overall energy saving is considered.

1.06 MTOE saving is estimated in moderate scenario and 1.28 MTOE under ambitious by deployment of adequate public transport system.

Table 42 Major Agglomeration in Gujarat[43]

Sr. No.	Major Agglomeration name	Population
1	Ahmedabad	63,57,693
2	Surat	45,91,246
3	Vadodara	18,22,221
4	Rajkot	13,90,640
5	Bhavnagar	6,05,882
6	Jamnagar	6,00,943

[42] https://mohua.gov.in/upload/uploadfiles/files/final_Report.pdf
[43] https://www.citypopulation.de/en/india/cities/gujarat/

7	Junagadh	3,19,462
8	Anand	2,88,095
9	Navsari	2,82,791
10	Surendra Nagar	2,53,606
11	Morvi	2,51,859

Table 43: Energy Saving Potential

Particulars	Moderate Scenario for 2031	Ambitious Scenario for 2031
Energy Saving Potential (MTOE)	1.06	1.28
GHG Emission Reduction Potential ($MtCO_2$)	3.33	4.00

Gujarat state, located on the western coast of India, has an extensive coastline and relies on water transport for various purposes, including fishing, cargo transportation, and tourism and waterways comes under Gujarat Maritime Board (GMB). Energy efficiency in the water transport sector is crucial to minimize the environmental impact and reduce operating costs. Here are some initiatives and measures can be taken to improve energy efficiency in Gujarat's water transport sector:

Port Infrastructure: Gujarat has several major ports, including Kandla, Mundra, and Dahej, which handle a significant volume of cargo. The port infrastructure modernization, adopting energy-efficient technologies would reduce emission as well as energy consumption. This includes the use of energy-efficient cranes, lighting systems, and cargo handling equipment to reduce energy consumption.

Vessel Upgrades: Upgrading engines, optimizing hull designs, and adopting advanced technologies help reduce fuel consumption and emissions. Ex: Shore power for vessels when they are at berth and require electricity

Awareness and Training: The state government, along with various maritime organizations and institutions, conducts awareness programs and training sessions to promote energy-efficient practices among water transport operators. These programs focus on educating operators about fuel-efficient navigation, proper maintenance practices, and adopting energy-saving technologies.

5.1.3 Strategy 3: Ethanol Blending

The ethanol blending policy of fuels can have a significant impact on the economy and environment of Gujarat. By blending ethanol with petrol, the state can reduce its dependence on imported crude oil and promote the use of cleaner fuels. According to the Ministry of Petroleum and Natural Gas, India's ethanol blending program has resulted in a reduction of 7.9 million tonnes of CO2 emissions in 2020-21.

The state can leverage its agricultural resources to promote the production of ethanol and create new job opportunities. Government of India, with the aim to enhance India’s energy security, reduce import dependency on fuel, save foreign exchange, address environmental issues and give a boost to domestic agriculture sector, has been promoting the Ethanol Blended Petrol (EBP) Programme. The ‘National Policy on Biofuels’ notified by the Government in 2018 envisaged an indicative target

of 20% ethanol blending in petrol by year 2030. However, considering the encouraging performance, due to various interventions made by the Government since 2014, the target of 20% ethanol blending was advanced from 2030 to 2025-26.

A "Roadmap for Ethanol Blending in India 2020-25" was also released by the Hon'ble Prime Minister in June, 2021 which lays out a detailed pathway for achieving 20% ethanol blending. This roadmap also mentioned an intermediate milestone of 10% blending to be achieved by November, 2022[44].

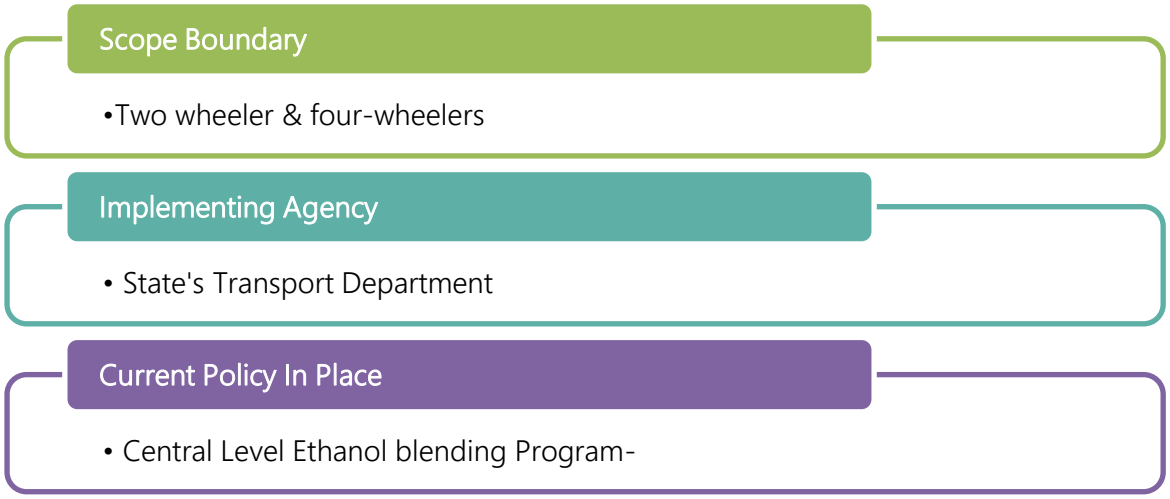


Figure 43 Ethanol Blending: Scope Boundary, Implementing agency and Policy

Energy Saving Potential

The saving potential is estimated based on following assumptions.

	FY 2026		FY 2031	
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)	1,028	1,542	1,242	1,864
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)	0.90	1.36	1.09	1.64

It is considered that by blending 20% to 30% ethanol, quantity of petrol will be saved. In state 10% of blending is already in place by targeting another 10% and 20% of the blending 1242 Mn Lit and 1864 Mn Lit of petrol would be avoided in moderate and ambitious scenario by 2031.

[44] https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1831289

Table 44: Energy Saving Potential

Particulars	Moderate Scenario for 2031	Ambitious Scenario for 2031
Energy Saving Potential (MTOE)	1.09	1.64
GHG Emission Reduction Potential ($MtCO_2$)	4.58	6.86

Action Plans

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

Policy/Scheme	Action Plan	Timeline
Technological Intervention	1. Enabling infrastructure for ethanol availability for blending. State can ease storage, movement, and permit norms for industrial fuel-grade ethanol.	Short Term
Subsidy	1. 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
	2. Interest subsidy of some percent (subject to state govt.) on term loan for 5 years with cap in addition to the assistance received under central govt, for encouraging ethanol manufacturing in the state.	Short Term

5.2 Energy saving targets & monitoring mechanism

The overall energy saving potential for the transport sector is 3.33 MTOE in moderate scenario and 4.51 MTOE in ambitious scenario.

Table 45 Summary of energy saving from the strategies by 2031

Strategy	Energy Saving Target (Moderate) 2031	Energy Saving (Ambitious) 2031
1. Electrification of Road Transport	1.17	1.60
2. Facilitating Adequate Public Transport	1.09	1.64
3. Ethanol blending	1.06	1.28

Total	3.33	4.51

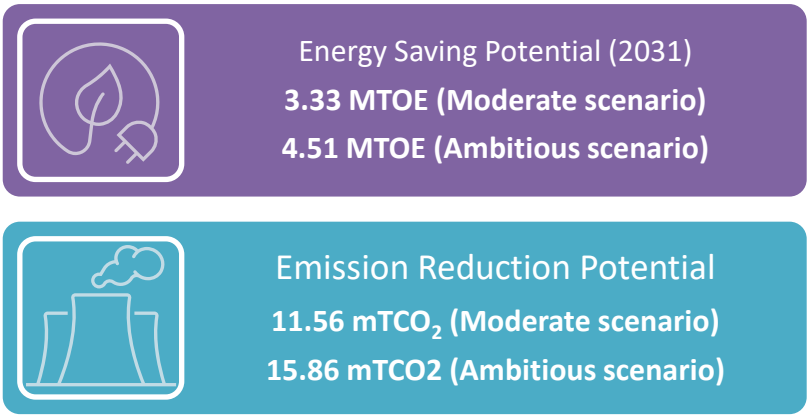


Figure 44 Energy saving in emissions reduction potential in transport sector 2031

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

Action	Monitoring Mechanism
Data Collection	Regular data collection and analysis can help track progress towards energy efficiency and emission reduction. The state government can collect data from Vahan Dashboard 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.

The following presents case studies that can be adopted and implemented in the state of Gujarat.

Delhi Case Study: Aggregator Policy

All cab companies, food delivery firms, and e-commerce entities operating in Delhi will be required to switch to an all-electric fleet by April 2030. The policy will apply to both existing and new players in the market.

Cab aggregators will be required to obtain a license from the Delhi government to operate in the city.

The license will be valid for a period of five years and will be renewable upon compliance with the policy's provisions.

The policy will mandate the use of only electric vehicles (EVs) with a valid permit from the Delhi Transport Department.

The government will provide incentives and subsidies to promote the adoption of EVs by cab aggregators.

Cab aggregators will be required to maintain a minimum fleet size of 2% electric vehicles in the first year, 5% in the second year, 10% in the third year, and 25% in the fourth year, and 100% by 2030.

The policy will also require cab aggregators to set up charging infrastructure for their EV fleet and install GPS-enabled meters for fare calculation.

The policy will ensure the safety of passengers and drivers by mandating that all drivers undergo background checks and providing insurance coverage for both passengers and drivers.

The policy will also regulate surge pricing, commission charged by the cab aggregators, and other operational aspects to ensure a level playing field for all players in the market.

Development of an Integrated Metro-Bus Transportation System

Case of Kochi

Kochi, a major port city in the Indian state of Kerala, has been facing significant traffic congestion and air pollution due to the rapid increase in the number of vehicles on the roads. To provide efficient and sustainable mobility solutions, the Kochi Metro Rail Limited (KMRL) has been developing a multimodal transport system that integrates the metro, buses, informal transport, and ferries.

The following are the key features of the multimodal integration between metro, buses, informal transport, and ferries of Kochi.

Integrated Fare System:

The KMRL has implemented an integrated fare system that enables commuters to use the metro, buses, and ferries with a single ticket. The integrated fare system has reduced the transaction time for the commuters and increased the efficiency of the system.

Last Mile Connectivity:

The KMRL has established last-mile connectivity solutions, such as feeder buses and auto-rickshaws, to provide seamless connectivity from the metro stations to the final destinations. The last-mile connectivity solutions have reduced the travel time and increased the accessibility of the system.

Smart Card System:

The KMRL has implemented a smart card system that enables commuters to use the metro, buses, and ferries with a single card. The smart card system has reduced the dependence on cash and increased the efficiency of the system.

Real-time Passenger Information (RTPI) System:

The KMRL has implemented a RTPI system that provides real-time information on the arrival and departure of the metro, buses, and ferries. The RTPI system has increased the convenience of the commuters and reduced the waiting time.

Intermodal Transfer Facilities:

The KMRL has established intermodal transfer facilities, such as bus bays and boat jetties, at the metro stations to provide seamless transfer between the different modes of transport. The intermodal transfer facilities have increased the efficiency of the system and reduced the travel time.

Multi-Level Parking:

The KMRL has established multi-level parking facilities at the metro stations to provide parking space for the commuters using private vehicles. The multi-level parking facilities have reduced the on-road parking and the traffic congestion.

Bicycle Sharing System:

The KMRL has established a bicycle sharing system at the metro stations to provide an eco-friendly mode of transport for short distances. The bicycle sharing system has increased the accessibility of the system and reduced the air pollution.

6 Building Sector Energy Efficiency

6.1 Overview

In Gujarat, the residential sector consumed 5.98 MTOE which accounted for 10.34% of total energy for FY 2020. And the commercial sector consumed 0.65 MTOE which accounted for 1.13% of total energy for FY 2020. The adoption of energy-efficient building practices is critical for reducing energy consumption and greenhouse gas emissions in Gujarat. Gujarat has not yet notified Energy Conservation and sustainable building code (ECSBC) in commercial sector and Eco-Niwas Samhita (ENS) in residential sector.

The building sector indeed has a large potential for energy efficiency improvements. Buildings consume a significant amount of energy for heating, cooling, lighting, and powering various systems and appliances. However, many buildings which are not energy efficient and consume more energy than necessary, resulting in higher energy bills and increased greenhouse gas 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. In Gujarat, the domestic and commercial sector is the third largest consumer of electricity and second largest

consumer of total energy consumption. Effective use of energy efficiency strategies in this sector paves the way to reduce the future energy consumption of the state.

ECSBC is not yet mandatory in Gujarat. To begin with, ECSBC 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. Also ECO-Niwas Samhita should be implemented in residential sector.

Gujarat is one of the fastest growing states in India, with rapid economic growth, urbanization, and building floorspace expansion. Gujarat's per capita GDP was $2100 in 2014,1 45% higher than India's national average[45].The share of urban population in Gujarat increased from 37% in 2001 to 43% in 2011, higher than India's average urbanization rate of 31% in 2011[46]. This rapid growth of urban centers also brings big demand for new construction. In the long term, the floorspace to be built in India through 2050 would more than double that of today.

