State Energy Efficiency Action Plan

Karnataka

KREDL

Confederation of Indian Industry

PREFACE

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

All states/UTs are grouped into six zones for this assignment: north-east, east, north-1, north-2, west, and south. Confederation of Indian Industry (CII) has been appointed by BEE as a technical consultant for the preparation of SEEAP for Karnataka, which is being undertaken in association with Karnataka Renewable Energy Development Limited (KREDL). During the study stakeholders across various sectors like industry, transport, building, municipal, agriculture & fisheries have been consulted for their suggestions and feedback on the action plan given for Karnataka State. The impact of this study extends far beyond its initial scope. Foremost, the State Energy Efficiency Action Plan (SEEAP) promises to furnish policymakers, planners, domain consultants, and other key stakeholders with a robust framework for informed decision-making. By integrating the diverse perspectives garnered through stakeholder consultations, the resultant action plan is poised to be a dynamic blueprint for effective energy efficiency enhancement. The study's significance lies not only in its outcomes but also in its inherent potential for knowledge exchange. As stakeholders converge from various sectors and disciplines, a fertile ground for cross-pollination of ideas and experiences is cultivated.

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 Karnataka.

CII is grateful to Shri Abhay Bakre, Director General, BEE, and Shri Milind B. Deore, Secretary, BEE, for their overall guidance and encouragement for successful completion of this project.

We are also thankful to Shri Abhishek Sharma, Joint Director, Shri Manish Kumar, Project Engineer, Shri Vikas Jha, Project Engineer, and Shri Gautam Anand, Project Engineer, with whom the team regularly consulted during the project for assistance, feedback, and valuable inputs.

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1 INTRODUCTION

1.1 Background

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

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

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

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

1.2 India's Nationally Determined Contributions (NDCs)

[1]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, 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 lifestyle adopted, and E-waste reduced, are the 7 actions fall under the Mission Life 2022-23[2].
- 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.

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

[2] https://www.niti.gov.in/sites/default/files/2022-10/Brochure-10-pages-op-2-print-file-20102022.pdf

- 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 State Energy Efficiency Action Plan

This assignment aims to provide technical assistance for the identification of focus sectors for the State Energy Efficiency Action Plan for Karnataka 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 below.

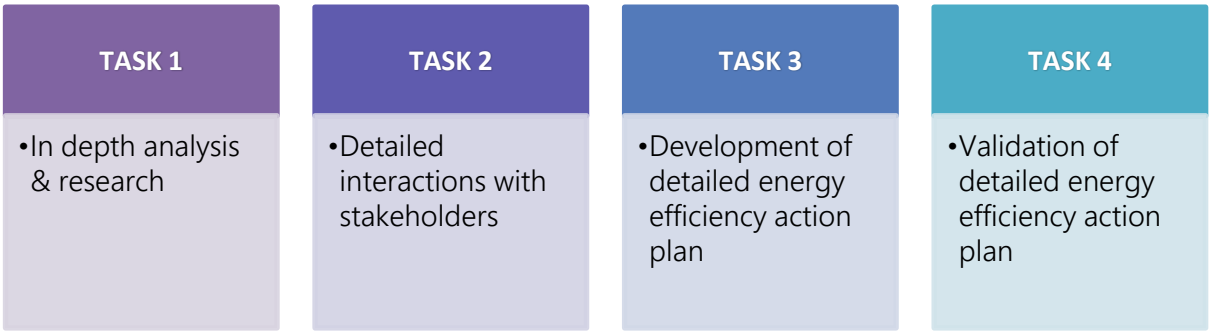


Figure 1 Key tasks in state energy action plan

Outcome:

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

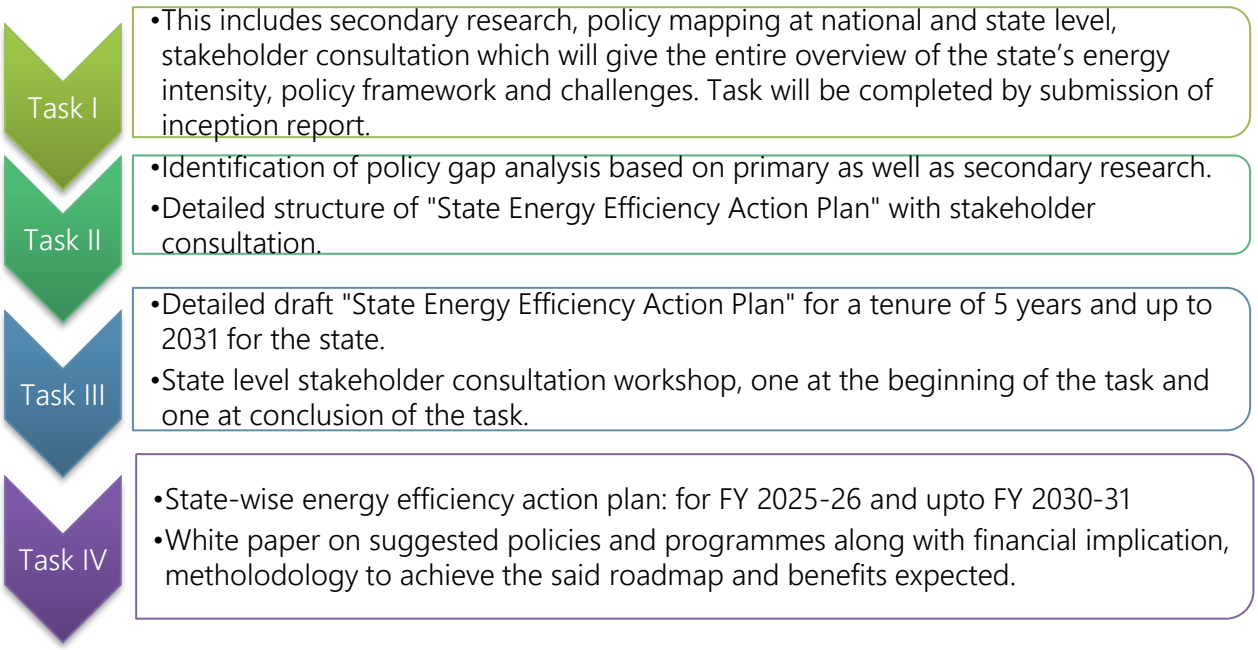
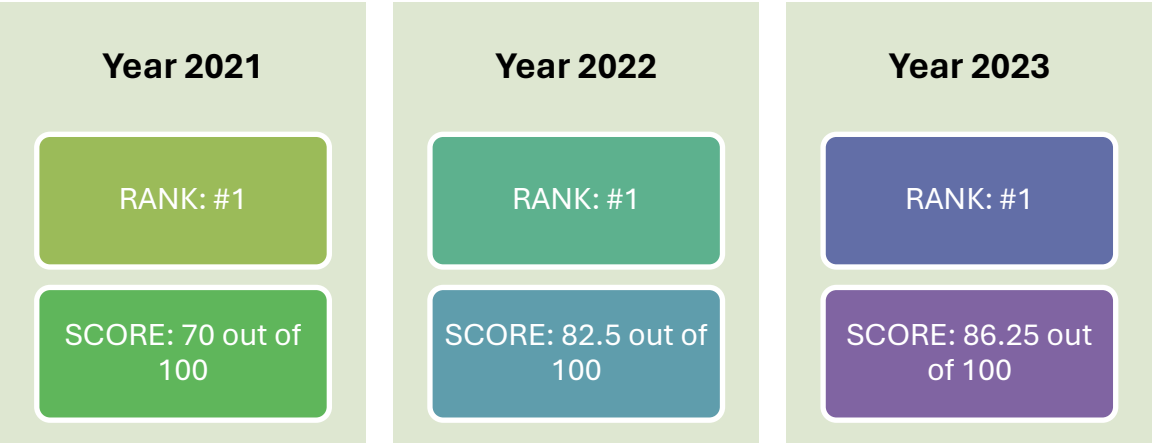


Figure 2 Task wise expected outcome of the study

Energy Efficiency Drivers for the State

Karnataka has emerged as a leader in energy efficiency, consistently topping the State Energy Efficiency Index (SEEI) for the past three years. Their score has steadily climbed, reaching 70 in 2021, 82.5 in 2022, and a remarkable 86.25 in 2023 (as shown in the figure).

Figure 3 State Energy Efficiency Index of Karnataka



Driving Efficiency Through Innovation

This impressive achievement is driven by a range of initiatives. The state government's "Karnataka Energy Conservation and Energy Efficiency Policy 2022-2027" sets a roadmap for promoting energy efficiency across various sectors. This policy focuses on program adoption, financial mechanisms, and capacity building within key energy-consuming industries.

The implementing agency, SDA Karnataka, has provided comprehensive data showcasing various successful initiatives. These include:

- Building Energy Efficiency Programme (BEEP) for public and commercial buildings.
- Demonstration projects for energy-efficient appliance retrofits in government hostels.
- Electric vehicle (EV) charging infrastructure projects.
- Procurement of EVs for government and public use.
- Light-emitting diode (LED) street lighting projects.
- Energy-efficient water pumps.

Furthermore, SDA Karnataka conducts regular training programs to raise awareness and disseminate best practices in energy efficiency across all stakeholder groups.

The above interventions are driven by the following key drivers:

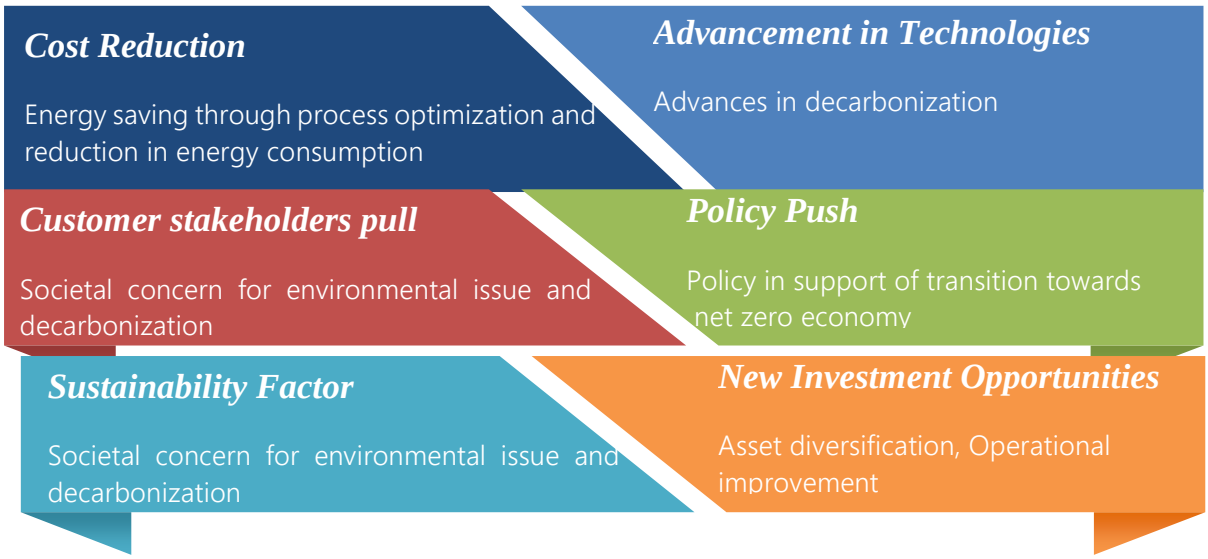


Figure 4 Energy efficiency drivers of the state

1.4 Karnataka State Profile

Karnataka, formerly (until 1973) Mysore, state of India, located on the western coast of the subcontinent. It is bounded by the states of Goa and Maharashtra to the north, Telangana to the east, Tamil Nadu to the southeast, and Kerala to the south and by the Arabian Sea to the west. The state extends for about 420 miles (675 km) from north to south and for about 300 miles (480 km) from east to west. Its coastline stretches for some 200 miles (320 km). The capital is Bengaluru (Bangalore), near the south-eastern border.