Sha yu. Et.al., estimated total floorspace in Gujarat would increase by more than 4 times, and the growth rate differs across building types. Driven by strong urbanization and construction boom in urban areas, total floorspace in urban residential buildings and commercial buildings would grow by around 7 and 8 times, respectively[47].

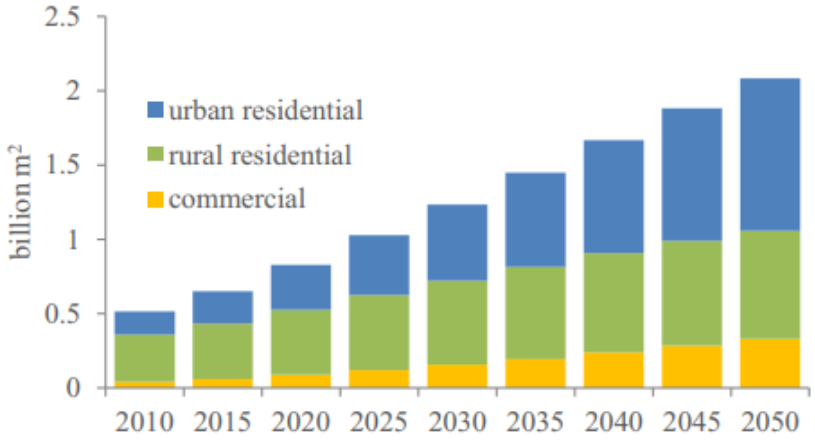


Figure 45 Floor space growth in Gujarat

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.

[46] Government of Gujarat, 2011. State Domestic Product Gujarat State, Ahmedabad, India. Government of India, 2009. National Mission on Enhanced Energy Efficiency

[47] Improving building energy efficiency in India: State-level analysis of building energy efficiency policies, Energy Policy 110 (2017) 331–341

6.2 Energy efficiency strategies in the buildings sector

6.2.1 Strategy 1: Implementation of ENS-Residential Sector

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

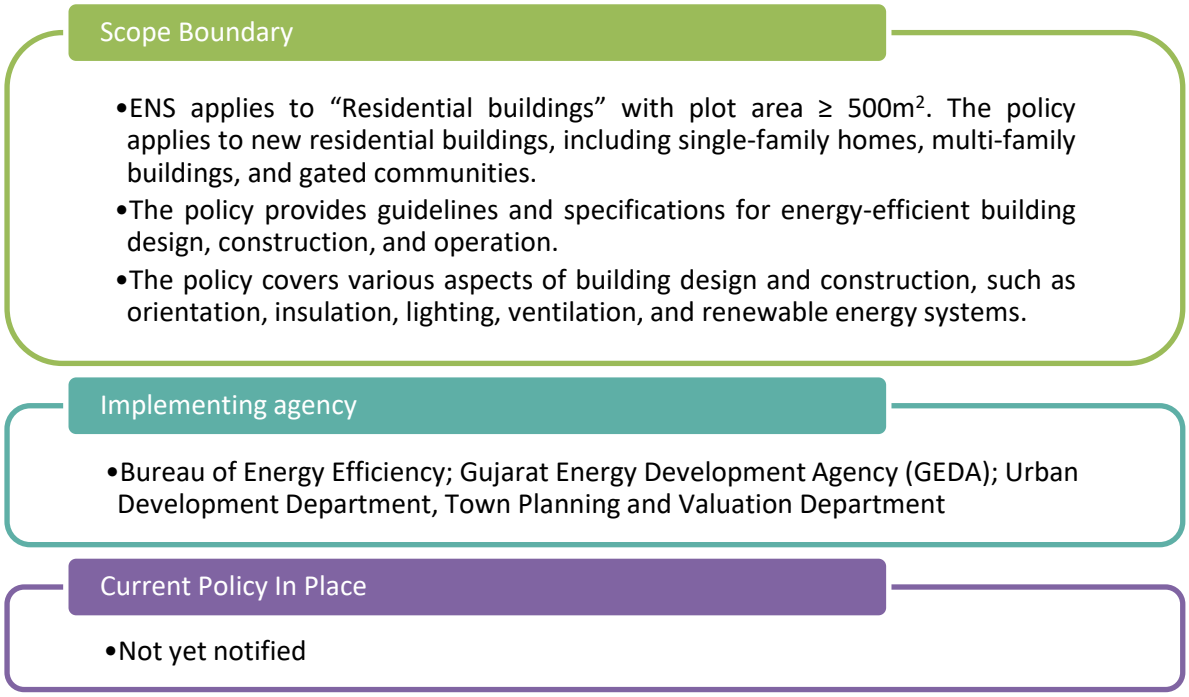


Figure 46 ENS in residential sector: Scope Boundary, Implementing agency and Policy

According to the housing Census 2011 of Gujarat state, there nearly 40.72 lakhs urban households and total number of households were projected to 2031 as shown below:

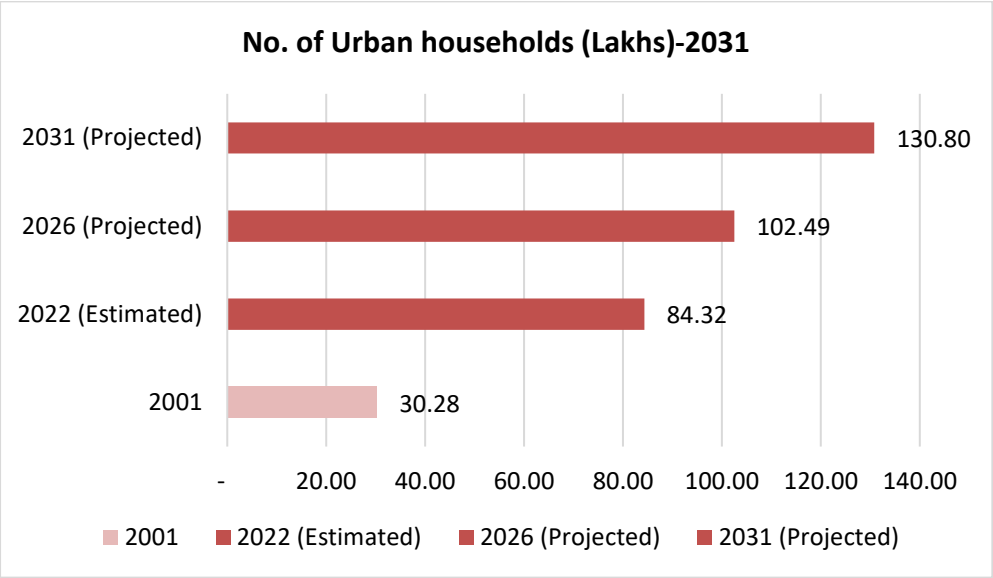


Figure 47 Projected no of residential households (Urban)

Energy Saving Potential

The saving potential in residential sector is estimated as 0.15 MTOE in moderate scenario and 0.20 MTOE in ambitious scenario which is estimated by calculating energy saving per household (kWh/household) which is then multiplied with the projected households for FY2031 for both moderate and ambitious scenarios. Similarly, the GHG saving potential for this strategy is 0.61 $MtCO_2$ in ambitious scenario.

Table 46: Energy Saving Potential

Particulars	Moderate Scenario for 2031	Ambitious Scenario for 2031
Energy Saving Potential (MTOE)	0.15	0.20
GHG Emission Reduction Potential ($MtCO_2$)	0.46	0.61

Action Plans for ENS in residential sector

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 plan

Policy Type	Action Plan	Timeline
Awareness & Capacity Building	1. Market Outreach for ENS compliant products, radio jingles, social media awareness.	Short Term
	2. Home Energy Auditor Training.	Short Term

Subsidy	2. Compliance structure and rebates on energy savings for first few residential projects.	Short Term
Technology Intervention	1. Development and maintenance of ENS compliance portal.	Short Term
	2. Pilot project investment for ENS as case studies.	Long Term

6.2.2 Strategy 2: Deepening of Standard & Labelling Programme-Residential Sector

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

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

This, in turn, will help in mitigating greenhouse gas emissions, reducing energy bills for consumers, and promoting sustainable development. After introduction of S&L by BEE, there is shift in consumer demand for energy efficient appliances, however the more deep penetration of energy efficient appliances is required for increasing efficiency of building sector.

The implementation of the strategy is explained below:

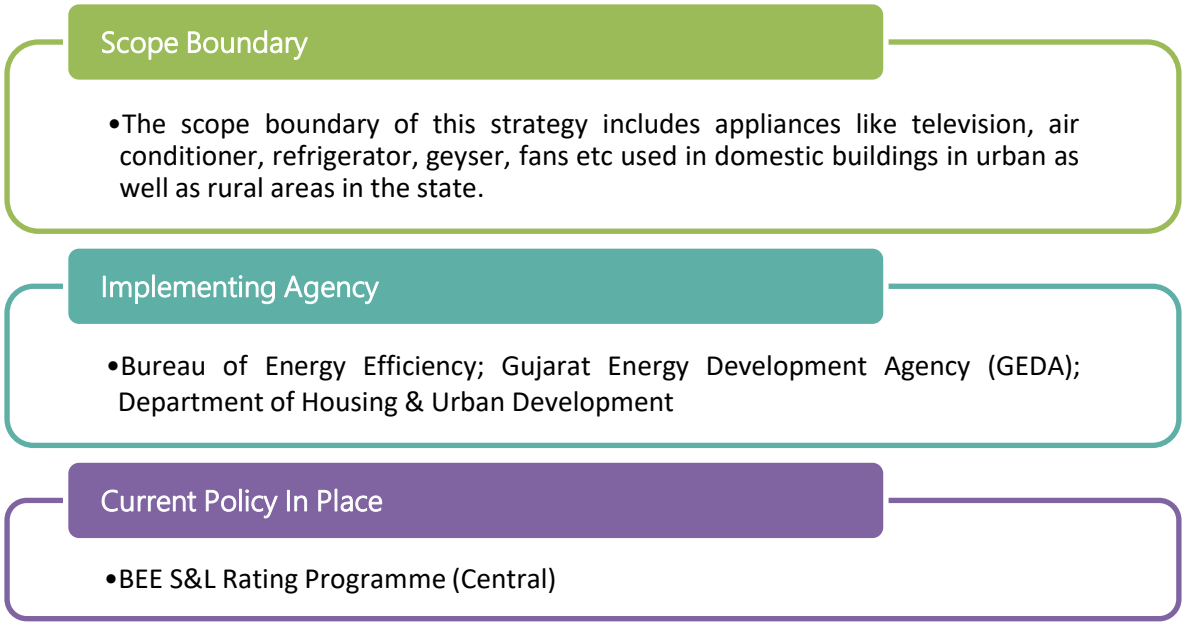


Figure 48 ENS in residential sector: Scope Boundary, Implementing agency and Policy

The EC Act, 2001, stipulates that states have an important role in the energy efficiency mandate in the country. The act empowers state governments to designate any agency as an SDA to enforce provisions for the efficient use of energy and its conservation within the state. For this purpose, the act empowers SDAs to take measures necessary for effective implementation of schemes formulated by BEE. The function of SDA with respect to S&L program are given below;

Section 15(e): Take all necessary steps to raise awareness and spread knowledge regarding energy conservation and efficient equipment or appliances.

Section 15 (f): Arrange and organise training of personnel and specialists in the techniques for efficient use of energy and its conservation and measures for preferential treatment of energy-efficient appliances.