1.4.1 Socio Economic Profile of Karnataka

1.4.1.1 Economy of Karnataka state

- According to the economic survey 2022-23 of the state at current prices, Karnataka's gross state domestic product (GSDP) stood at Rs. 16.11 Lakh crore (US$ 202 billion) in 2019-20[3]
- India's overall GDP as of 2021 is Rs. 203.4 Lakh crore at current price where the contribution of Karnataka state is Rs. 16.11 Lakh crore which is approximately 7.92%[4]
- The state's GSDP increased at a CAGR of 11% between 2015-16 and 2019-20.
- The state's per capita GSDP was Rs. 2,43,727 in 2019-20

1.4.1.2 Population of Karnataka State[5]

- The southern state of Karnataka is currently (2021) home to over 71,609,495 (7.16 Crores) people. Total population in state was recorded to be 69,371,567 and 70,462,375 in the year 2019 and 2020. Annual growth of population in the state is estimated to be over 1.1 million people.

[3] Gross State Value Added by economic activity – Karnataka, MoSPI (As on 15/03/2023)
[4] PRESS NOTE PE and Q4 estimates of GDP.pdf (mospi.gov.in)
[5] www.indiaonlinepages.com, Karnataka population

1.4.1.3 Literacy Rate[6]

- Karnataka State Literacy is 75.60% and sex ratio is 973 per 1000 males as per 2011 census, where the male literacy rate is 82.5% and Female Literacy rate is 68.1% (ref. Figure 5)

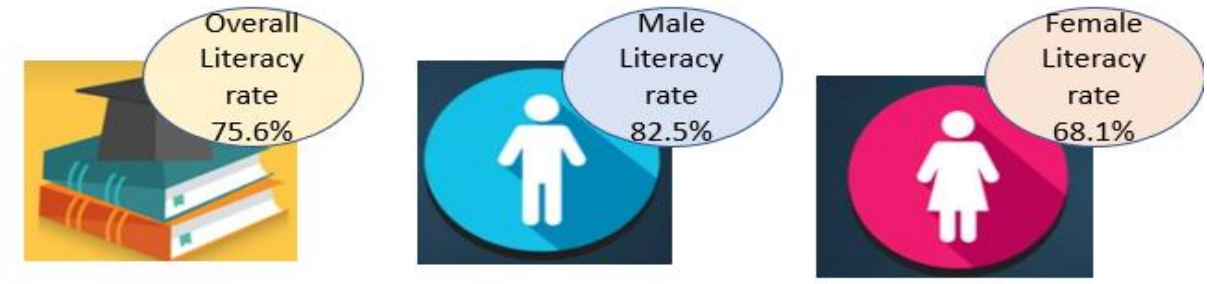


Figure 5 Literacy rate Karnataka

1.4.1.4 Mineral Resources[7]

The State is endowed with rich deposits of asbestos, bauxite, chromite, dolomite, gold, iron ore, kaolin, limestone, magnesite, Manganese, ochre, quartz, and silica sand. It is also the sole producer of felsite, moulding sand (63%) and fuchsite quartzite (57%). Karnataka is the major gold producing State in the Country with the two major mines located in the districts of Kolar and Raichur. The gold mines at Kolar and Hutti are producing about 3,000 kg of gold, about 84% of countries production per annum. Karnataka is very rich in Iron and Manganese ores.

1.4.1.5 Water Resources

Karnataka accounts for about six per cent of the country's surface water resources of 17 lakh million cubic metres (Mcum). Rivers are a source of water for drinking, irrigation, and electricity generation in Karnataka. Most of the rivers originate in the Western Ghats that generally flow westward meet the Arabian Sea after a short run varying from 50 kilometres to 300 kilometres. Almost all the major east-flowing rivers are inter-state rivers and runs towards the eastern side of the state and drain towards the Bay of Bengal.

1.4.2 Physical Infrastructure:

1.4.3.1 Road

Karnataka provides efficient public transport to people of different income groups across the state as well as in neighbouring states. As shown in Table 1, the state has a total of 275,158 km of road area. The national highways run for around 7,335 km and the state highways extend as much as 2,71,163 km.

[6] www.populationu.com/in/karnataka-population
[7] www.kla.kar.nic.in/council/karnataka.htm

Table 1 Road Infrastructure in Karnataka (Km)[8]

Road Infrastructure of Karnataka	2019-20
National Highways (March 2019)	7,335
State Highways	2,71,563
Major district road	55,515
Municipal road	8,366
Rural Road	1,77,542

1.4.3.2 Rail

Karnataka is well connected to other parts of the country through the railways. The state has a railway network of 3,540 kms.

1.4.3.3 Airport

The state has five domestic airports. These are located in Bengaluru, Mangalore, Hubli, Mysore and Belgaum. In March 2017, the Government gave 'in principle' approval for construction of an airport at Shimoga which is inaugurated in February 2023.

1.4.3.4 Ports

There are 13 ports in Karnataka, of which New Mangalore is a major port. New Mangalore Port is the ninth major port in India with the deepest inner harbour on the west coast.

1.4.4 Industrial infrastructure: SEZs and industrial estates[9]

As of February 2020, in Figure 4 the state has 32 operational, 52 notified SEZs and 63 formally approved SEZs. The Karnataka Industrial Areas Development Board has developed 141 industrial areas spread across the state. The state plans to develop and upgrade eight clusters around Bengaluru with an investment of US$ 348.4 million in coming years. The Karnataka State Industrial & Infrastructure Development Corporation has promoted more than 135 start-up ventures in the state through equity participation and has provided debt to core industries such as steel, cement, mining, and textiles, as well as new sectors such as IT, aerospace, and telecom.

[8] IBEF, Karnataka March 21
[9] IBEF, Karnataka March 2021

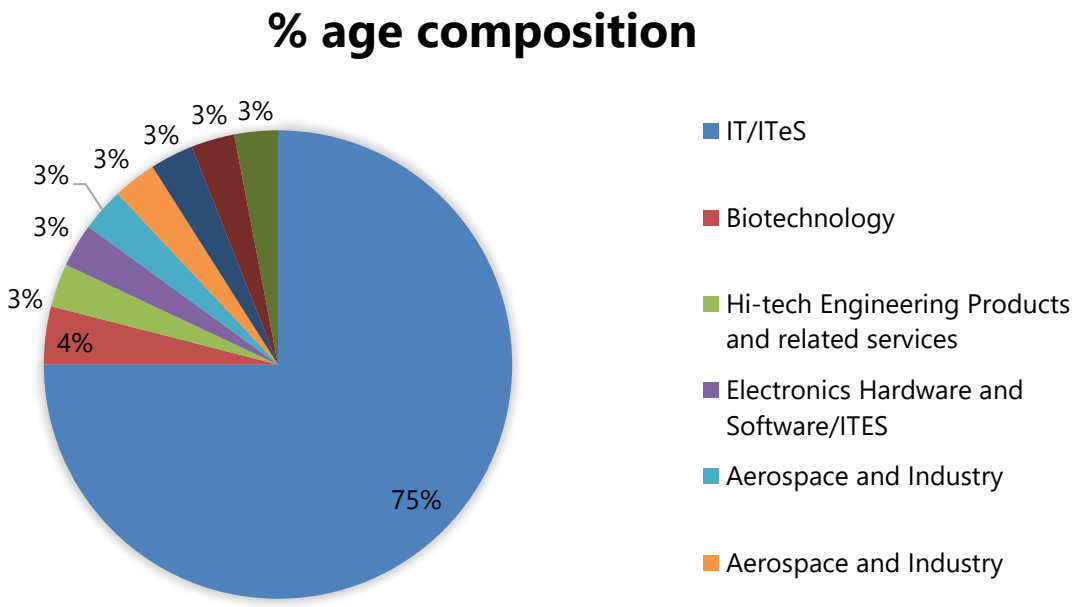


Figure 6 Industrial Infrastructure Karnataka

1.5 Current Energy Scenario of Karnataka

The Total Final Energy Consumption (TFEC) of Karnataka in Million TOE (MTOE) is 27.16 in 2020. It accounts for the total energy consumed from electricity[10], coal, gas, and oil[11].

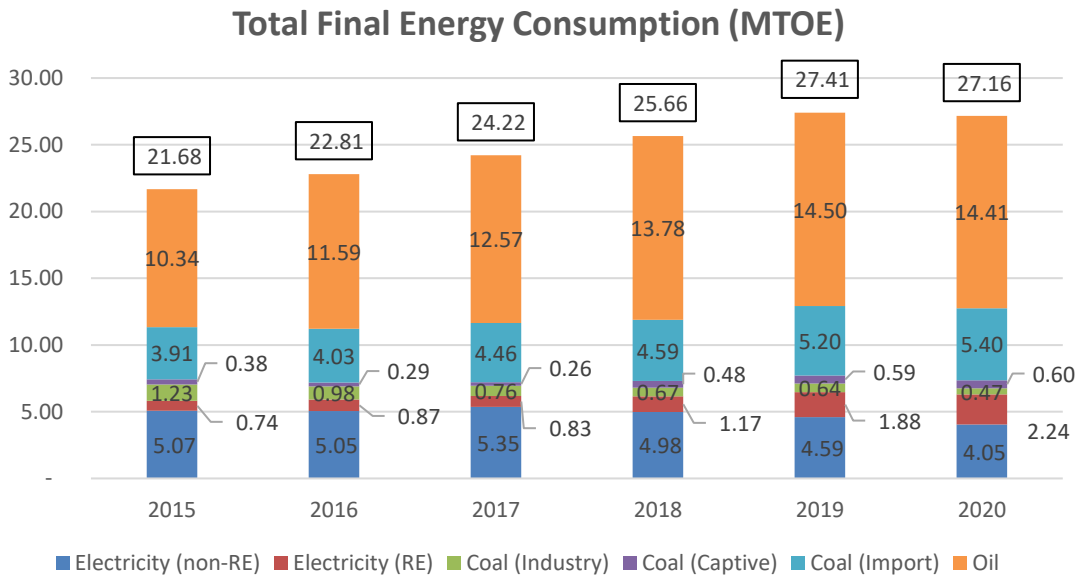


Figure 7 Total Final Energy Consumption trend

The final energy consumption as shown in the Figure 7, has increased by a CAGR of 4.6% between 2015-2020. The oil is major final energy source in the state, accounting for 53% of the total energy consumption in 2020. This includes the consumption of different petroleum products across the sectors.

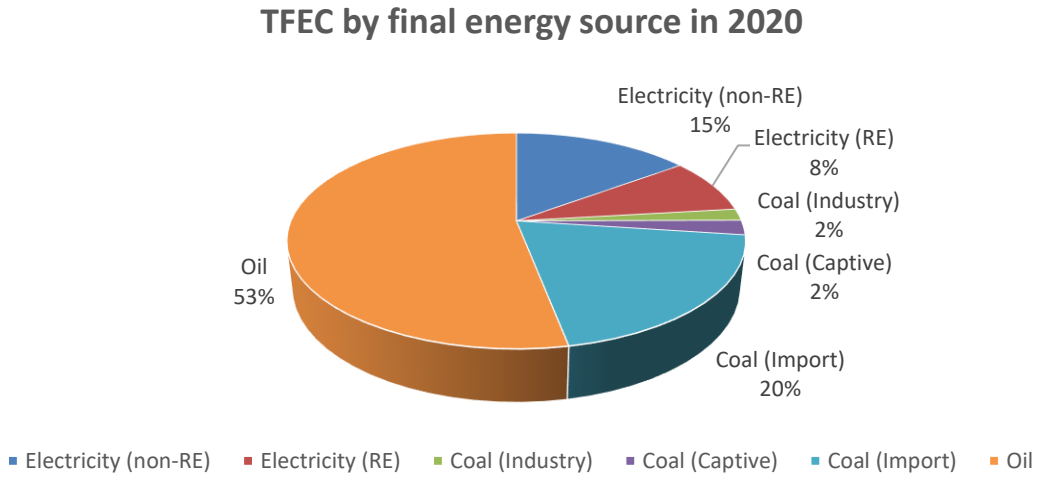


Figure 8 TFEC by final energy source in 2020

The TFEC trend of Karnataka by sectoral energy consumption from 2015 to 2020 in MTOE is shown in Figure 9

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

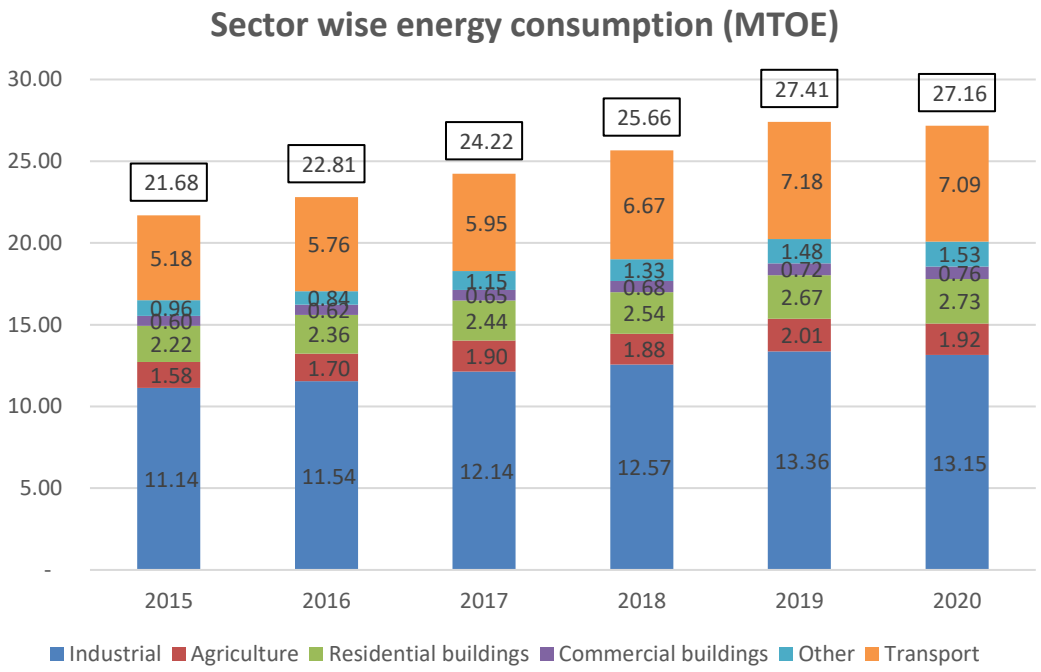


Figure 9 Sector wise energy consumption (MTOE)

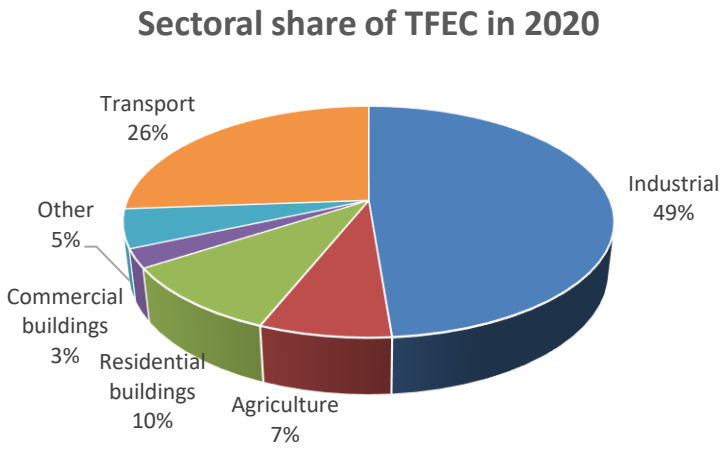


Figure 10 Sectoral share of TFEC in 2020

The industrial sector is the largest energy consumer and accounts for 13.15 MTOE, which is about 49% of the total energy consumption in 2020. Electricity, Diesel and furnace oil are the major sources of energy used in the sector.

Transport is the second largest energy consumer in the state, contributing to 26% of TFEC of the State, equivalent to about 7.09 MTOE of energy in 2020; the major fuels consumed are petrol, diesel and CNG.

Residential buildings sector accounts for nearly 10% of the TFEC of the state and consumes 2.73 MTOE. Electricity, LPG and PNG are the major fuels consumed in Domestic sector. 19% of total electricity consumption is by residential consumers.

Agricultural sector consumes 1.92 MTOE, which is nearly 7% of the total energy consumption and the Commercial sector consumes 1.53 MTOE of energy, which is 3% of the TFEC. The others include the energy consumption majorly from municipal sector accounts for about 5%.

Thermal and electrical energy consumption trend

Total energy consumption can be divided into thermal (fuel-Coal and Oil) and electrical energy consumption and the year wise trend has been shown Figure 11. In 2020, of the TFEC of 27.16 MTOE, 20.87 MTOE is the thermal energy. While rest of the 6.29 MTOE is from electricity.

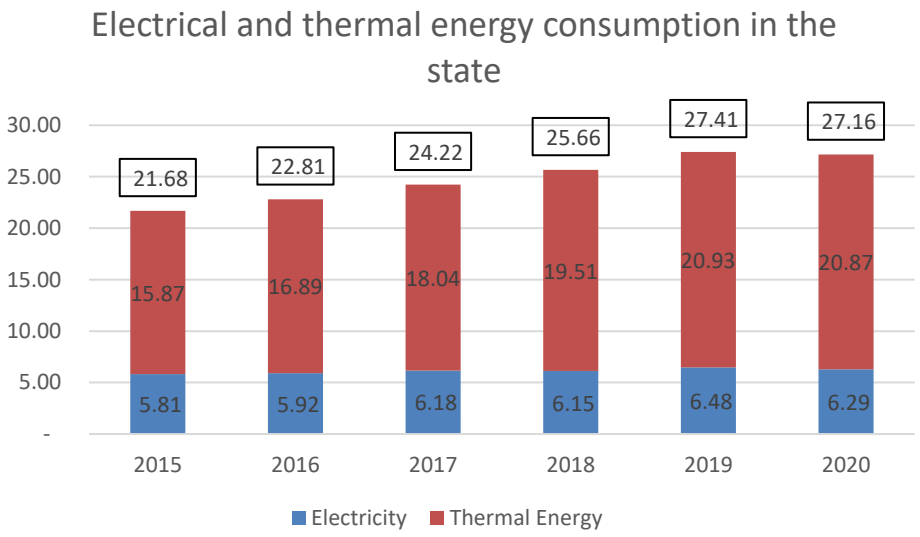


Figure 11 Total energy consumption (Fuel and electricity) (MTOE)

Electricity sub sector

India overall installed capacity is 3,70,106 MW and Karnataka state capacity is 29,823 MW as of 31st March 2020 (ref. Table 2) which nearly 8% of India's overall capacity. State's overall capacity grew by approx. 4% CAGR over last four years from 2018 to 2021.

Table 2 Installed electricity capacity in Karnataka (MW)[12]

Power Capacity (MW)	FY 2018	FY 2019	FY 2020	FY 2021
Karnataka	26,797	27,947	29,823	30,089
Year on Year increase		4.7%	6.7%	1%

[12] CEA Annual reports FY2018 to FY2021

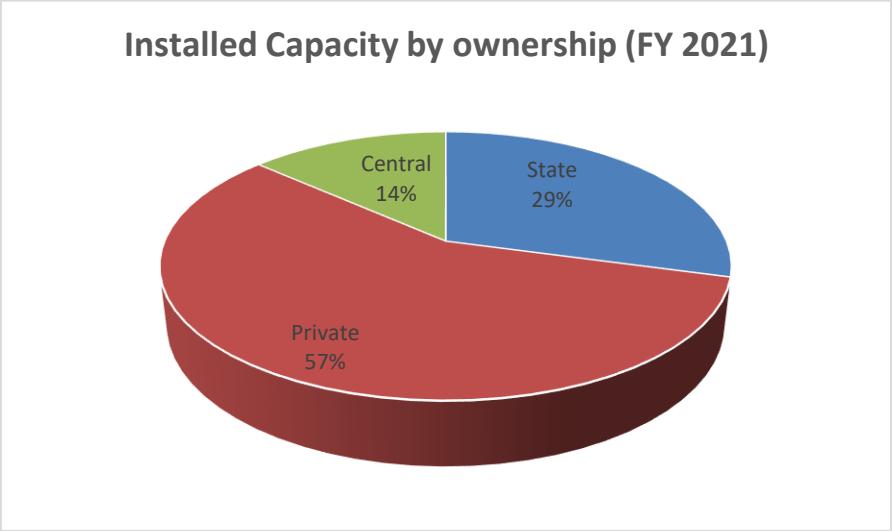


Figure 12 State contribution of Installed capacity by ownership

The above installed capacity of the state is contributed by Central, Private and State where 57% is share of Private followed by state and central as shown in Figure 12.