SDA has important role to play Monitoring Verification and Enforcement (MV&E). Label verification is a relatively important task and market surveillance need to be carried out in all states and here SDA can conduct label verification. Programs or those initiated by the Bureau under the S&L Program, functions of SDAs are as follows:

A) Monitoring and Market Surveillance[48]

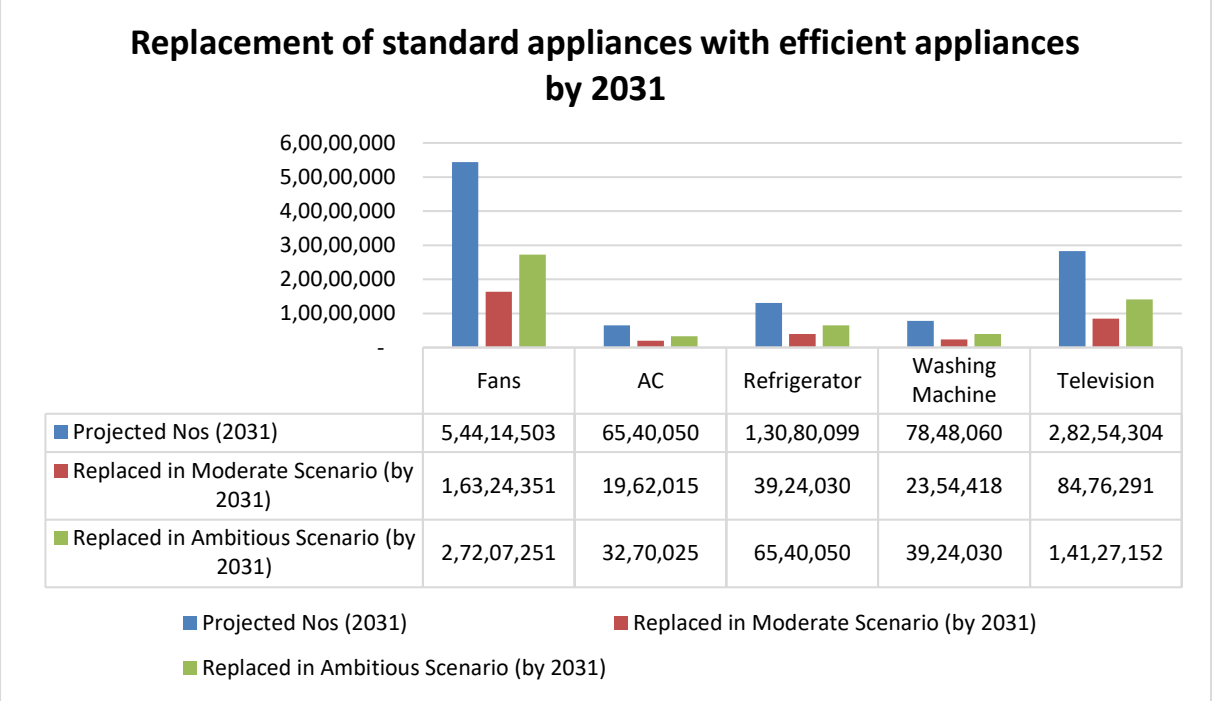
i. Conduct market surveillance based on complaints received within the state;
ii. Maintain list of non-complying appliance/equipment/ permittee and submit quarterly report on the outcome of market surveillance to the Bureau;
iii. Ensure that non-compliant appliance/equipment are not sold in the market, as per the instructions of the Bureau

Enforcement:

In order to have smooth and successful functioning of the enforcement activities in the state, SDAs may constitute a state level implementation committee under the Chairmanship of the State Power Secretary or the head of any appropriate authority decided by the state government.

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.



	Fans	AC	Refrigerator	Washing Machine	Television
Projected Nos (2031)	5,44,14,503	65,40,050	1,30,80,099	78,48,060	2,82,54,304
Replaced in Moderate Scenario (by 2031)	1,63,24,351	19,62,015	39,24,030	23,54,418	84,76,291
Replaced in Ambitious Scenario (by 2031)	2,72,07,251	32,70,025	65,40,050	39,24,030	1,41,27,152

[48] https://beestarlabel.com/Content/Media/OM_BEE.pdf

By considering replacement of appliances as shown below, 0.35 MTOE energy saving potential is estimated under moderate scenario and 0.59 MTOE in ambitious scenario. The S&L program includes efficient appliances of both old as well as new houses.

Table 47: Energy Saving Potential

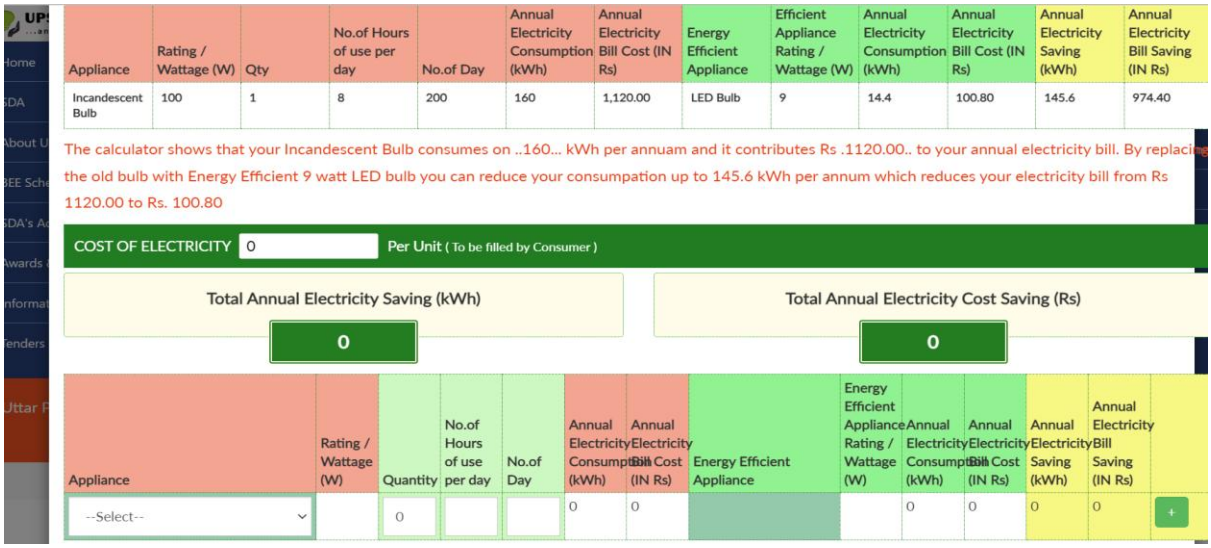
Particulars	Moderate Scenario for 2031	Ambitious Scenario for 2031
Energy Saving Potential (MTOE)	0.35	0.59
GHG Emission Reduction Potential ($MtCO_2$)	1.11	1.84

Action Plans

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

Policy Type	Action Plan	Timeline
Awareness & Capacity Building	1. Energy Efficient Technology Workshops for capacity building of Technology Suppliers and Professionals 2. Web portal to disseminate information on energy saving for public	Short Term
	3. Home Energy Auditor Training.	Short Term
Subsidy	4. DSM Schemes through DISCOM for energy efficient appliances such as BLDC fans, AC	Short Term

The purpose of web-portal is to increase the consumer awareness for energy saving and verifying the appliances which they are buying. Example: Uttar Pradesh Govt has developed a portal for end users to calculate how much energy and money they can save if they are buying energy efficient appliances compared to old appliances.



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	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

6.2.3 Strategy: Implementation of ECBC-Commercial Sector

ECSBC is not yet mandatory in Gujarat. 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 ECBC 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:

Scope Boundary

- Upcoming new commercial buildings and retrofit of existing buildings

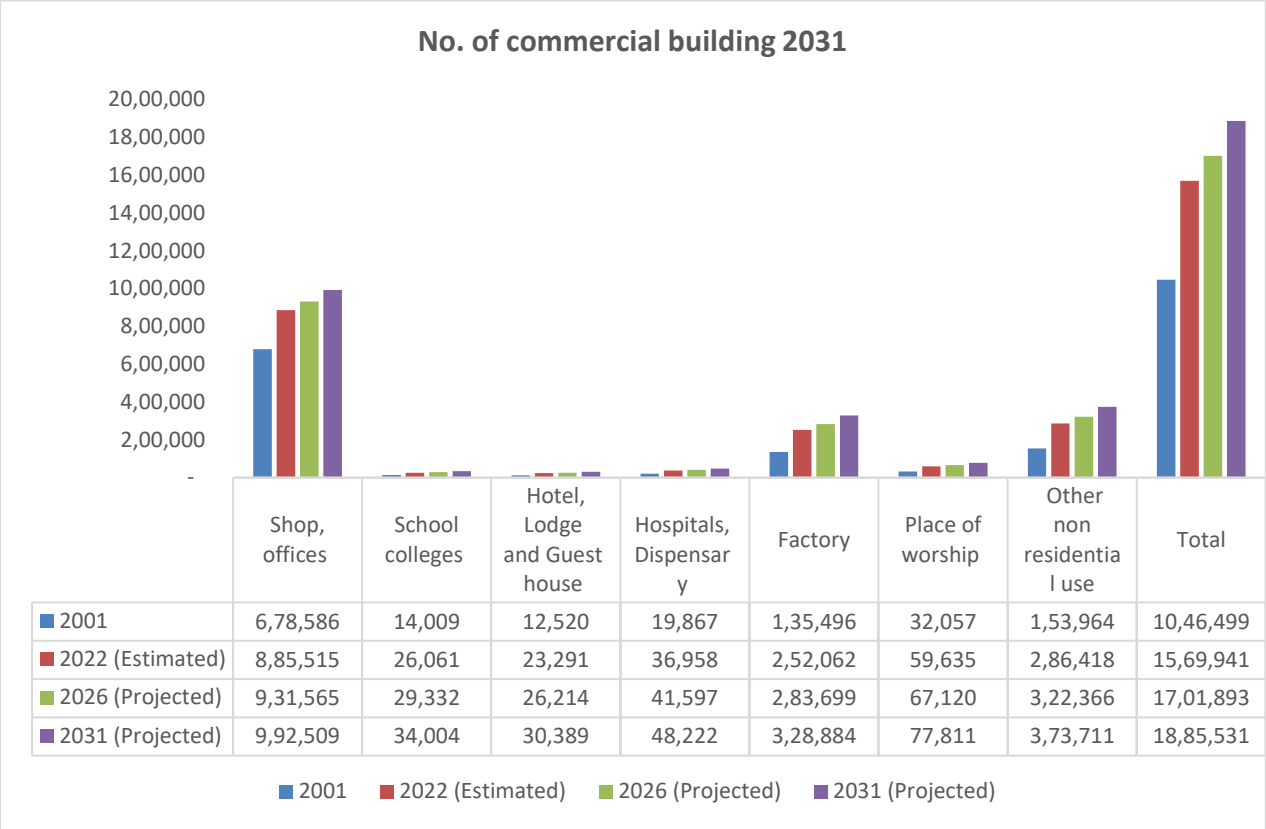
Implementing agency

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

Current Policy In Place

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

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



	Shop, offices	School colleges	Hotel, Lodge and Guest house	Hospitals, Dispensary	Factory	Place of worship	Other non residential use	Total
2001	6,78,586	14,009	12,520	19,867	1,35,496	32,057	1,53,964	10,46,499
2022 (Estimated)	8,85,515	26,061	23,291	36,958	2,52,062	59,635	2,86,418	15,69,941
2026 (Projected)	9,31,565	29,332	26,214	41,597	2,83,699	67,120	3,22,366	17,01,893
2031 (Projected)	9,92,509	34,004	30,389	48,222	3,28,884	77,811	3,73,711	18,85,531

Figure 49 Projected no of commercial buildings

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 48: Energy Saving Potential

Particulars	Moderate Scenario for 2031	Ambitious Scenario for 2031
Energy Saving Potential (MTOE)	0.89	1.07
GHG Emission Reduction Potential ($MtCO_2$)	2.79	3.34

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.

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

6.2.4 Strategy 3: Standard and Labelling in commercial sector

Commercial sector electricity consumption is majorly for the purpose of cooling and lighting and breakup of %age consumption is as shown in the below figure;

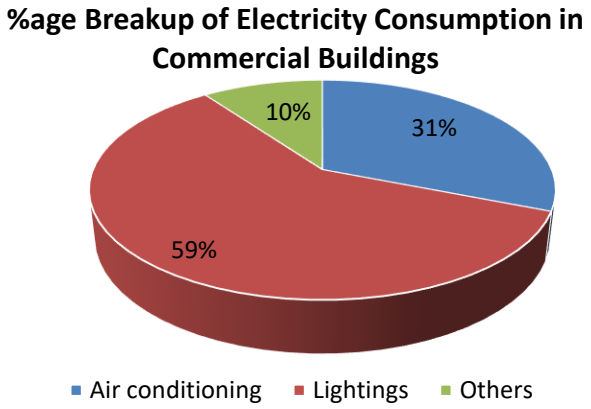


Figure 50 Electricity consumption breakup in commercial buildings

According to the study of BEE energy saving potential in commercial sector by type of end use is given in below table;

Sector	End Use	Saving% 2031	Saving% 2041
Commercial	Educational Buildings	3%	17%
	Hospitals	34%	40%
	Hotels	15%	41%
	Shops & Malls	18%	40%
	Offices	15%	47%

The implementation of the strategy is explained below:

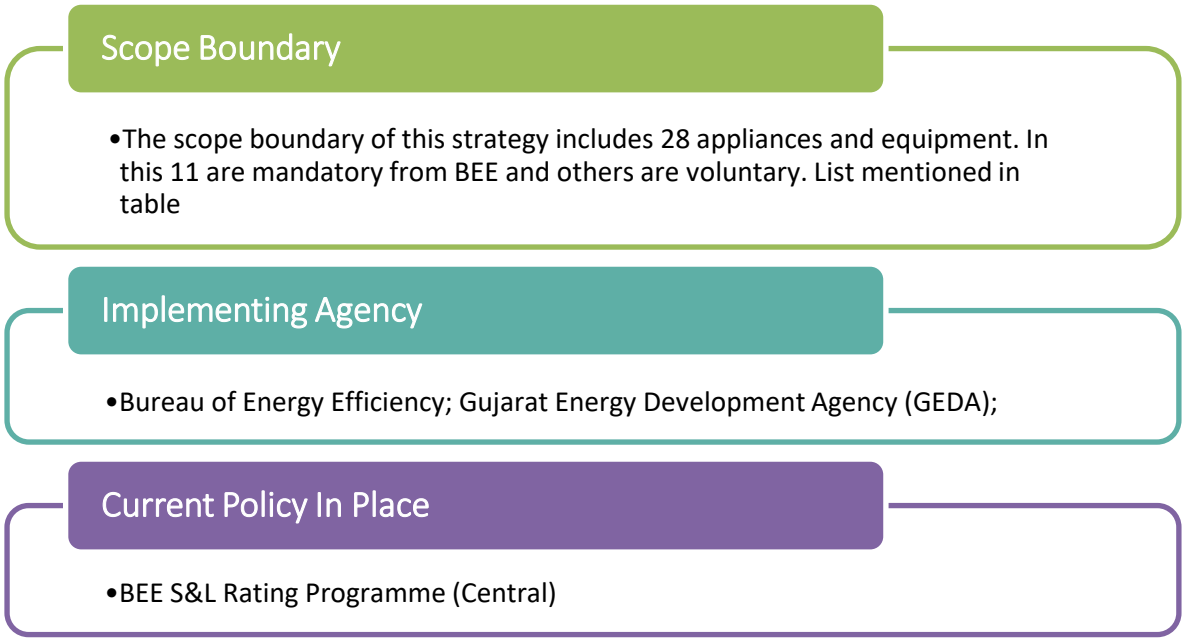


Figure 51 S&L in Commercial sector: Scope Boundary, Implementing agency and Policy

Table 49 Mandatory and Voluntary appliances list: BEE

Sr. No.	Appliance / Equipment	Sr. No.	Appliance / Equipment
1	Room Air Conditioners (Fixed Speed)	16	Agriculture Pump sets
2	Room Air Conditioners (Variable Speed)	17	Washing Machines
3	Room Air Conditioners (Cassette, Floor Standing Tower, Ceiling, Corner AC)	18	Office equipment (Printer, Scanner, Copier, MFDs)
4	Frost Free Refrigerators	19	Solid State Inverters
5	Direct Cool Refrigerators	20	Deisel generator sets
6	Tubular Fluorescent Lamps	21	Ballast
7	Distribution Transformers	22	Microwave
8	Stationary Storage Type Electric Water Heaters	23	

Sr. No.	Appliance / Equipment	Sr. No.	Appliance / Equipment
			Diesel Engine Driven Mono-set Pumps for Agricultural Purposes
9	Colour Telivision	24	Solar water heaters
10	LED Lamps	25	Light commercial air conditioners
11	Ceiling Fans	26	Deep Freezers
12	Computer Notebook/Laptops	27	Chillers
13	Domestic Liquefied Petroleum Gas (LPG) Stoves	28	Air compressors
14	Induction Motors	29	UHD TV
15	High Energy Li-Battery	30	Tyres

Energy Saving Potential

The total no of commercial building forecasted in Gujarat state as 13.12 lakhs by 2026 and 14.34 lakhs by 2030 and it is assumed that the S&L penetration would reach 50% of the commercial buildings in moderate scenario and 60% of the commercial buildings in ambitious scenario by 2031.

The saving potential through S&L is estimated as 0.21 MTOE in moderate scenario and 0.44 MTOE in ambitious scenario which is estimated by calculating energy saving by penetration of S&L of equipment in commercial 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 1.39 $MtCO_2$ in ambitious scenario.

Table 50: Energy Saving Potential

Particulars	Moderate Scenario for 2031	Ambitious Scenario for 2031
Energy Saving Potential (MTOE)	0.21	0.44
GHG Emission Reduction Potential ($MtCO_2$)	0.65	1.39

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 51 Standard and Labelling-Action Plan

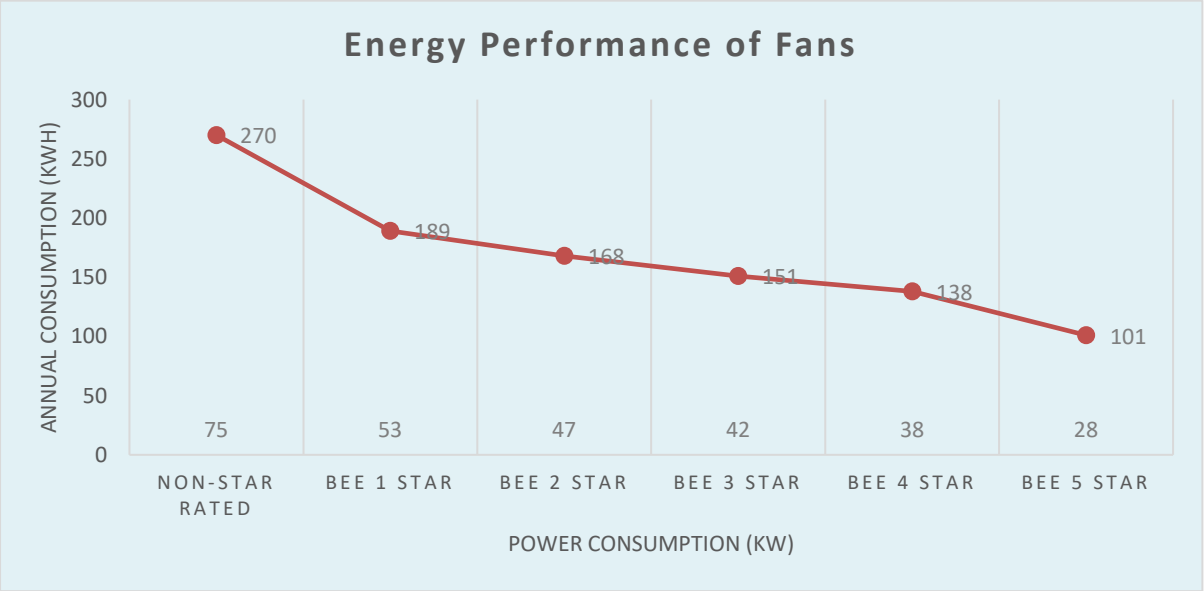
Policy/Scheme	Action Plan	Timeline

Awareness & Capacity Building	1. Awareness for energy efficient appliance and equipment. 2. Encourage green education	Short Term
	3. Energy Auditor Training for auditing commercial	Short Term
	4. Energy saving web-portal for end uses of appliances	Short-Term
Subsidy	5. Rebate/discount on replacement of inefficient appliances with energy efficient appliances	Short Term
Procurement (Scheme)	6. Availability of energy efficient equipment and appliances to end users through bulk procurement or under some financing mechanism	Short Term

Case of Bulk Procurement for fan technologies:

Fans play a vital role in the daily lives of people across India, especially in a state like Andhra Pradesh with a tropical climate. However, it is also important to note that fans are one of the largest consumers of electricity in households and commercial spaces. In Andhra Pradesh, the energy consumption by fans is estimated to be around 12% of the total energy consumption, which is significant.

To address this issue and promote energy-efficient fans, the government of Andhra Pradesh can initiate a bulk-purchase scheme for superfan technologies like BLDC (Brushless Direct Current) fans. These fans are known for their energy efficiency and can save up to 50% of energy compared to traditional fans. This can significantly contribute to energy conservation efforts in Andhra Pradesh and reduce the energy consumption of fans.



The scheme can be implemented in partnership with manufacturers, promoted through awareness campaigns, and made easily accessible to consumers with the help of local distribution companies.

The scheme can be implemented by partnering with manufacturers of BLDC fans and offering bulk purchase orders at discounted rates. The scheme can also be extended to government offices, public

institutions, and commercial buildings. Additionally, the existing five-star rating for fans can be promoted to become the new one-star minimum. This will encourage manufacturers to produce more energy-efficient fans and drive down the prices of energy-efficient fans further.

To ensure the success of the scheme, the state designated agency (SDA) can collaborate with the Bureau of Energy Efficiency (BEE) to create awareness among the public about the benefits of energy-efficient fans and the importance of purchasing energy-efficient products. The SDA can also work with local distribution companies to ensure that energy-efficient fans are available and easily accessible to consumers.

Case Study of Delhi: BEE 5 star rated Super Energy Efficient Fan Replacement Scheme[49]

BSES Rajdhani Power Limited (BRPL) has launched a limited period 'FAN Replacement Scheme' in partnership with leading BLDC FAN manufacturers like R R Kabel Ltd, Halonix Technologies Private Ltd, Atomberg Technologies Private Limited.

It will enable BRPL domestic consumers, to either exchange their old fans with the new BEE 5 star rated super energy efficient BLDC Fans (herein after referred as "BLDC Fans") or can directly purchase them. Consumers can avail discount up to 64%* on MRP under buyback mode and 62%* on MRP on new purchase of BLDC Fans

Wattage of the BLDC Fans offered in the scheme is 28 Watts whereas average wattage of old non star rated ceiling fans is around 75 Watts. Hence replacing the non-star rated ceiling fan with BLDC Fans would result in savings to the tune of 63%.

All the models in the scheme are Remote Controlled and has a sweep of 1200mm. Consumers can avail maximum 3 BLDC fans under buyback or maximum 2 BLDC fans under without buyback with an overall ceiling of 3 BLDC fans per CA. 50000 BLDC Fans are available on first come first serve basis valid till 20th March 2021 or till stocks last under which 40000 BLDC Fans are available for purchase under Buyback Mode and 10000 BLDC Fans are available for fresh purchase without any exchange of old fan

Case Study: Energy Efficient Air Conditioners in India by BEE and CLASP[50]

Objective

The objective of the project is to accelerate access to energy-efficient air conditioners (ACs) in India, considering the country's growing middle-class population and rising disposable income. The focus is on creating awareness about energy-efficient schemes and interventions to influence purchase decisions and promote the adoption of high-quality and affordable AC products.

Project Activities:

- 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.

[49] https://www.bsesdelhi.com/web/brpl/other-initiative

[50] Increasing Access to Air Conditioners in a Heating India, CLASP

- 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.

Case Study: Energy Efficient Air Conditioners in India by BEE and CLASP[51]

Objective: 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.

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:

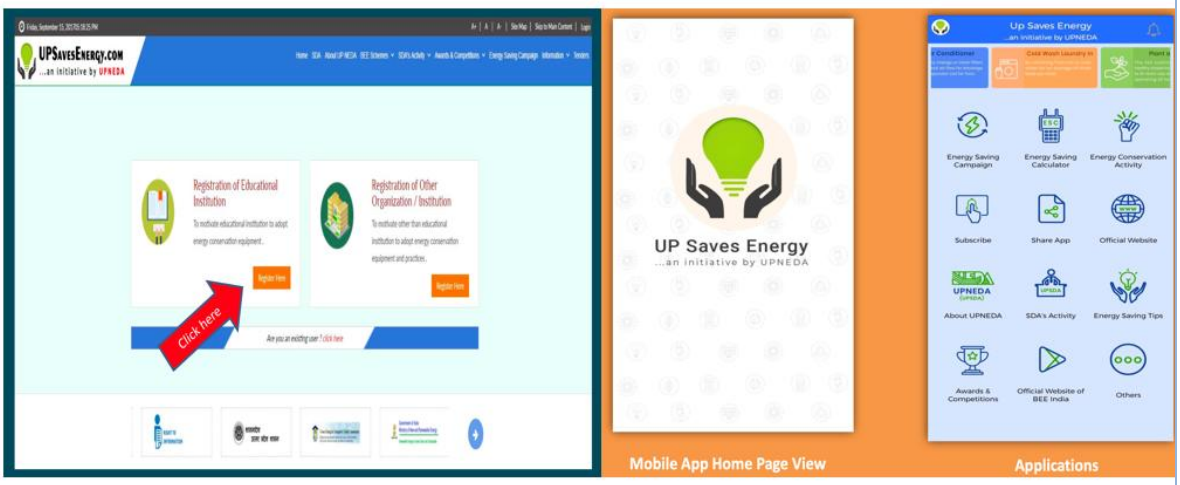
Cost of Electricity = Rs 7.0 per unit (Assumed)

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 replacir 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)	Total Annual Electricity Cost Saving (Rs)
40.00	240.00



[51] http://upsavesenergy.com/

6.2.5 Strategy: BEE Star Rating of Buildings, Green buildings in Residential and commercial sector

Green buildings rating in India incorporates various features such as energy-efficient lighting, heating, ventilation, and air conditioning systems, and use renewable energy sources such as solar and wind power. Green-rated Buildings comply with ECBC and are at least 20 - 30% more energy efficient than conventional buildings.

- Incentives for green buildings has been declared in the state in 2020:
  - Gujrat Tourism Policy 2021-25 offers reimbursement of 50% of Certification fee, with a maximum limit of INR 10.0 lakh, to hotel / wellness resorts obtaining green rating.
  - Industries Commissionerate, Industries and Mines Department provides incentive upto 50% of consulting charges, with a maximum limit of INR 2.50 lakh, for Industrial Buildings with green rating.