The Source wise installed capacity of the state is as shown in Table 3 and percentage contribution of each source is given in Figure 13.

Table 3 Source wise Installed capacity of the state FY 2021

Source of Energy	Installed capacity (MW)
RENEWABLES	15,463
COAL	9,845
LIGNITE	472
DIESEL	25
NUCLEAR	698
HYDRO	3,586
Total	30,089

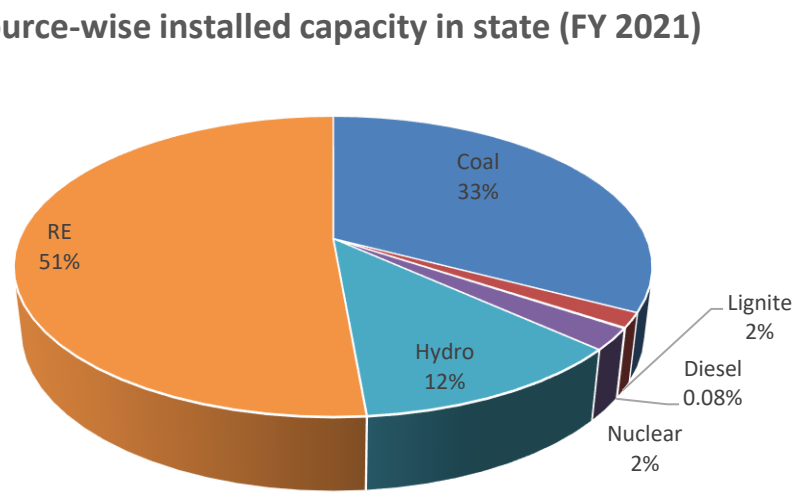


Figure 13 Source wise installed capacity in the state

Renewable Energy Progress in the State

Karnataka holds the distinction of being India's leading renewable energy (RE) state, boasting an installed capacity exceeding 16,400 MW as of December 2023. This accounts for nearly 51% of the state's total power generation, demonstrating a commendable commitment to clean energy transition. Solar and wind energy are leading, with installed capacities of 8,362.5 MW and 5,301.6 MW respectively, followed by smaller contributions from co-gen (1,731.16 MW), small hydro (907.46 MW), biomass (139 MW).

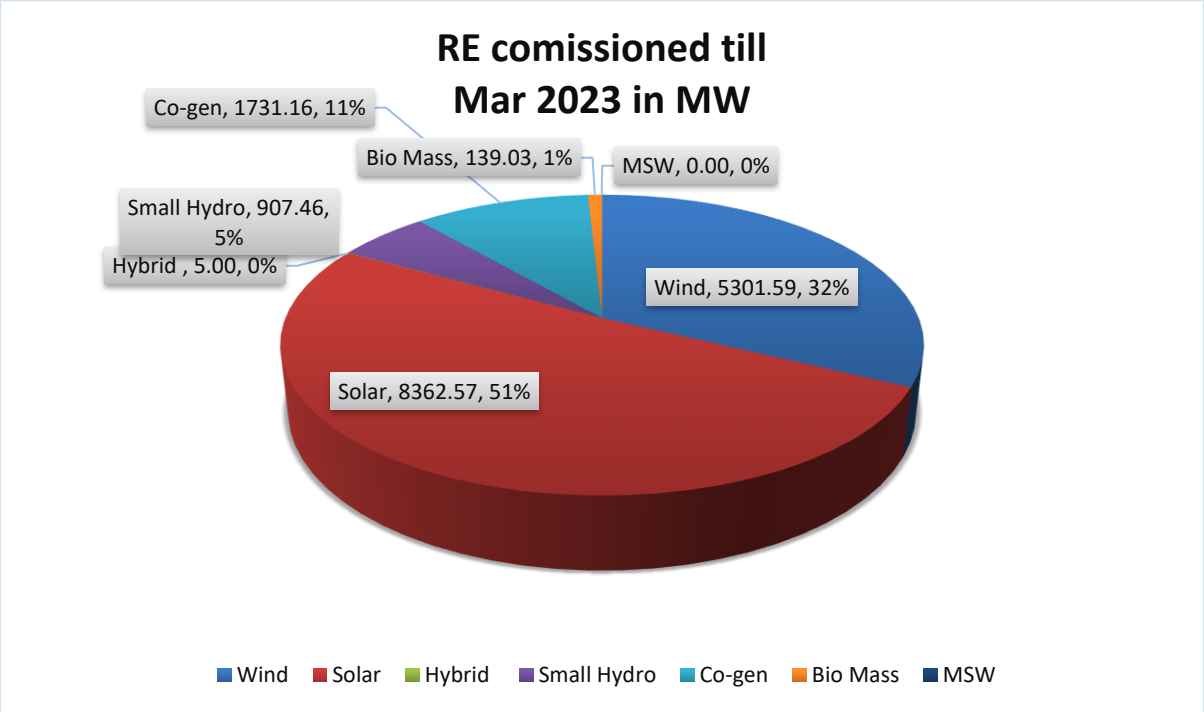


Figure 14 RE commissioned till 31-12-2023 in MW[13]

[13] Source: KREDL

The cumulative progress of allocated and commissioned RE (Renewable Energy) as on 31-12-2023 is displayed in the following table.

Figure 15 Cumulative Progress as on 31-12-2023

Cumulative Progress as on 31-12-2023

	RE Sources		Allotted Capacity in MW	Commissioned Capacity in MW	Cancelled Capacity in MW	Balance Allotted Cap. in MW to be Commissioned
			(a)	(b)	(c)	(d=(a-b-c))
1	Wind		29128.90	5301.59	11079.41	12747.90
2	Solar- Ground mounted		15278.77	7820.57	1196.50	6261.70
3	Roof Top, IPDS, 13thFinance Commission		516.78	516.78	0.00	0.00
4	Off- Grid Captive		22.63	22.63	0.00	0.00
5	Suryaraitha		2.58	2.58	0.00	0.00
Solar Total			15820.76	8362.57	1196.50	6261.70
6	Hybrid (Wind & Solar)	Wind	785.85	3.75	0.00	782.10
7		Solar	725.75	1.25	0.00	724.50
Hybrid Total			1511.60	5.00	0.00	1506.60
	Small Hydro		3046.35	907.46	1873.17	265.73
8	Co-gen		2212.65	1731.16	0.00	481.49
9	Bio Mass		395.13	139.03	0.00	256.10
10	MSW		59.00	0.00	0.00	59.00

Grand Total	52174.39	16446.81	14149.08	21578.51

Karnataka is the first southern State in India to notify "Karnataka Renewable Energy Policy 2009-14" in 2009 to harness green, clean renewable energy sources for environmental benefits and energy security. The Policy initiatives have enabled the State to achieve the capacity addition of 2,014 MW to harness the potential of solar resources in the State, Government of Karnataka had published a separate Solar Policy for the period 2011-2016, and subsequently had been amended and published as "Karnataka Solar Policy 2014-21 for the period 2014-2021.Karnataka Solar Policy 2014-21 had targeted for development of 6,000 MW solar capacity by 2021 and the State has surpassed the target with a solar installed capacity of 7,523 MW as on Dec 2021. In order to further harness, the additional potential of RE in the State, the Karnataka Renewable Energy Policy 2022-2027 has been notified on 06.05.2022 by the Government of Karnataka.[14]

1.6 Overview of Institutional framework

In exercise of power conferred under clause (d) of section 15of the Energy Conservation Act, 2001, the Government of Karnataka designated the Karnataka Renewable Energy Development Limited as 'The State Designated Agency' to coordinate, regulate, and enforce the provisions contained in said act within Karnataka state. With the help of the Bureau of Energy Efficiency, KREDL established a distinct department within the organisation to execute the provisions of the Energy Conservation Act 2001 and took the required measures for a capacity building programme in KREDL.

The Karnataka Legislature (Government of Karnataka) approved the Karnataka Electricity Reforms Act (KERA) in 1999 to enhance the state's electricity sector's performance. It required the Karnataka Electricity Board to be unbundled (KEB). As a result, in 2002, the Karnataka government established four new independent distribution businesses. These are Bangalore Electricity Supply Company (BESCOM), Mangalore Electricity Supply Company (MESCOM), Hubli Electricity Supply Company (HESCOM) and Gulbarga Electricity Supply Company (GESCOM).

Chamundeshwari Electricity Supply Corporation Limited (CESC) was formed in 2005 from MESCOM and is responsible for the distribution of electricity in the five districts. CESC has been in operation since 2005, with its headquarters in Mysore. The Karnataka Electricity Regulatory Commission (KERC) is authorized for drafting state rules as well as overseeing all other regulatory concerns pertaining to electricity generation, transmission, and distribution. The Karnataka Power Transmission Corporation Limited (KPTCL) was established in 1999 and is completely owned by the Karnataka government. KPTCL is a power transmission company based in Karnataka. Figure 16, depicts the power sector's institutional structure in Karnataka.

[14]https://kredl.karnataka.gov.in/storage/pdffiles/ECREGIONALWRKSHP/Karnataka%20Renewable%20Energy%20Policy%202022-27.pdf

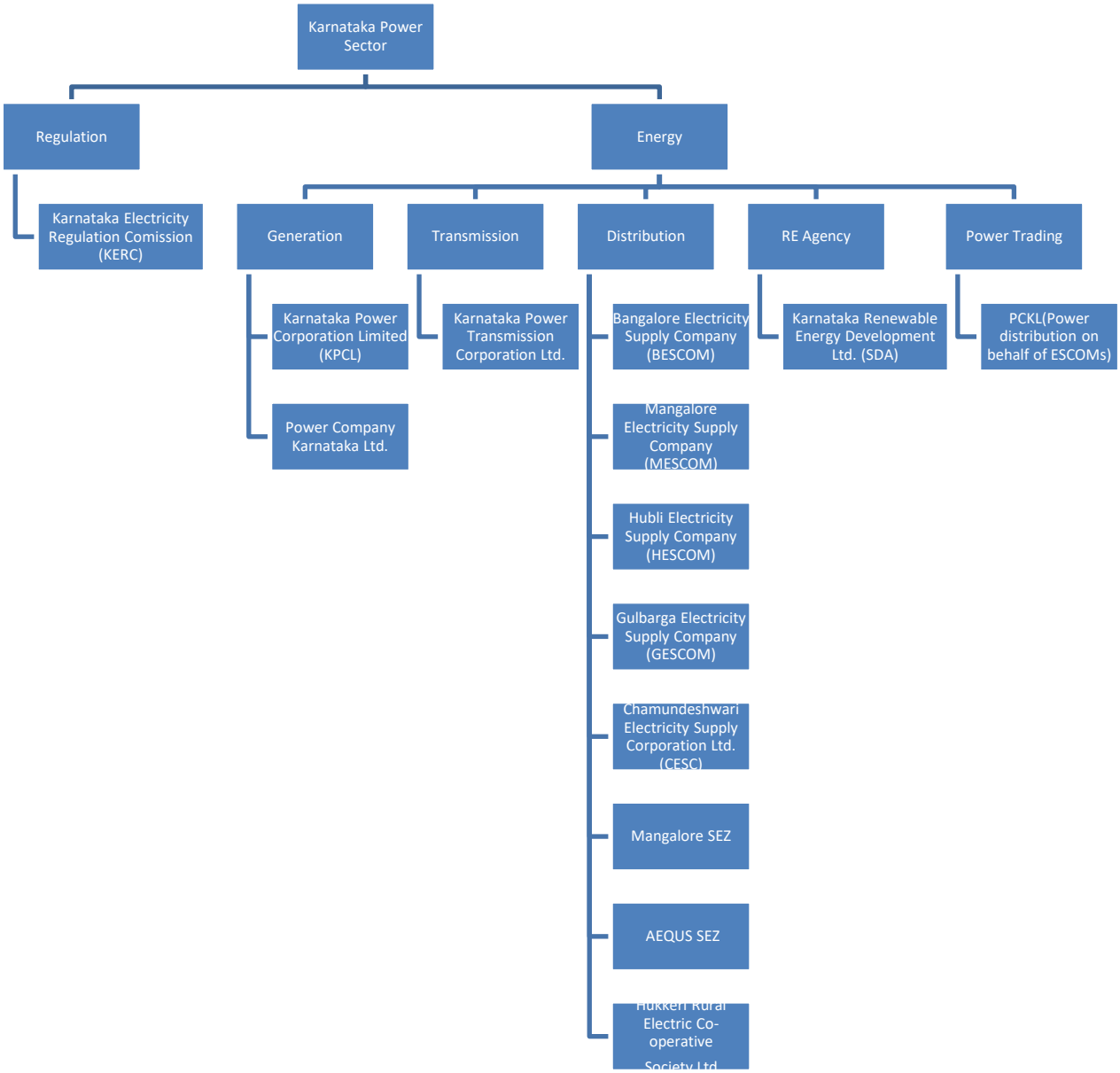


Figure 16 Institutional Framework of Karnataka State in energy sector

2 IDENTIFICATION OF FOCUS SECTORS

2.1 Identified focus sectors

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

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

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

3 PROJECTIONS AND FORECASTING

The Kaya identity is a useful equation for calculating the total amount of anthropogenic carbon dioxide (CO2) emissions. The equation, which is based on information that is easily accessible, can be used to calculate current emissions as well as how the important variables must evolve through time in relation to one another 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, the identity is a specific application of the I = PAT identity, which relates human impact on the environment (I) to the product of population (P), affluence (A) and technology (T). On first inspection, the Kaya identity may appear to be a frivolous equation given its construction as cancelling terms leaves you with F = F. In practice, however, it is commonly used to calculate an absolute value for global CO2 emissions from anthropogenic activities. It is also helpful in understanding how the four factors need to change relative to each other over time to reach a target level of CO2 emissions in future, and to understand how the four factors have changed in the past.

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

KAYA Equation usages in Policy making:

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

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

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

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

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

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

As per the economic survey of Karnataka 2022-23[15], the state GSDP is 22.41 Lakh crore in 2022-23. The report also includes the state's vision to reach a GSDP of 99.5 Lakh crore by 2032. As per the state's vision, the GSDP is expected to grow at a CAGR of 18% between FY2023 to FY2032. Based on this, the GSDP is expected to reach 84.3 Lakh crore by FY2031.

The available historical energy data, when correlated with the GSDP of the corresponding year the energy intensity of the state can be evaluated. The calculated energy intensity data of the state shows, a decreasing trend from FY 2015 to FY 2020 where it observed to be decreasing by 6.6% year on year. However, in long run under business-as-usual scenario, the decrease in energy intensity is assumed as 1.5 %. By assuming decrease by 1.5% till FY 2031, the expected energy intensity is about 1.43 MTOE/ INR Lakh crore in FY 2031 as compared to 1.66 MTOE/INR Lakh crore in FY 2020.

Using the calculated GSDP of 84.3 Lakh crore and energy intensity of 1.43 MTOE/ INR Lakh crore, the TFEC for FY 2031 is calculated to be 120 MTOE. The below graph shown in Figure 17 depicts the trends of GSDP, energy intensity and TFEC between FY 2015 to FY 2031.

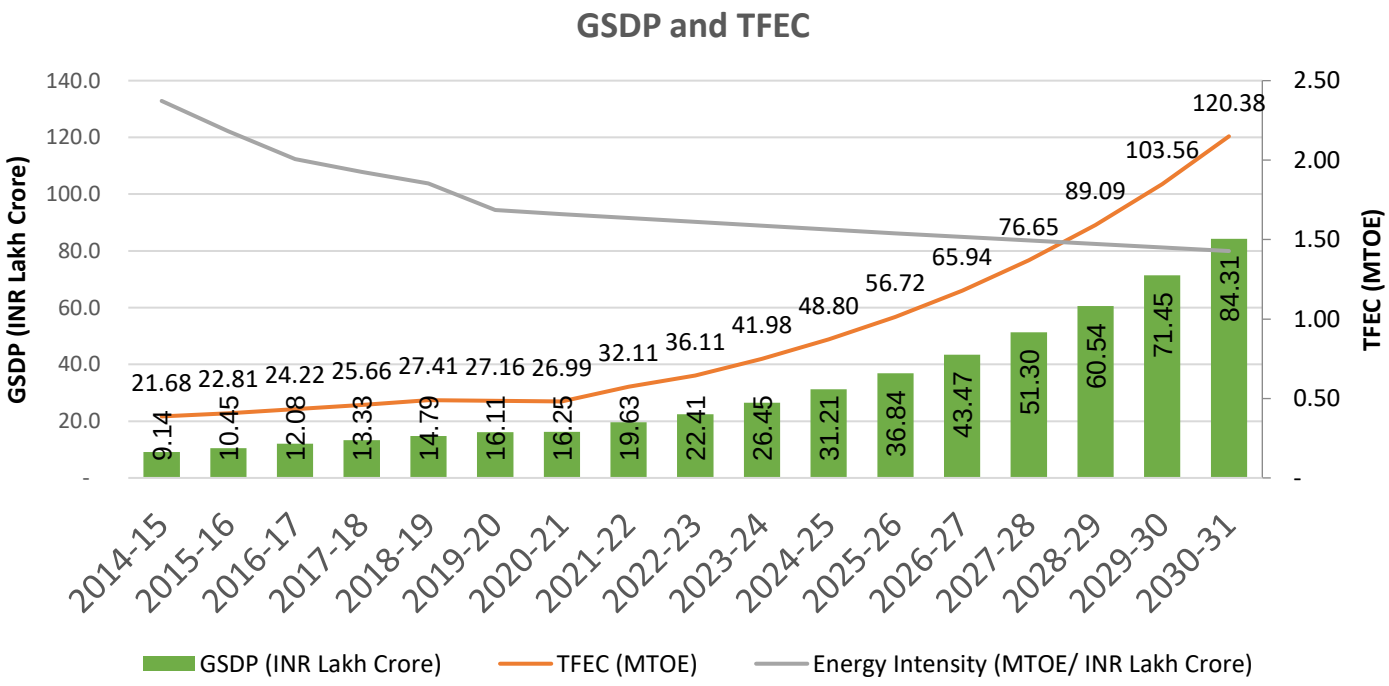


Figure 17 GSDP, TFEC & Energy Intensity trends of Karnataka

[15] https://des.karnataka.gov.in/storage/pdf-files/Economic%20Survey%202022-23%20English.pdf

4 FOCUS SECTOR 1: INDUSTRY

4.1 Overview

In the economy, the industrial sector consumes the most energy. In industry, fossil fuels are largely used for captive energy generation and process demands. The most prevalent fossil fuels are coal, lignite, natural gas, and naphtha. Due to a dearth of coal reserves in the state, Karnataka imports industrial coal and lignite from neighbouring states. Energy costs can account for as much as 20% of overall production costs in large corporations. As a result, increasing industrial energy efficiency (EE) is crucial. In FY 2021, the electricity consumption by the industrial sector in the state is decreased by 10.48% compared to previous year electricity consumption.

4.2 Energy efficiency strategies in the industry sector

4.2.1 Strategy: Deepening and widening of PAT Scheme

The Perform, Achieve and Trade (PAT) scheme, launched by the Bureau of Energy Efficiency (BEE) in 2012, is aimed at improving energy efficiency and reducing greenhouse gas emissions in energy-intensive industries. Karnataka, 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 Karnataka achieve its energy efficiency and emission reduction targets by incentivizing industries to adopt energy-efficient practices and technologies.

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

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

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

Scope Boundary

- Units in existing sectors under PAT namely Cement,, Iron & Steel, Pulp& Paper.
- Sectors like automobile, chemical, pharma, food and fisheries, tyre, glass, ceramics etc are considered based on energy consumption patterns of the industries, their contribution to the state's economy, and their potential for energy efficiency improvements

Implementing Agency

- Bureau of Energy Efficiency(BEE), KREDL and Department of Industry and Commerce

Current Policy In Place

- PAT Scheme

Saving Potential

Specific Energy Consumption (SEC) is calculated with the ratio of industry energy consumption and annual production. Table 4 shows the SEC of FY 2020 and estimated SECs for moderate and ambitious scenario. Based on the SECs of each industry, savings were derived as 2.27 MTOE savings in moderate scenario and 3.14 MTOE in ambitious scenario.