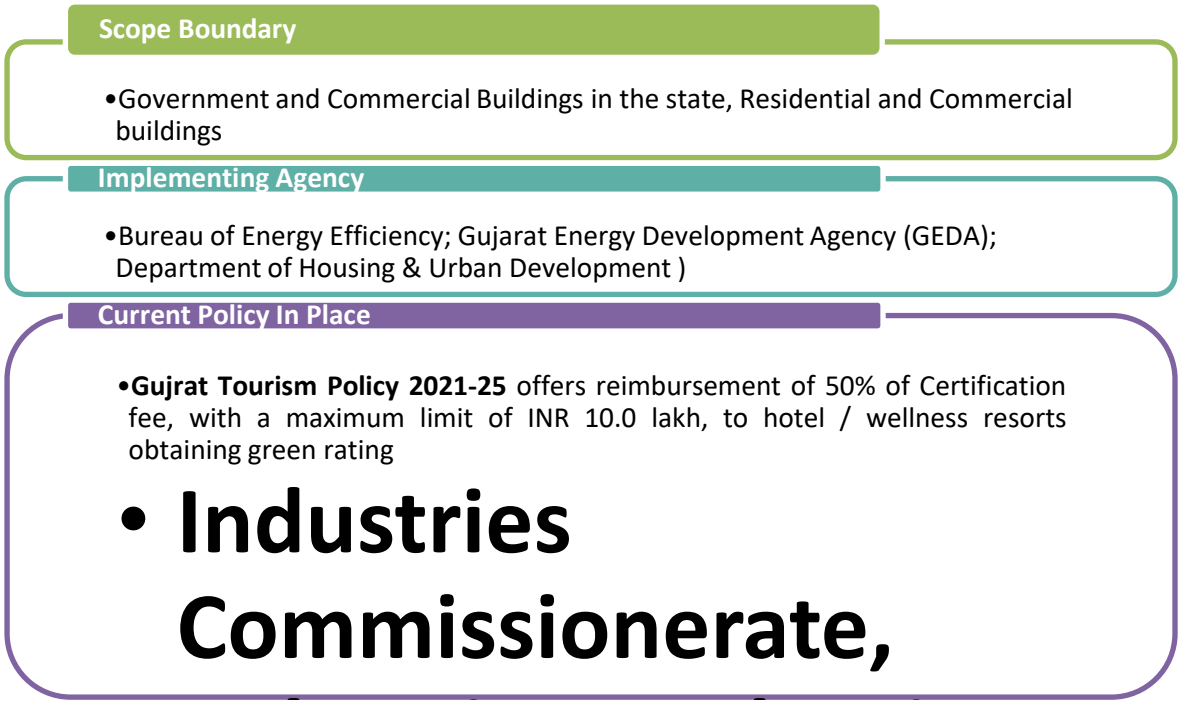


Figure 52 Green rating, star rating of buildings: Scope, Implementing agency and current policy

Saving Potential

As of Dec 2022, 580 numbers of buildings are certified as green buildings (IGBC rated) in Gujarat state.

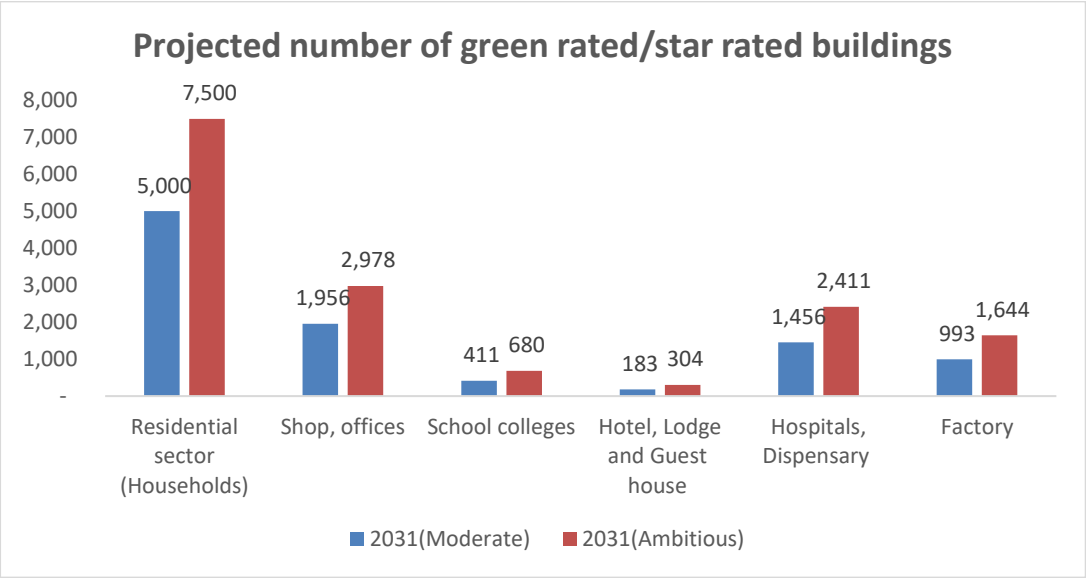


Figure 53 Projected number of green rated/star rated buildings

As per the housing census data, commercial buildings are further divided into offices, schools, hotels, lodges, factories, etc. The total number for each of the category in the state is projected to FY2026 and FY 2031 and assumption is made for number of star and green rated buildings in state by 2031. Energy saving potential through this is given below;

Table 52: Energy Saving Potential

Particulars	Moderate Scenario for 2031	Ambitious Scenario for 2031
Energy Saving Potential (MTOE)	0.03	0.05
GHG Emission Reduction Potential ($MtCO_2$)	0.08	0.17

Action Plans

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

Policy Type/Scheme	Action Plan	Timeline
Awareness & Capacity Building	1. Encouraging Green Education	Short Term
Subsidy	1. Incentives (Rebate in property Tax Additional FAR, reduction in stamp duty and faster environmental clearance for upcoming, green-rated building projects)	Short Term

	2. Transformation of government buildings to Net-Zero 3. Incentive policy support to encourage net zero buildings	

A green building is one that uses less water, optimizes energy efficiency, conserves natural resources, generates less waste and provides healthier spaces for occupants, as compared to a conventional building. The Indian green building council (IGBC) has certified 1,0571 Lakh Sq. ft. area in Gujarat state.

Projects registered and certified in IGBC green building rating system –Gujarat[52]

Total Number of Projects certified: 272 (No of Govt Projects: 19, Private Projects: 253)

Total area certified: 1,0571 Lakh sq.ft (Govt Projects: 650 Lakh sq.ft, Private Projects: 9921 Lakh sqft.)

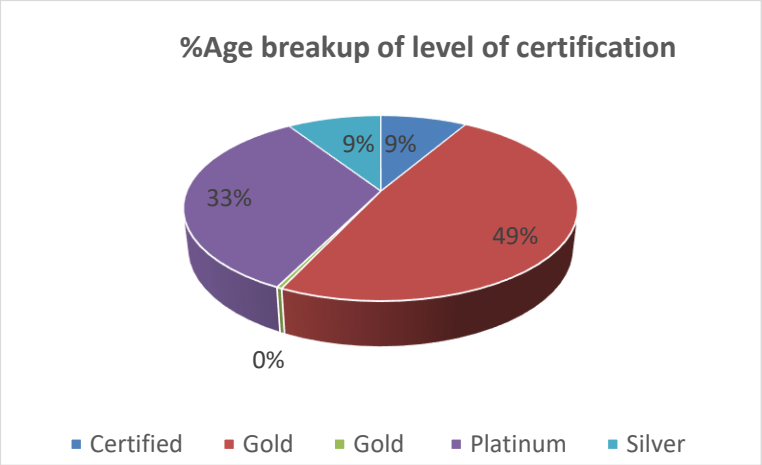


Figure 54 Breakup of certification level of 272 projects in Gujarat state under green building rating system

6.3 Energy saving Potential & monitoring mechanism

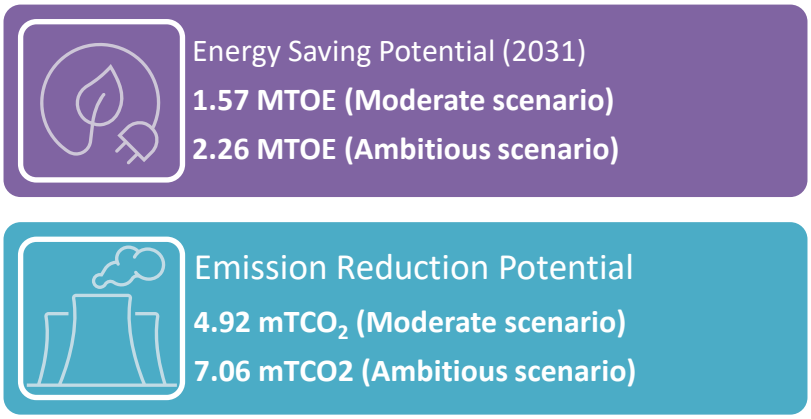
Energy saving target of the building sector is 0.89 MTOE and 1.63 MTOE for moderate and ambitious scenarios by FY2031 respectively as seen from below table;

Table 53 Summary of energy saving from the strategies

Strategy	Energy Saving Target (Moderate) 2031	Energy Saving (Ambitious) 2031
1. Implementation of ENS-Residential buildings	0.15	0.20
2. Deepening of S&L in domestic buildings	0.35	0.59
3. Implementation of ECBC in commercial buildings	0.16	0.35

[52] https://igbc.in/

4. Deepening of S&L in Commercial buildings	0.89	1.07
5. Star rated/Green Rating/net zero buildings	0.03	0.05
Total	1.57	2.26



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

Table 54 Monitoring Mechanism Gujarat State

Action	Monitoring Mechanism
Energy Committee at state level	Formation of state level committee to monitor the implementation of energy saving programs in building sector
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.
Market surveillance	General inspection by a team of experts and reporting non compliance cases to SDA and BEE
Auditing and Inspection	Inspection of energy intensive buildings

6.4 CII-IGBC building sector experts recommendations

- **ECBC is not mandatory yet in Gujarat**. *To begin with, 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.*

- Green-rated Buildings comply with ECBC and are at least 20 - 30% more energy efficient than conventional buildings.

- **Incentives for green buildings has been declared in the state in 2020.**
    - Gujrat Tourism Policy 2021-25 offers reimbursement of 50% of Certification fee, with a maximum limit of INR 10.0 lakh, to hotel / wellness resorts obtaining green rating from Indian Green Building Council (IGBC).

    - Industries Commissionerate, Industries and Mines Department provides incentive upto 50% of consulting charges, with a maximum limit of INR 2.50 lakh, for Industrial Buildings with green rating from Indian Green Building Council (IGBC).

    - Any owner or developer producing a certificate from any Government recognized Institute (Green Rating body), showing the certification level awarded to the building, would be eligible from the Competent Authority for some incentives in the rate of chargeable FSI for the energy efficient buildings (Green Building) as 5% discount in the total payable amount.

- 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.

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

- 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.

- **Additional FAR, 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 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**
  - Mandate PWD, Healthcare and other government departments to develop all upcoming projects as green and / or net zero energy buildings. This would encourage more stakeholders in the private sector to be convinced about the

viability of such projects and adopt sustainable design, construction, operation and maintenance practices.

- 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 Agri and Fisheries Sector Energy Efficiency

7.1.1 Agriculture sector

Overview of pumps sets in Gujarat sate

Historical data of number of pump-sets have been taken from NITI Ayog edm dashboard and projected further from the year 2021 as shown in below figure. It is projected that number of pump-sets in Gujarat will increase to 22,82,924 from 16,02,127 numbers of pumps sets in Gujarat.

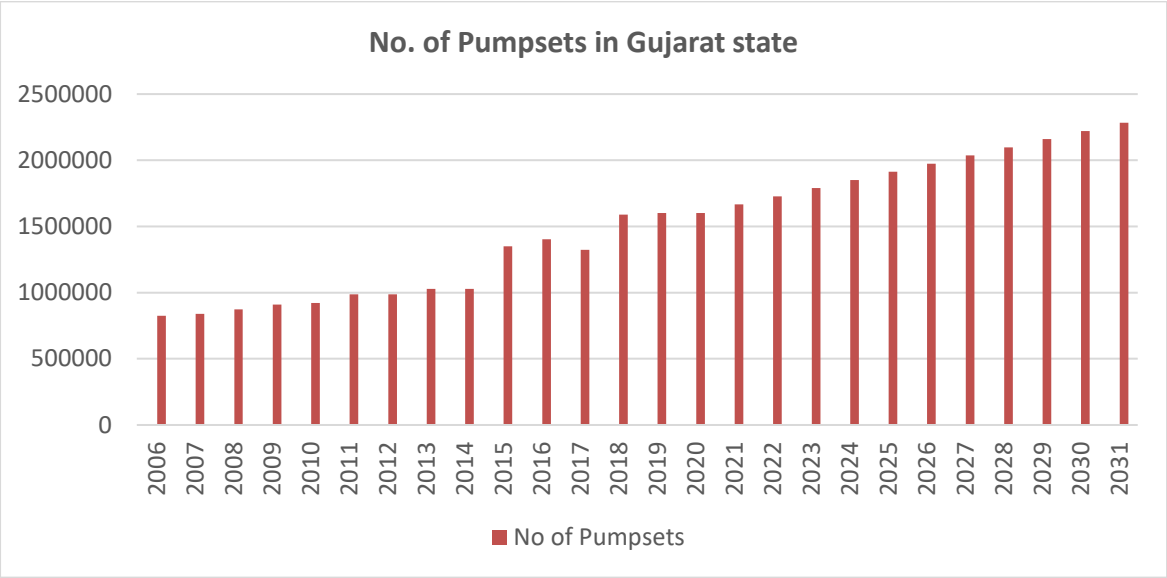


Figure 55 No of Pump-sets in Gujarat historical (till 2020) and projected (from 2021 onwards)

Also according to the All India Agriculture Input Survey 2016-17, total number of diesel pump sets in Gujarat is 6,74,800 and total No. of Standalone Solar Pumps installed till 30.06.2022 is 11,981. Energy efficiency in Agriculture sector is mainly due to replacement of inefficient pumps to energy efficient pumps, solarization of pumps and replacement of diesel pumps with energy efficient pumps or solar pumps.