Table 4 SEC Comparison sector wise – Deepening of PAT[16]

Sector	Baseline SEC (toe/tonne)	Moderate SEC (toe/tonne)	Ambitious SEC (toe/tonne)	Production in FY 2031 (million tonnes)	Energy saving in moderate scenario (Mtoe)	Energy saving in ambitious scenario (Mtoe)
Cement	0.075	0.068	0.061	57.3	0.17	0.33
Iron & Steel	0.641	0.590	0.564	37.6	0.90	1.35
Pulp & Paper	0.540	0.501	0.479	1.92	0.05	0.07
Total					1.12	1.76

[16] BEE, Indian Minerals Yearbook, Invest India, others

Table 5 SEC Comparison sector wise – Widening of PAT[17]

Sector	Baseline SEC (toe/INR Lakh)	Moderate SEC (toe/INR Lakh)	Ambitious SEC (toe/INR Lakh)	Projected Gross Value Addition (INR Lakh) in FY2031	Energy saving in moderate scenario (Mtoe)	Energy saving in ambitious scenario (Mtoe)
Automobile	0.065	0.048	0.045	25,31,131	0.04	0.05
Chemical	0.795	0.596	0.556	17,15,522	0.34	0.41
Pharma	0.073	0.055	0.051	21,01,804	0.04	0.05
Food & beverages processing	0.277	0.208	0.194	33,49,403	0.23	0.28
Tyre manufacturing	0.575	0.431	0.402	1,72,624	0.02	0.03
Glass	0.234	0.175	0.163	21,537	0.001	0.002
Ceramics	4.554	3.415	3.188	4,17,464	0.48	0.57
Total					1.15	1.40

Table 6 Energy Saving Potential – Deepening and Widening of PAT

Particulars	Moderate Scenario for FY 2031	Ambitious Scenario for FY 2031
Conventional Energy Offset Potential (MTOE)	2.27	3.14
GHG Emission Reduction Potential ($MtCO_2$)	7.11	9.83

Action Plans

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

Policy Type	Action Plan	Timeline

[17] Annual Survey Industries 2018-19

Awareness & Capacity Building	Capacity Building of Energy Managers and Energy Auditors in PAT DCs and new probable sectors for compliance with scheme and new technologies. Building capacity for operational side: 1. Strategically scheduling machinery operation (Peak energy usage) 2. Well-designed machine control system (Adjust speed to match demand) 3. Efficient maintenance of equipment to reduce energy wastage or transmission loss (Proper insulation)	Short Term
Formation of energy monitoring team	1. Constituting Energy Management Team: Creating a plan to monitor energy consumption (Power down idle machines, Turn-off conveyors, Switch off lights etc). 2. Creating an industrial energy productivity Road-Map (Future focus on Decarbonisation of grid, Clustering of Industries etc).	
Technological Intervention	Creating linkages between agencies, Technology demonstration centres (TDC) and other R&D labs to act on the feedback from heavy Industries and provide relevant technical inputs on EE	Short Term
	Encouraging industries for deployment of energy efficient technologies. BEE has ADEETIE (Assistance in Deploying Energy Efficient Technologies in Industries and Establishments)-List of 150+ technologies available on the portal	Short Term
	Feasibility Study of new probable sectors (Ceramic, Foundry, Food processing, bricks etc.) to be included in PAT scheme	Short Term
	Benchmarking study and data collection in Industries: Strengthening of survey, studies to evaluate the performance of the sector with respect to energy use and processes	Long Term
Financial Support	Tie up with financial institutions and technology providers for commercially scalable projects	Short Term
	Clubbing energy efficient equipment loans with existing CAPEX loans taken by the MSMEs. Thus, reducing the additional transaction costs associated with smaller energy efficiency loans	Short Term

Case Study: PAE guidelines by BEE[18]

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.

The key features of the scheme include,

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

Key benefits to MSME:

1. Ample hand-holding support during scheme implementation including guidance for identifying and implementing efficient technology and measure, collecting, analysing and reporting of energy statistics
2. A mechanism for monetizing of ESCerts earned by MSMEs will be put in place, thus offering an additional financial incentive over and above the energy savings achieved
3. This activity will generate a huge quantity of first-hand, measured and verified, industrial energy consumption data. Promote the culture of EMS, ISO50001 resulting in improved efficiency, productivity and profits for MSMEs

4.2.2 Strategy: Decarbonising MSMEs through cluster approach

Karnataka, a progressive state, wants to accelerate urbanisation and maintain industrialization. The demand for resources and energy will probably significantly increase because of these transitions.

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

1. Bangalore Machine Tools cluster
2. Belgaum Foundry cluster
3. Shimoga Foundry cluster

[18] BEE, Ministry of Power

4. Malur Brick cluster
5. Gokak Jaggery cluster

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

There is a huge potential for implementing energy efficiency projects in these clusters. Some of the energy efficiency interventions in foundry cluster include replacement of conventional furnaces with energy efficient IGBT based induction furnaces. The energy efficiency projects in brick/ ceramic sectors include reduction of radiation losses by energy efficiency coating on kiln.

Some of the energy efficiency interventions possible in these sectors is added in the table below.

EE intervention in Brick/ ceramic clusters	EE Interventions in Foundry clusters
Low investment: • Waste heat recovery in roller kiln • Waste heat recovery in tunnel kiln • Reduction in ball mill power by installation of VFD on ball mill drive • Installation of VFD in screw compressor to avoid unloading • Retrofit energy efficient ceiling fans in place of conventional fans • Energy efficient pumps • Energy conservation in compressor by modifying airline system • Transvector nozzle for compressed air sanitaryware mould cleaning application • Maximum demand controller for avoiding excess contract demand penalty • Installation of VFD on agitator motor • Installation of on-off controller system in agitator motor • Installation of energy efficient motor in place of existing conventional motors in agitator system Medium investment: • High alumina balls in glaze ball mill in the place natural stone/pebbles • Energy conservation in compressor by modifying airline system	Low Investment: • Optimization of Air Compressor VFD performance through PID loop optimization. • Installation of electric grinders in place of pneumatic grinders to save energy in a foundry unit. • Installing timer for sand plant process in a foundry. Medium Investment: • Installation of LID Mechanism for Induction Furnace. • Automation of heat treatment process. • Replacement of existing raw water pump with energy efficient pump. • Replacement of existing motors with energy efficient (IE3) motors. • Improve power factor by Installing KVAR compensator. • Installation of VFD for compressor. High Investment: • Replacement of SCR-based Induction furnace with IGBT Induction Furnace.

• Energy efficient coating to reduce the radiation losses in kiln and reduce fuel consumption • Improvement of kiln insulation in roller kiln to reduce radiation losses • Excess air control system to maintain optimum air to fuel ratio in kiln • Replacement of inefficient centrifugal fans with energy efficient fans in spray dryer • Installation screw compressor with VFD in place of reciprocating compressor • Retrofit energy efficient motors in place of old rewinded motors • Power factor correction & harmonic mitigation at main LT incomer • Low thermal mass for reduction of kiln furniture losses in sanitaryware units • Implementation of CFD Analysis for improving heat transfer in spray dryer • High speed blunger in place of ball mill for raw material grinding process High investment: • Solar rooftop system • Solar-wind hybrid system • Hydroxy gas combustion in kiln firing in roller kiln • Installation of Energy Efficient burners in place of existing old conventional burners in kiln firing • Optimization of water consumption by installation of water softener unit • Installation of Energy Management System • Insulation improvement in Hot air generator for spray dryer • Excess air control system to maintain optimum air to fuel ratio in Hot air generator (HAG)	• Replacement of cupola furnace with EE Induction Furnace. • Replacement of normal cupola furnace with divided blast furnace. • Replacement of all old reciprocating air compressors with new energy efficient screw air compressor. • Replacement of conventional sand plant with energy efficient sand plant.

Saving Potential

Considering the energy reduction in these MSME clusters by mandating energy audits and having energy reduction targets in 3 year cycles similar to the PAT scheme will result in potential savings of 0.02 MTOE and 0.05 MTOE in moderate and ambitious scenario by FY 2031.

Scope Boundary

- Promoting and mandating the Energy audits in MSME clusters

Implementing Agency

- KREDL, Department of Industries and Commerce, District Industries Centre

Coverage

- Moderate Scenario:
  - Mandating energy audits in the clusters and energy saving targets to reduce SEC by 3% in cycle of 3 years till FY 2031
- Ambitious Scenario:
  - Mandating energy audits in the clusters and energy saving targets to reduce SEC by 4% in cycle of 3 years till FY 2031

Table 7: Energy Saving Potential – Key MSMEs Industries

Energy Saving Potential by 2031 (in MTOE)		
Cluster name	Moderate	Ambitious
Bangalore Machine Tools cluster	0.0002	0.0003
Belgaum Foundry cluster	0.0046	0.0069
Shimoga Foundry cluster	0.0067	0.0101
Malur Brick cluster	0.0094	0.0141
Gokak Jaggery cluster	0.0046	0.0159
Total	0.0256	0.0473

Table 8 Energy Saving Potential – Decarbonizing Industries and MSMEs

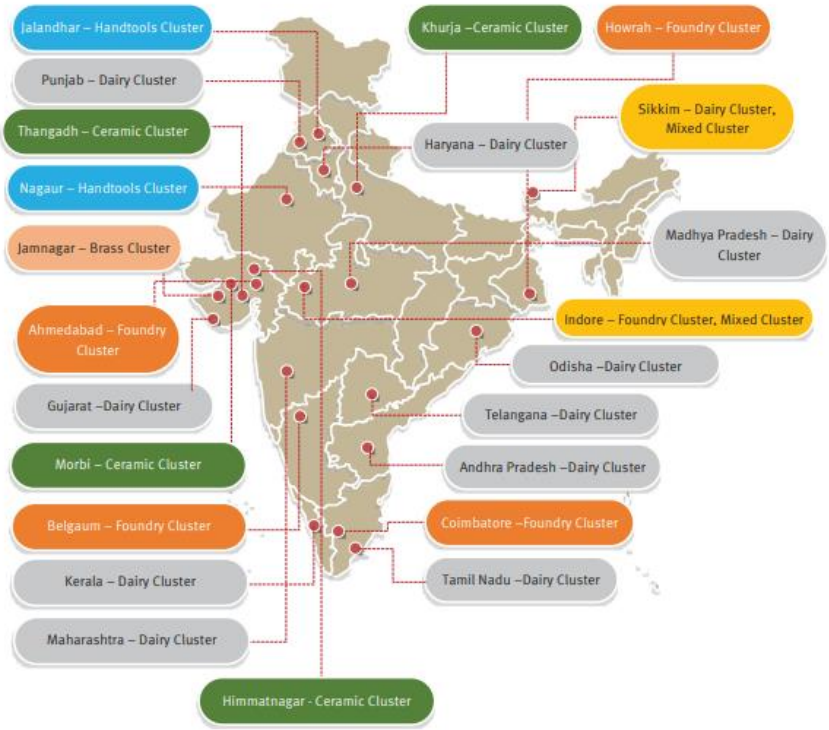
Particulars	Moderate Scenario for FY 2031	Ambitious Scenario for FY 2031

Energy Saving Potential (MTOE)	0.02	0.05
GHG Emission Reduction Potential ($MtCO_2$)	0.06	0.15

Action Plans

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

S. No.	Action Plans	Timeline
1	Sector-specific policy development for financial assistance on benchmarking the MSMEs within the clusters	Short Term
2	Subsidies for conducting energy audits and implementation of energy efficiency projects. i. The current industry policy provides interest subsidy on technology upgradation loans, same can be extended to energy efficiency projects as well. ii. The current industry policy has also discontinued the subsidies for conducting energy audits. The subsidies can be reinstated to improve energy efficiency activities among the industries.	Short Term
3	Promotion of Green Rating for Companies. (List of green rated companies is added in Annexure 13.1) i. The green rating of companies can be promoted a. It is recommended by the stakeholders to integrate with Zero Defect Zero Effect scheme	Long Term
4.	Building capacity for operational side: 1. Strategically scheduling machinery operation (Peak energy usage) 2. Well-designed machine control system (Adjust speed to match demand) 3. Efficient maintenance of equipment to reduce energy wastage or transmission loss (Proper insulation) 4. Creating linkages between agencies, Technology demonstration centres (TDC) and other R&D labs to act on the feedback from heavy Industries and provide relevant technical inputs on EE	

Case Study: Promoting energy efficiency and renewable energy in selected micro, small and medium enterprises (MSME) clusters in India[19]
The UNIDO-BEE project named "Promoting EE/RE in selected MSME Clusters in India", is to provide support to the MSME units in implementing EE & RE technologies. The major activities undertaken in the project are, 1. Organizing awareness programs and identification of potential enterprises 2. Conducting walk-through audits 3. Preparing cluster-specific EE & RE-based technology compendium and 4. Implementation support to participating units. Through this project, more than 1800 EE & RE projects were facilitated in the MSMEs which are worth INR 250 crore and have a potential for annual GHG emission reduction of about 140,000 tCO2 across more than 1500 participating units. 

4.2.3 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

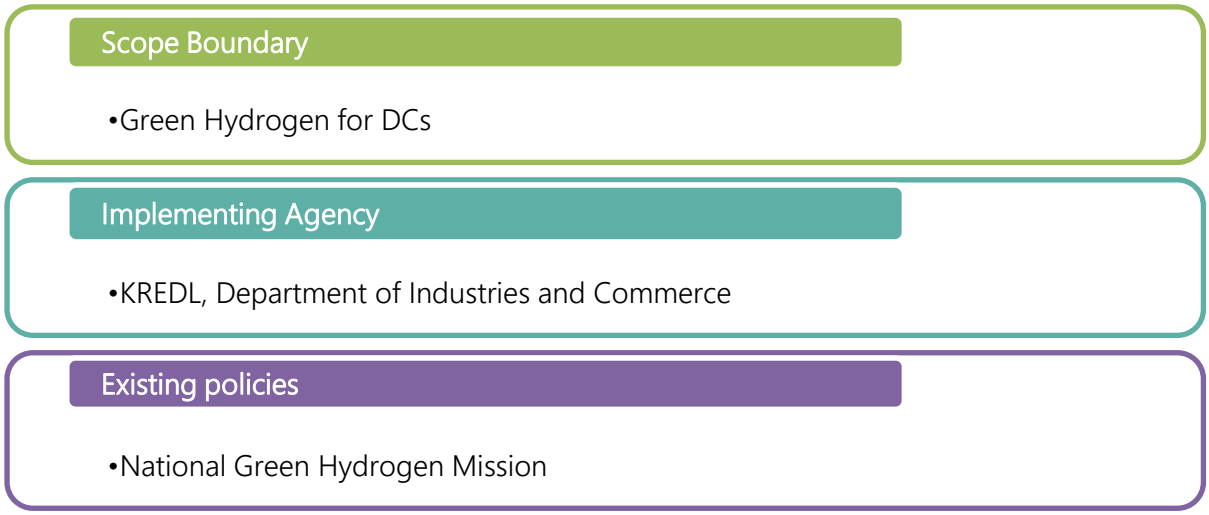
[19] Promoting energy efficiency and renewable energy in selected micro, small and medium enterprises (MSME) clusters in India (isid4india.org)

used in the electricity, the "greener" 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.

Large areas of the Karnataka have wind speeds that are well above the Indian national average, which combined with ample sunshine could allow for extensive utilisation of electrolysers, further increasing Karnataka's attractiveness for production of hydrogen and its derivatives. With more than 50% of its electricity generation being based on renewables, state can take advantage of utilizing it for generation of green hydrogen and ammonia. The state is also envisaging on creating India's first hydrogen cluster in Mangaluru.

The companies like JSW, Shell and Adani, and renewable based independent power producers like ACME, Avaada, ReNew Power, O2 and ABC Cleantech have already announced their plans for hydrogen generation in the state [20].

As Government of India also focussing on green hydrogen and its derivatives through the Green Hydrogen Mission, and with obligations on Designated Consumers (DCs) to utilize non-fossil fuel expected to come in near future, state should look at facilitating the adoption of green hydrogen in industries especially among the DCs.



Saving Potential

As per the PAT cycle 2017, the industries in the state account for about 10 MTOE. At the current growth of industry, the energy consumption by DCs by 2031 in the state is expected to reach about 15 MTOE. By considering a 10% and 7% of the fuel consumption being replaced by green hydrogen and derivatives by 2031 in ambitious and moderate scenarios respectively, the energy savings would be about 1.5 MTOE and 1 MTOE.

[20] Firms earmark $35bn for Indian green H2 in Karnataka | Argus Media

Table 9 Energy Saving Potential – Green Hydrogen

Particulars	Moderate Scenario for FY 2031	Ambitious Scenario for FY 2031
Energy Saving Potential (MTOE)	1.00	1.50
GHG Emission Reduction Potential ($MtCO_2$)	3.13	4.70

Table 10 RE generation capacity required to support the targetted green hydrogen generation

Particular	Unit	RE 2031	
		Moderate	Ambitious
Mn TOE per year	Million TOE	1	1.5
H2 generated	Mn kCal	10000000	15000000
H2 Calrofic Value	kCal/Kg	33889	33889
H2 generated	KgH2	29,50,80,999	44,26,21,500
H2 generated per kWh	KWh/Kg H2	48	48
RE-Generation	GWh	14163.88	21245.83
RE capacity required for green Hydrogen	GW	8.58	12.88

Table 11 Green Hydrogen projects in Karnataka

Project Name	Project Status	End case use	Specification
ACME Group	Proposal Cleared	Ammonia	1.2 MTPA NH3
ReNew Power	Proposal Cleared	Ammonia	1 MTPA NH3
Avaada		Ammonia	1 MTPA NH3

JSW (Green Hydrogen)		Ammonia	
ABC Cleantech	Agreement signed	Ammonia	1 MTPA NH3
Petronas	Agreement signed	Ammonia	0.5 MTPA NH3
O2 Power	Agreement signed	Ammonia	

Policy Type	Action Plan	Timeline
Ease of doing business	• Single window clearance platform would support new green hydrogen/ammonia investment projects and existing units to support seamless expansion • Schemes for promoting investment for green industrial parks • Ease of doing renewable energy open access transactions	Short Term
Advancing Green H2 Ammonia ecosystem	• Infrastructure and manufacturing capacity expansion plan for green hydrogen/ammonia to ensure long-term demand and support • Develop green hydrogen/ammonia industrial clusters/hubs/valleys in the state • Procurement of Renewable Energy	Long Term
Fiscal Incentive	• Land and water incentives • Infrastructure incentive (support for Capex) • Operational Incentive	Short Term
Financing	• Green H2 ecosystem support • Financial support for technology advancement and adoption, such as electrolysers, carbon dioxide recovery units, etc., to promote a green hydrogen/ammonia ecosystem	Short Term

4.3 Energy saving potential & monitoring mechanism

Energy saving potential of the industry sector is 3.29 MTOE and 4.68 MTOE for moderate and ambitious scenarios FY2031 respectively.

Table 12 Summary of energy saving from the strategies – Industry Sector

Action Plan	Energy Savings in FY 2031 under moderate scenario (Mtoe)	Energy Savings in FY 2031 under ambitious scenario (Mtoe)
Deepening and Widening of PAT	2.27	3.14
Decarbonising Industries and MSMEs	0.02	0.05
Green Hydrogen for DCs	1.00	1.50
Total	3.29	4.68

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

Policy Type	Monitoring Mechanism
Regulatory	The Karnataka State Electricity Regulatory Commission (KERC) is responsible for regulating the power sector in the state, including the implementation of energy policies for industries. The KERC can monitor compliance with these policies through inspections, audits, and other enforcement measures.
Industry associations	Industry associations can play a key role in monitoring energy policies for their members.
SDA (State Designated Agency)	KREDL can monitor industry compliance with energy policies through data collection and analysis, as well as through partnerships with industry associations and other stakeholders.
Audits and energy efficiency interventions	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. Promoting the implementation of energy efficiency projects in the industries through ESCO model
Reporting	Mandatory reporting requirements or through voluntary reporting programs that incentivize companies to disclose their energy use and emissions data.

5 FOCUS SECTOR 2: TRANSPORT

5.1 Overview

The oil consumption in transport sector of Karnataka is shown in figure 16. The equivalent oil consumption has shown an increasing trend from 2015 to 2020. Oil equivalent consumption grew from 5.18 MTOE in 2015 to 7.09 MTOE in 2020 with CAGR growth of 6.47% over the last five years. Transport sector plays a pivotal role in augmenting the economic growth of a country owing to its role in connecting countries, states, cites, and so on, and fostering inter and intra-regional trade. However, greater passenger mobility and freight movement are anticipated to have far-reaching consequences in terms of increased energy consumption, greenhouse gas (GHG) emissions, and local pollution.

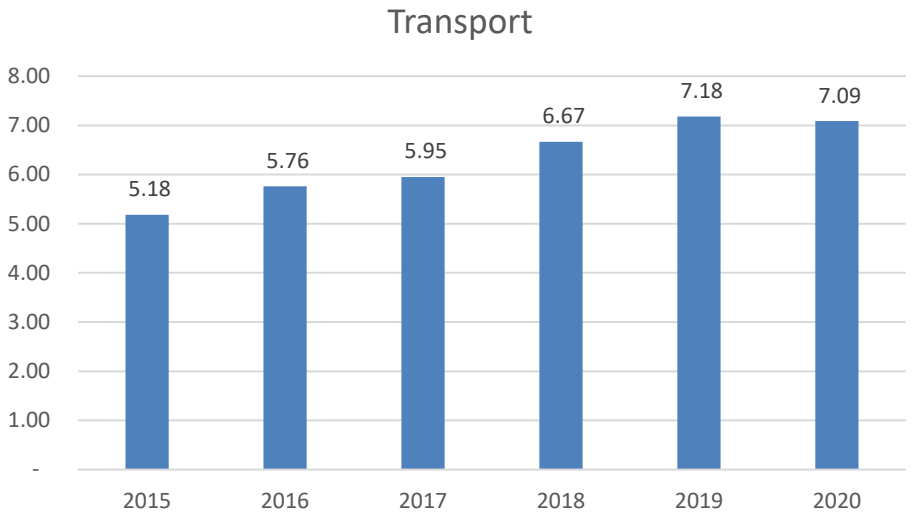


Figure 18 Transport sector fuel (oil) consumption (MTOE)

Few Energy Efficiency measures in Transport sectors:

- Electrification in transport sectors-Like railway electrification & electrification of road transport
- Increased use of alternative fuels-like increased uses of bio-ethanol blending in petrol & diesel
- Increased share of public transport for passenger movement
- Increased fuel efficiency for vehicle category
- Management of traffic which indirectly reduces the consumption of fuel
- Training of officials on Energy Efficiency (EE)

5.2 Energy efficiency strategies in the transport sector

5.2.1 Strategy: Transition of conventional 2W, 3W, 4-W, Goods, Vehicles, Heavy Vehicles, Buses into EV fleet by FY 2031 in all cities

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.