The implementation of the strategy is explained below:

Scope Boundary

- The scope boundary of this strategy includes number of pumps in agriculture sector. 10% of solarization of pumps in moderate scenario and 15% of solarization of pumps in ambitious scenario by 2031. Similarly replacement of 30% and 40% of inefficient pumps to energy efficient star rated pumps by 2031.
- Replacement of diesel pumps 50% and 60% in moderate and ambitious scenario respectively by 2031.

Implementing Agency

- Department of Agriculture, Energy and Petrochemical department, EESL

Current Policy In Place

- PM KUSUM Yojna, **Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)**

Figure 56 Agri sector: Scope, Implementation and Current policy

7.1.2 Energy efficiency strategies in Agriculture sector

Saving Potential

The saving potential is estimated by assuming 10% of solarization of pumps in moderate scenario and 15% of solarization of pumps in ambitious scenario by 2031. Similarly replacement of 30% and

40% of inefficient pumps to energy efficient star rated pumps by 2031 and replacement of diesel pumps 50% and 60% in moderate and ambitious scenario respectively by 2031 is as given below;

Replacement of diesel pumps 50% and 60% in moderate and ambitious scenario respectively by 2031.

Table 55: Energy Saving Potential

Particulars	Moderate Scenario for 2031	Ambitious Scenario for 2031
Solarization of Pumps	0.24	0.35
Replacement of Standard pumps with energy efficient pumps	0.14	0.28
Diesel Pumps with solar pumps	0.17	0.25
Total Energy saving potential	0.55	0.88
GHG Emission Reduction Potential ($MtCO_2$)	3.15	4.90

Action Plans

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

Action plan

Table 56 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 for pumping. This unique programme is being implemented in 32 districts in Telangana[53]	Short-Term

7.2 Fisheries sector

7.2.1 Overview of Fisheries sector

After China India is the 3rd largest fish producer and 2nd largest aquaculture country in the world. Gujarat contributes around 20% of total marine production, with a 1600km coastline. In FY 2021-2022, production of fish is around 8.74 lakh tons of fish[54] (6.88 lakh tons of marine fish and 1.86 lakh tons of inland fish). Fish production (marine + inland) of Gujarat state has increased by 1.04% CAGR over the past years from 2017-18 to 2021-22 and in value terms it is increased by 13.49%.

Sr.No	Year	Fish Production In M.T.			Value In Rs. Lakhs		
		MARINE	INLAND	TOTAL	MARINE	INLAND	TOTAL
1	2017-18	700743	137685	838428	495088	181285	676374
2	2018-19	699230	142880	842110	506510	194004	700514
3	2019-20	700809	157463	858272	532915	228352	761267
4	2020-21	619720	124705	744425	632876	244456	877332
5	2021-22	688272	185689	873961	765950	356177	1122127

[53] https://horticulturedept.telangana.gov.in/Horticultureteleangana/(S(gpkyvbhhvdwuwjypwpu0vrbe))/MIP_Aboutus.aspx

[54] https://dof.gov.in/sites/default/files/2021-02/Final_Book.pdf

The fisheries sector in Gujarat 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 Gujarat faces several challenges, including wastage, 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. Energy of audit was conducted in fisheries sector for Veraval area of Gujarat to know energy consumption and opportunities for energy savings. Through the audit energy consumption (SEC) across the fisheries value chain and energy saving is given below;

Table 57 Specific energy consumption across the Fish Value Chain

Value Chains	SEC Kcal/Kg	Sp. GHG (kgCO2/t)	Wastage
Aquaculture shrimp	11,507	8,339	33%
Major Carp	3,998	2,674	20%
Marine finfish	8,862	3,148	30%
Crab	9,311	3,127	75%

The energy saving is arrived on based on the audit conducted at Veraval Gujarat area by CII team. The key performance indicator (consumption per ton of marine catch) is mentioned in below figure as fuel consumption, equivalent energy consumption, energy cost, emission, ice consumption.

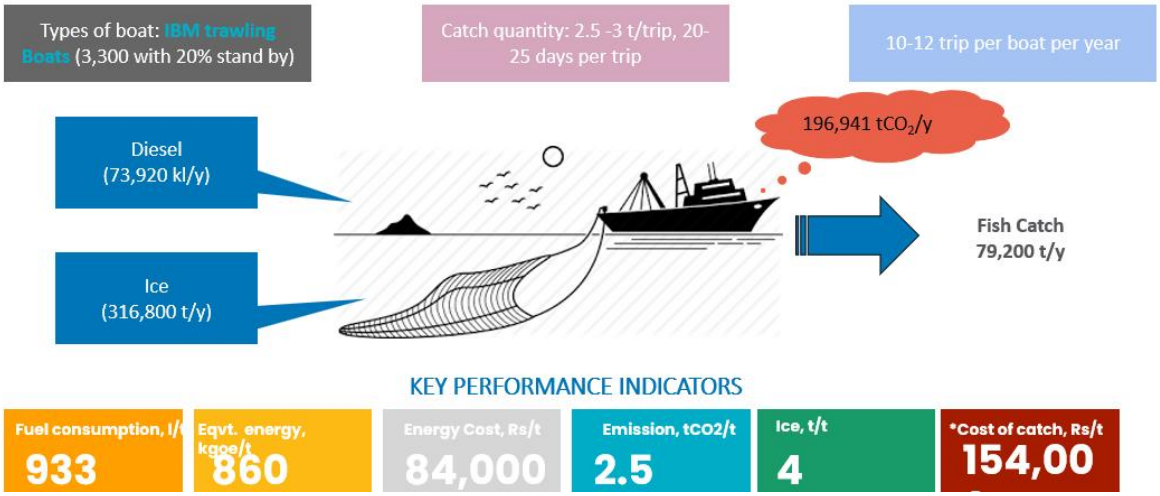


Figure 57 Energy Audit: Marine Catch- Veraval, Gujarat

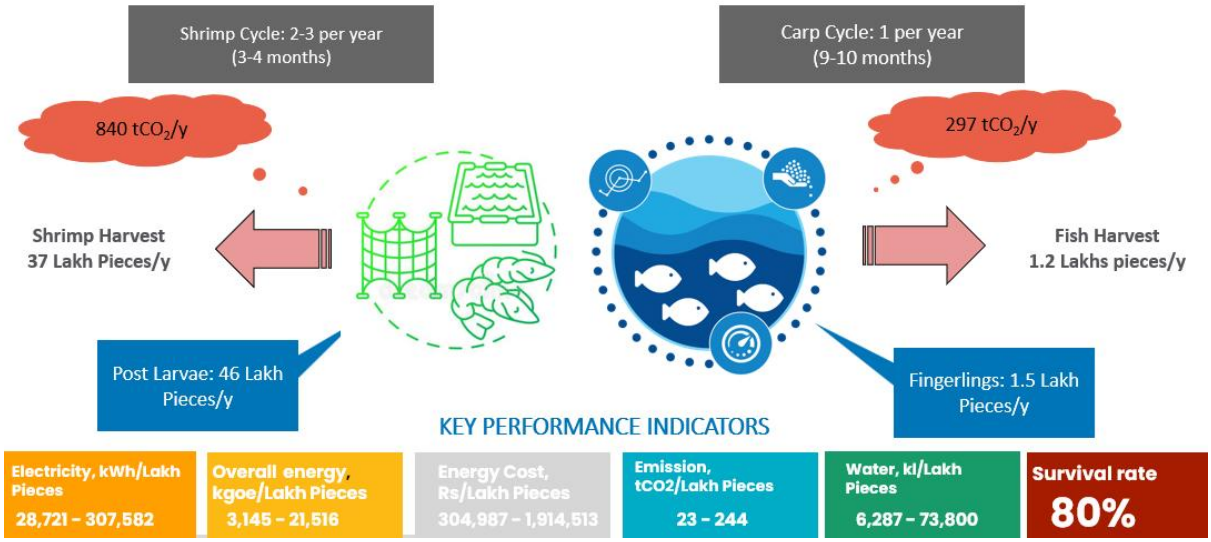


Figure 58 Energy audit: Aquaculture: Shrimp and IMC (farming)

Table 58 Fish value chain: Resource efficiency

Value Chain	Elements	Resource savings (%)				
		Electrical energy	Thermal energy	Water	Ice	GHG
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%

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

7.2.2 Energy efficiency strategies in the fisheries sector

Strategy: Energy efficiency across value chain of fisheries

According to Handbook on Fisheries Statistics 2020 by Department of Fisheries, Gujarat produced 7.01 lakh tonnes of Marine fishes and 1.58 lakh tonnes of inland fishes in FY 19-20

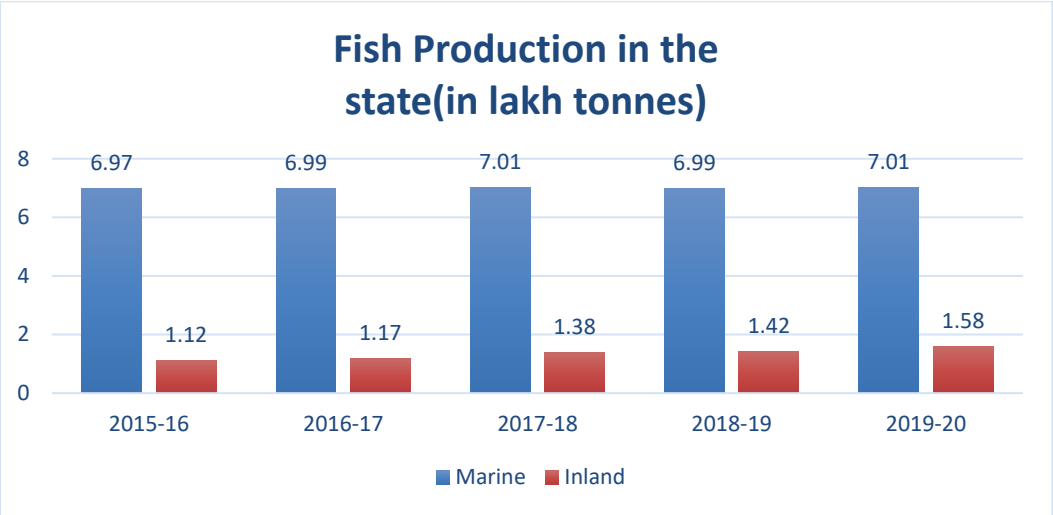
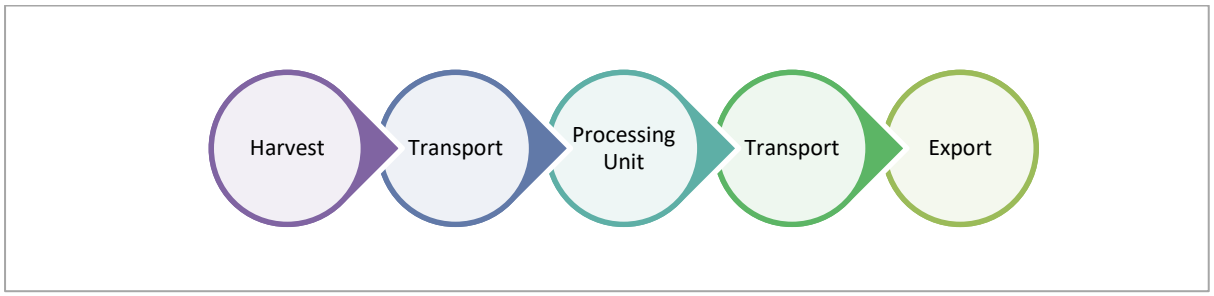


Figure 59 Fish Production (Lakh Tonnes) in Gujarat state

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



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

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

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

Scope Boundary

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

Implementing Agency

- Dept. of Fisheries
- Energy and Petrochemical department

Current Policy In Place

- Central policy-Pradhan Mantri Matsya Sampada Yojana (PMMSY) which has focus on enhancement of production and productivity, Infrastructure and post harvesting management, Fisheries management and Regulatory framework.

Energy Saving Potential

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

Table 59: Energy Saving Potential

Particulars	Moderate Scenario for 2031	Ambitious Scenario for 2031
Energy Saving Potential (MTOE)	0.18	0.23
GHG Emission Reduction Potential ($MtCO_2$)	0.55	0.73

Action Plans

This section describes several action plans, short-term and long-term that can be implemented across fisheries sector for this strategy.

Policy/Scheme/Intervention	Action Plan	Timeline
Awareness & Capacity Building	1. Provides skill development support. 2. Creating awareness Resource efficiency and cleaner refrigerant 3. Interventions and incentives needed to promote improved designs for fish transportation, transportation of live fish, mobile kiosks for street vendors under Make in India	Short Term

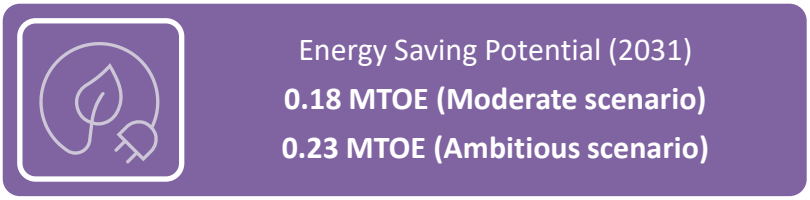
Policy Intervention	1. Guidelines for usage of BEE star rated products. 2. Partial support for conducting Energy audits in the value chain in line with the facility available for DC MSME. 3. Mandatory Collection and submission of basic data from processing units on Energy and emissions - facilitating data collection procedures/ISO 50001 to be mandated in all processing units. 4. Standardization of cold chain technologies and practices covering investment, RoI, energy specifications, vendor names and other operational benefits	Long Term
Technological Interventions	**First and last mile transportation:** • Phase Changing Materials (PCM) technology in Coolers/ Freezers • Energy Efficient Aerators • Adoption of EV	Long Term
	Cold storage & Processing: • Solar PV System for Fishery/cold storage • Efficient Ammonia / CO_2 Brine system in Cold storage • Use of Evaporative condenser for cooling • Low charge Ammonia refrigeration system	Long Term
	Reefer Transport • Mobile Chilling for Reefer trucks • Swapping the PCM material	Long Term
	Multiple Areas • Variable Frequency drive solution for Refrigeration systems • Electronic Level Control for Refrigeration system • IOT for Refrigeration systems	Long Term

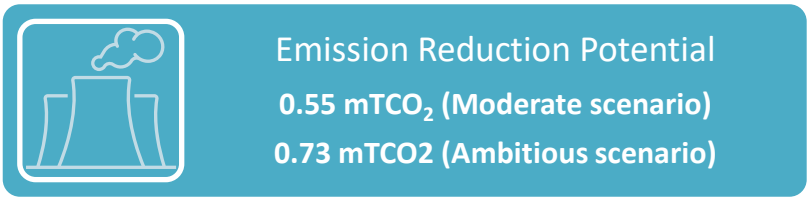
7.2.3 Energy saving potential & monitoring mechanism

Energy saving potential of the fisheries sector is projected as 0.18 MTOE and 0.23 MTOE for moderate and ambitious scenarios by FY2031 respectively.

Table 60 Summary of energy saving from the strategies.

Strategy	Energy Saving Target (Moderate)	Energy Saving (Ambitious)
Energy efficiency across all value chain in fisheries sector	0.18	0.23





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

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

Case Study: Alternate energy for fishing vessel[55]

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

Case Study: Energy-efficient fishing vessel[56]

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

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

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

[56] https://www.thehindu.com/sci-tech/technology/new-fuelefficient-fishing-vessel-to-set-sail/article8399605.ece

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

Case Study: Use of fuel-efficient propellers[57]

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

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

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

8 Overall energy saving, emission reduction and Investment Potential

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

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

Sector	Emissions Reduction (MtCO2) - FY2031		Energy Consumption Reduction (Mtoe) - FY2031		Investment Potential[58] 2031 (Ambitious scenario)
	Moderate	Ambitious	Moderate	Ambitious	
	MtCO2 reduction	MtCO2 reduction	Mtoe Reduction	Mtoe Reduction	INR Crores
Industry	13.25	18.94	3.13	4.22	7,766
Buildings	4.92	7.06	1.57	2.26	4,159
Transport	11.56	15.86	3.33	4.51	8,299
Agriculture & Fisheries	3.70	5.64	0.72	1.12	2,061
Total	33.43	47.5	8.75	12.11	22285

The energy saving investment potential of the state is estimated to be INR 22285 crores by the year 2031, under the ambitious savings scenario, with the transport sector constituting highest energy saving investment potential followed by industry sector.

9 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

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

9.1 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 60 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.

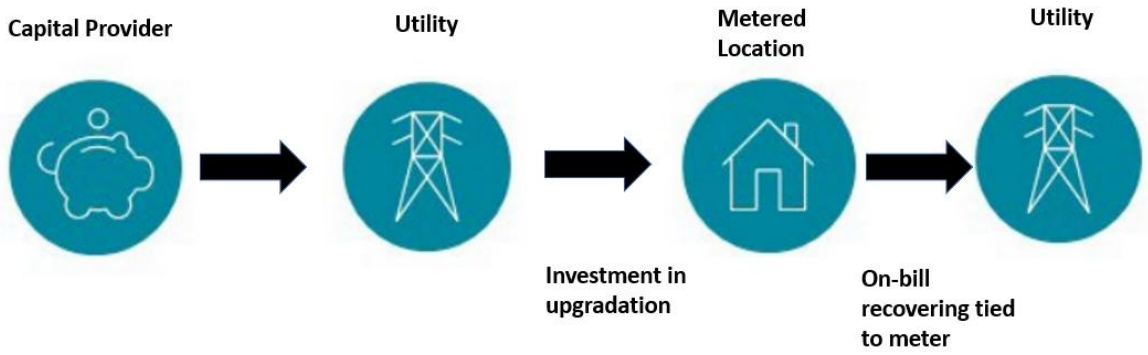


Figure 61 Modality of financing energy efficiency projects through on bill financing model

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.

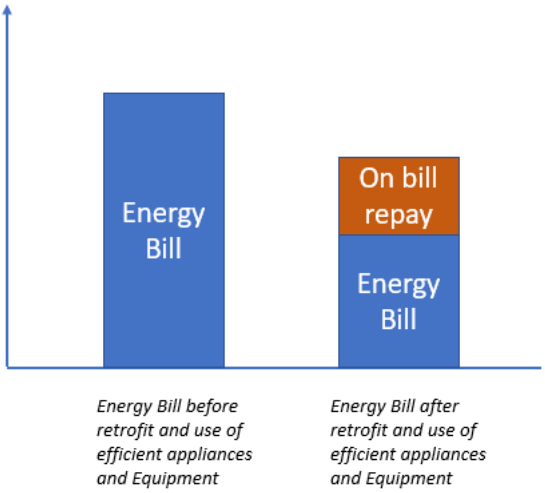


Figure 62 On bill financing structure

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

9.2 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.

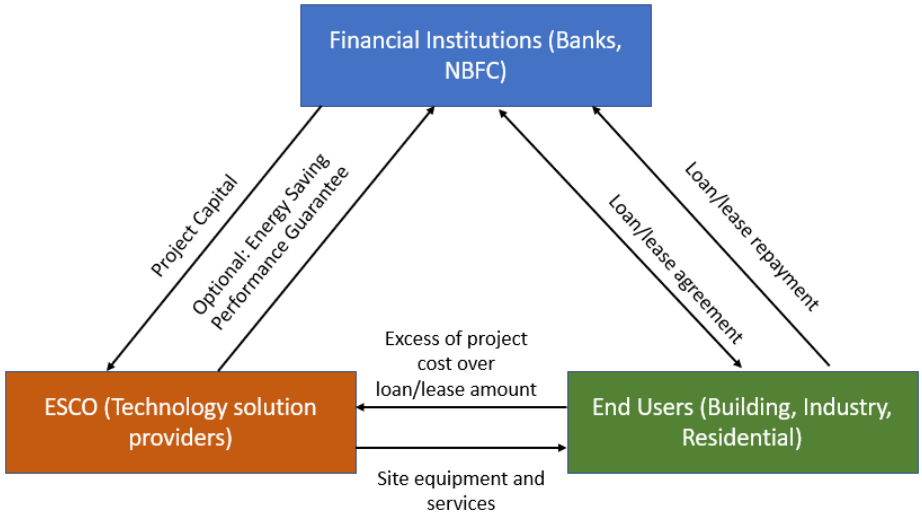


Figure 63 Guaranteed Saving Model

- **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.

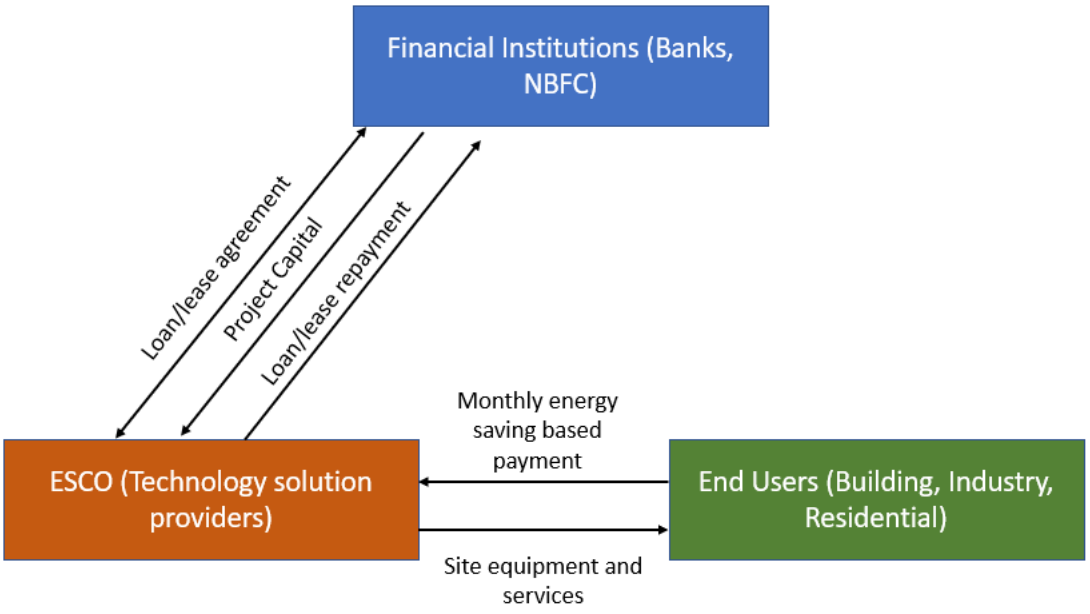


Figure 64 Shared ESCO saving Model

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

Table 61 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

9.3 Dealer or retailer financing model

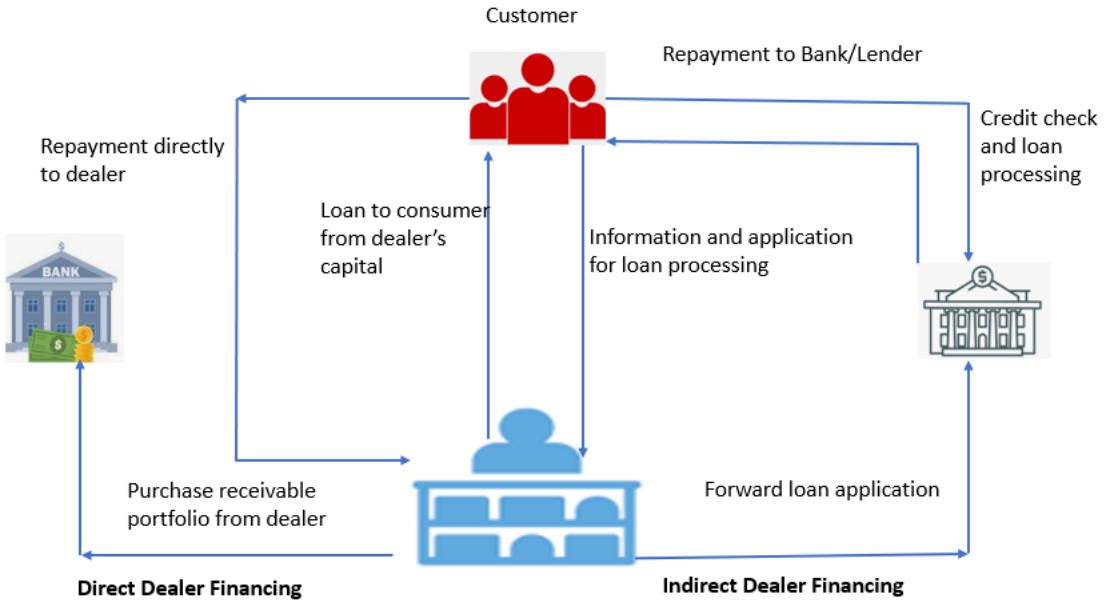


Figure 65 Dealer and retailer financing model

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.

9.4 Leasing financing model

Figure 66 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

9.5 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;

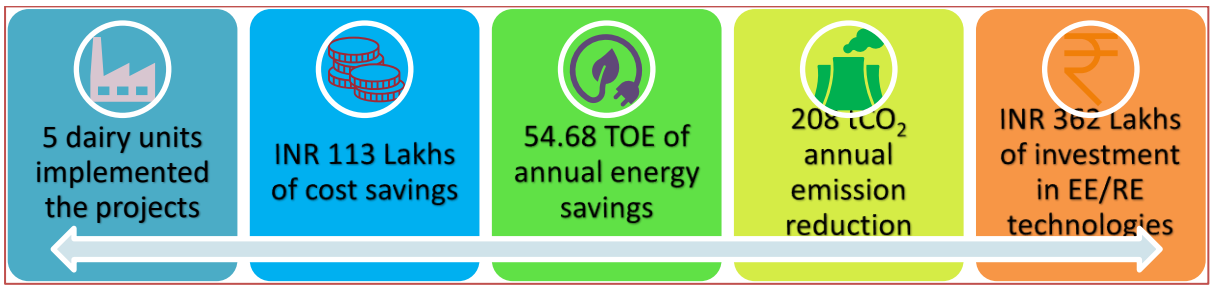


Figure 67 Key outcome of GEF funded Dairy Project

9.6 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.

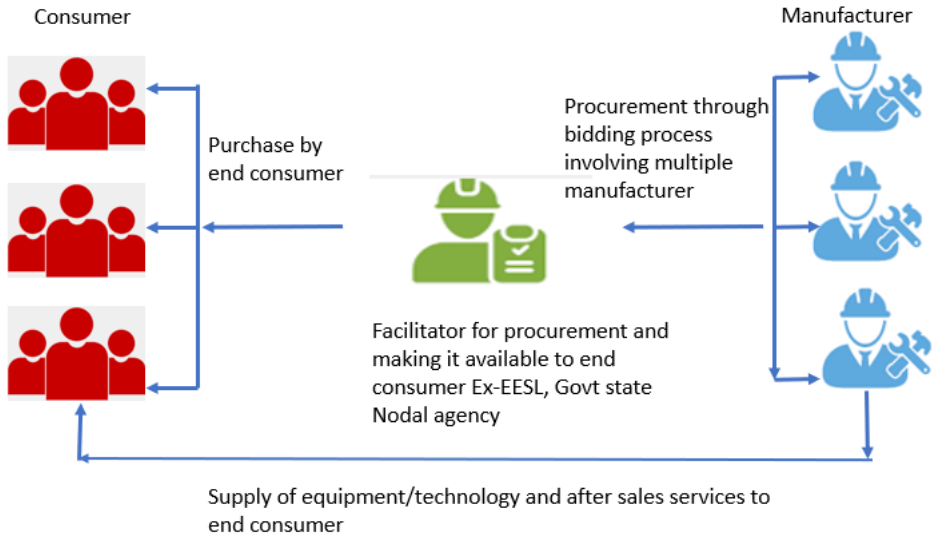


Figure 68 Bulk procurement model

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 62 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

10 Way Forward

The “State Energy Efficiency Action Plan” report for Gujarat 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. The proposed strategies are formulated in a way to aid the state in planning the resource allocation to achieve the state targets in line with the NDCs. The state is recommended to publish it as a formal guiding document to achieve energy efficiency and consider the proposed strategies as policy instruments while developing policies.

It is important 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 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. To ensure the successful implementation of the proposed action plan, it is also important to provide the training and capacity building for all the stakeholders involved. This will enable the awareness creation among the stakeholders and adoption of energy efficient practices. The proposed action plans across the sectors also requires innovation in technologies. Therefore, the government should also focus on encouraging the innovation and research in energy efficient technologies. This can be achieved by facilitating collaboration between industry and academia/ research institutes.

To summarize, the State Energy Efficiency Action Plan report for Gujarat 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 strategies, the state can achieve its energy efficiency goals, reduce greenhouse gas emissions, and contribute to a sustainable future.

11 ANNEXURES

11.1.1 List of Nodal officers from Stakeholder departments

1. Gujarat Energy Development Agency
2. Climate Change Department
3. Gujarat Power Corporation Limited
4. NTPC
5. MGVCL
6. DGVCL
7. UGVCL
8. PGVCL
9. Torrent Power Ltd.
10. Gujarat state electricity company limited
11. Gujarat Energy Transmission Corporation
12. State DISCOM's
13. PGVCL
14. UGVCL
15. MGVCL
16. DGVC
17. TORRENT
18. Chief Electrical Inspector and collector electricity duty
19. State Irrigation Department
20. State Transport Department
21. MSME Development Department
22. State Department of Finance
23. Roads and building dept
24. Public Health Engineering Department
25. Municipality administration, Urban Development and UHD
26. Agriculture, Farmers welfare and co-operation Department
27. Energy and petrochemical Department
28. Industries and Mining Department
29. Energy Auditors/Managers other energy Professionals
30. Designated Consumers (BEE, PAT Scheme)
31. Industrial Associations
32. Gujarat State Small Industries Federation
33. The Southern Gujarat Chamber of Commerce & Industry
34. Gujarat Chamber of Commerce & Industry
35. Gujrat State Plastics Manufacturers Association
36. GWSSB (Gujarat Water Supply And Sewage Board)
37. GWIL (Gujarat Water Infrastructure Limited)
38. GMFB (Gujarat Municipality Finance Board)
39. Commissioner of transport
40. GSRTC (Gujarat State Road Transport Corporation)
41. GIDC (Gujarat Industries Development Corporation)

42. Industries Commissioner
43. Capital Project Division
44. GMB (Gujarat Maritime Board)
45. Gujarat Housing Board
46. Regional Commissioner of Municipality
47. Gujarat Energy Research and Management Institute (GERMI)

The above is only a key stakeholder list and large number of stakeholders will be contacted during the survey under second task.

11.1.2 List of Primary & Secondary Data Collection Sources

1] Gujarat Budget 2019-20: Socio Economic Review
2] https://www.ibef.org/download/Gujarat-March-2021.pdf
3] https://stateenergyefficiencyindex.in/wp-content/uploads/2021/10/SEEI-2020-Report-Final-web.pdf
4] Niti Aayog Dashboard
5] https://researchrepository.murdoch.edu.au/id/eprint/53980/1/renewables.pdf
6] https://www.guvnl.com/img/home/Research%20_Report_on_Energy_Sector_in_Gujarat.pdf
7] https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-26000.pdf
8] CEA Load Generation Balance Report from 2016 to 2020
9] https://www.investindia.gov.in/state/gujarat
10] https://www.jstor.org/stable/resrep26070.9?seq=2
11] https://www.ijeat.org/wp-content/uploads/papers/v9i1/A1321109119.pdf
12] https://www.sciencedirect.com/science/article/am/pii/S0301421517304469
13] https://link.springer.com/chapter/10.1007/978-981-15-9335-2_5
14] http://www.gudcltd.com/municipal-energy-efficiency-project-meep

11.1.3 Minutes of Meeting – Key Stakeholders

MINUTES OF MEETING

Project Name	State Energy Efficiency Action Plan (SEEAP)		
SDA Name	Gujarat Energy Development Agency (GEDA)		
Date of Meeting	08 March 2022	**Time**	4.00 to 4.30 PM
Minutes Prepared By	CII	**Location**	Via Microsoft Teams
1.Meeting Objective			
Kick off meeting with GEDA on preparation of Energy Action Plan for Gujarat			
2.Attendees			

Gujarat Energy Development Agency

Sr. No	Name of the Attendee	Designation	Contact Detail	Email id
1	Mr Shwetal Shah	Tech. Advisor	9904085859	Spshah987@gmail.com
2	Ms Amita Pandya	Sr. Project Executive	9909922459	amita@geda.org.in
3	Ms HS Silajiya	Sr. Project APEX	7069038862	spexwind@geda.org.in
4	Mr Jay Khokhra	Project Officer	9016326728	Jayk41297@gmail.com

Confederation of Indian Industry, Hyderabad

Sr. no	Name of the Attendee	Designation	Contact Detail	Email id
1	Mr P V Kiran Ananth	Principal Counsellor	9849909671	kiran.ananth@cii.in
2	Mr Sougata Sarkar	Counsellor	9088014033	Sougata.sarkar@cii.in
3	Ms Shashikala Agrawal	Counsellor	7290035507	shashi.agrawal@cii.in
4	Mr Reetesh K	Counsellor	9325952689	reetesh.kocheta@cii.in

3. Discussion points

An online Kick off meeting was held on 8 March 2022 via Microsoft Teams to discuss on the activities & deliverables for preparation of Energy Efficiency Action Plan for Gujarat.
CII team presented the brief overview of the project to GEDA team.
CII's presentation contained

- Background of the project
- Task & Timelines
- Tool to be used for the study - http://iess2047.gov.in/
- Survey methodology & contents of survey forms
- Potential survey respondents including Govt departments, Associations, Industry and Energy Professionals
- BEE'S suggestion to consider baseline year of FY 2019-20

GEDA thanked BEE for this great initiative and offered their full support and cooperation for timely and successful completion of this study

4. Next Steps

1. CII will collect secondary data for 2019-20
2. CII will share the survey form (once approved) with SDA before its release
3. GEDA will arrange for a meeting with State Level EC committee to discuss about this project, take inputs and comments from members. Discuss on identification of nodal officers for further consultations.
4. GEDA will share their recent annual report/impact assessment report/recent compilation of all EC activities conducted/completed in state, if any

Annexure

Proposed committee for State Energy Efficiency Action Plan

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

11.1.4 List of Green rated companies as of May 2023 in Gujarat

S No	Company	Sector	Location	State	Rating Level	Month & Year of Award
1	Astral Limited (Silencio Manufacturing Division)	Engineering	Ahmedabad	Gujarat	Gold	Aug-21
2	Breech Oralcare Private Limited, Tooth Paste Division	FMCG	Vadodara	Gujarat	Silver	Sep-19
3	Dahod Loco, C & W Workshop	Engineering	Dahod	Gujarat	Certified	
4	DCM Shriram	Chemical	Bharuch	Gujarat	Silver	Oct-18
5	Diesel Loco Shed	Railways	Vatva, Ahmedabad	Gujarat	Gold	Dec-20
6	Expanded Polymer Systems Pvt. Ltd	Chemical	Dahej	Gujarat	Bronze	Aug-19
7	GAIL (India) Limited	Petrochemical	Vaghodia	Gujarat	Silver	Jan-21
8	GAIL Gandhar Gas Processing Station	Petrochemical	Gandhar	Gujarat	Silver	Jan-22
9	Godrej Industries Limited	Chemical	Valia	Gujarat	Silver	Jul-15
10	Godrej Industries Limited	Chemical	Valia	Gujarat	Gold	Apr-18
11	Godrej Industries Limited	Chemical	Valia	Gujarat	Platinum	Jan-22
12	Honda Motorcycle and Scooter India Pvt. Ltd	Automobile	Vittalapur	Gujarat	Platinum	Jan-20
13	HPCL - Mundra Oil terminal	Petroleum Marketing	Mundra	Gujarat	Platinum	Feb-20
14	Hyderabad Industries Limited	Engineering	Golan	Gujarat	Gold	Oct-13

S No	Company	Sector	Location	State	Rating Level	Month & Year of Award
15	Indian Oil Corporation Limited, Oil Terminal	Petroleum Marketing	Surat	Gujarat	Gold	Sep-22
16	Indian Oil Corporation Ltd - Rajkot BP	Petroleum Marketing	Rajkot	Gujarat	Bronze	Apr-22
17	Indian Oil Corporation Ltd - Sanand LPG BP	Petroleum Marketing	Sanand	Gujarat	Silver	Mar-22
18	Indian Oil Corporation Ltd - Sidhpur Oil Terminal	Petroleum Marketing	Sidhpur	Gujarat	Bronze	May-22
19	Indian Oil Corporation Ltd, Ahmedabad Terminal	Petroleum Marketing	Ahmedabad	Gujarat	Gold	Mar-20
20	Indian Oil Corporation Ltd, Ahmedabad Terminal	Petroleum Marketing	Ahmedabad	Gujarat	Platinum	May-22
21	J K Cement Works	cement	Mangrol	Gujarat	Gold	Sep-22
22	JK Lakhsmi Cement Ltd	cement	Kalol	Gujarat	Silver	Feb-15
23	Kirloskar Brothers Ltd	Engineering	Sanand	Gujarat	Silver	Feb-15
24	Ministry of Railways, Bhavnagar Workshop	Railways	Bhavnagar	Gujarat	Silver	May-18
25	Tata Motors Ltd	Automobile	Sanand	Gujarat	Platinum	Jul-18

Bureau of Energy Efficiency

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