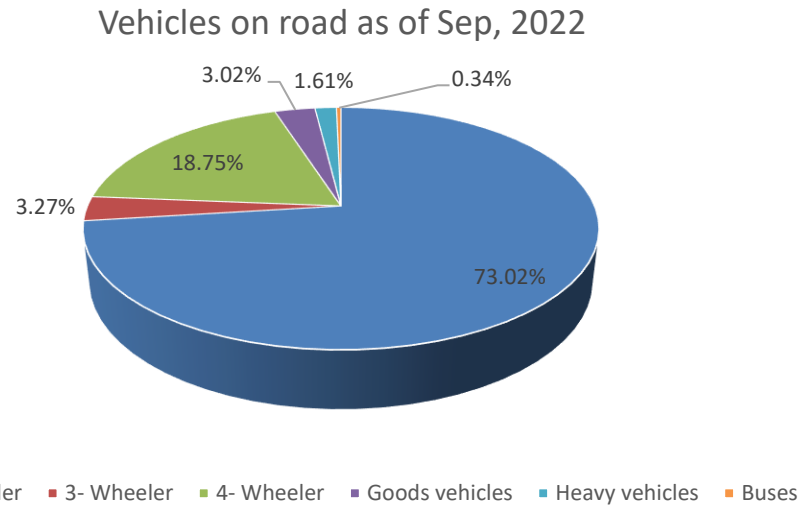


Figure 19 Classification of vehicles as of Sep 2022

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, Karnataka still has a long way to go to transition from ICE vehicles to electric vehicles, with only 0.54 % of registered vehicles being electric.

Table 13 Fuel Wise Vehicle Categories as of Sep 2022

Vehicle Category	Petrol	Diesel	Electric
2- Wheeler	2,05,93,541	27,615	1,34,707
3- Wheeler	5,87,372	3,33,959	7,278
4- Wheeler	27,76,193	25,40,003	11,843
Goods vehicles	33,688	8,24,469	137
Heavy vehicles	5,490	4,50,888	11
Buses	541	95,409	371
Total	2,39,96,825	42,72,343	1,54,347

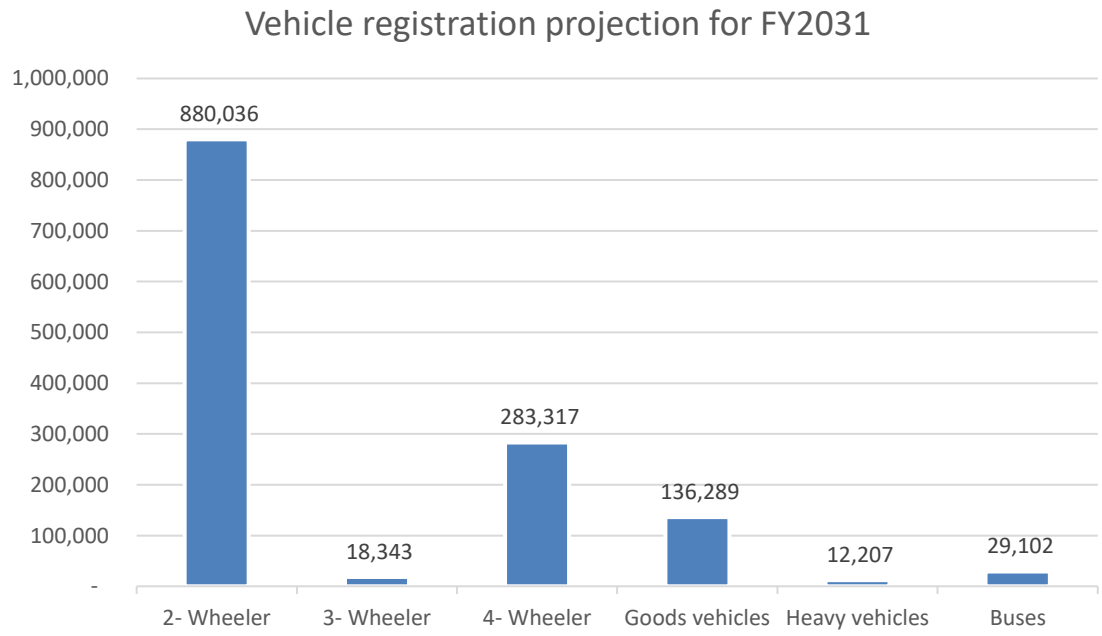


Figure 20 Projected number of vehicles for FY2031

The strategy and its implementation are explained below.

Scope Boundary

- Two-wheelers, three-wheelers, four-wheelers, bus and heavy vehicles.
- Electric Vehicle charging infrastructure

Implementing Agency

- State Transport Department including BMTC,KSRTC, RTO and BESCOM, Urban Developement Agencies

Current Policy In Place

- Karnataka Electric Vehicles Policy 2017

Saving Potential

By increasing the share of EVs in the vehicle stock of Karnataka with *24* lakh EVs in moderate scenario and *41* Lakh EVs in ambitious scenario by 2031, additionally *70k* charging stations and battery swapping infrastructure in moderate scenario and *115k* charging stations and battery swapping infrastructure in ambitious scenario by 2031, with Level-1, Level-2 and Level-3 (DC) chargers across all cities.

The below figures shows the EV sales targets which translate into the energy saving potential in the transport sector through electrification of road transport

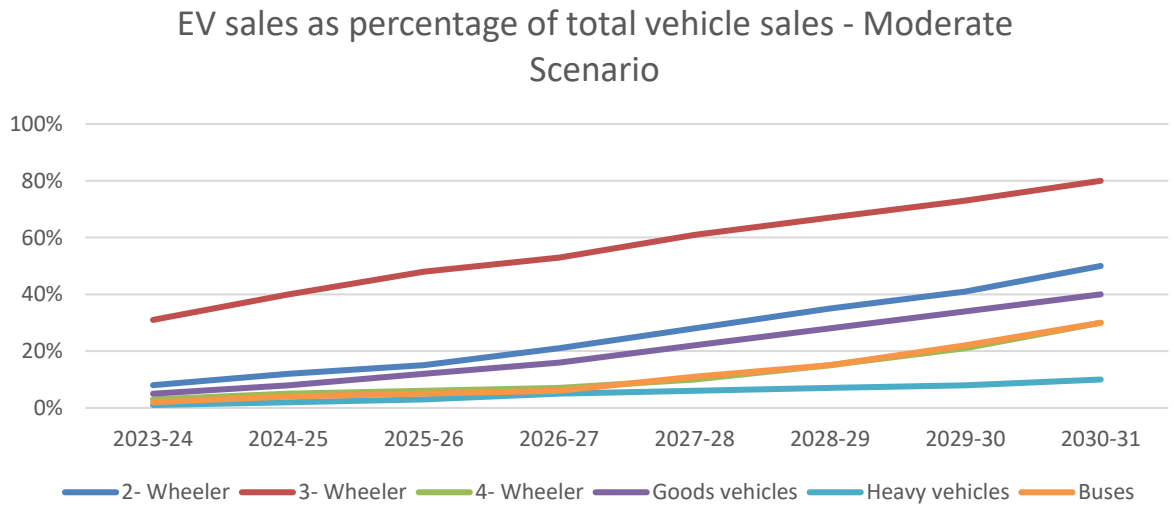


Figure 21 EV sales as percentage of total vehicle sales – Moderate Scenario

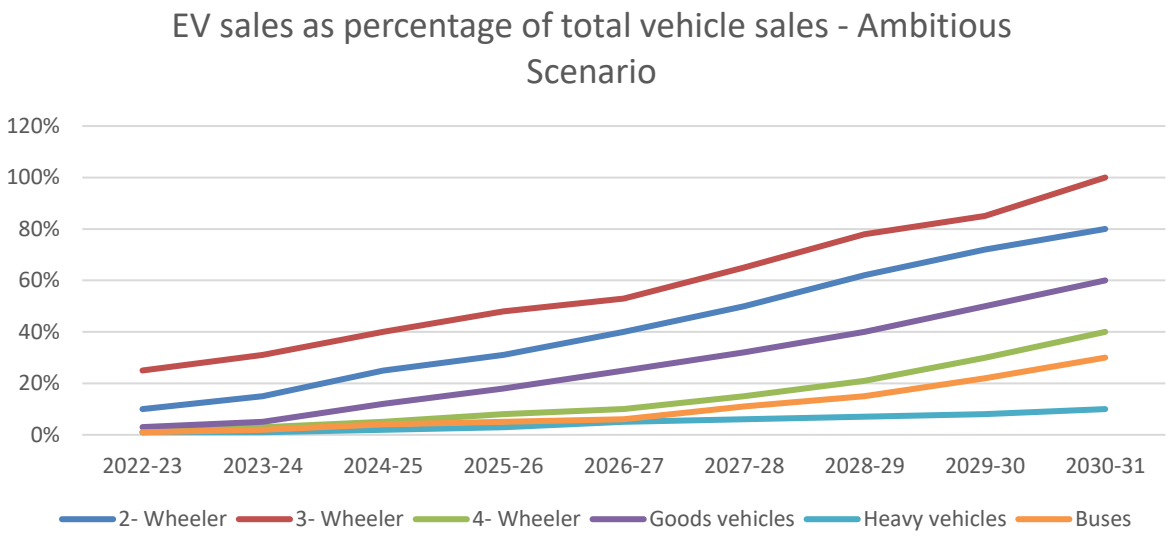


Figure 22 EV sales as percentage of total vehicle sales – Ambitious Scenario

Table 14 Energy Saving Potential – Electrification of road transport

Particulars	Moderate Scenario	Ambitious Scenario
Energy Saving Potential (MTOE)	2.23	3.30
GHG Emission Reduction Potential (MtCO2)	6.99	10.34

Action Plans

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

Policy Type	Action Plan	Timeline
Awareness & Capacity Building	1. Creating awareness/ wide publicity through social media, other communications regarding prevalent subsidy system, Govt. schemes/ Incentives for purchasing EV. 2. Awareness on Standard & Labelling Program for Tyres	Short Term
	3. Awareness on Energy Efficiency Program on High Energy Lithium-Ion Traction Battery Packs and Systems. 4. Creating awareness/ wide publicity through social media, other communications regarding prevalent subsidy system, Govt. schemes/ Incentives for purchasing EV	Short Term
Technological Intervention	1. Combined Charging Systems (CCS Standard)	Short Term
	2. Charging stations based on open access	Long Term

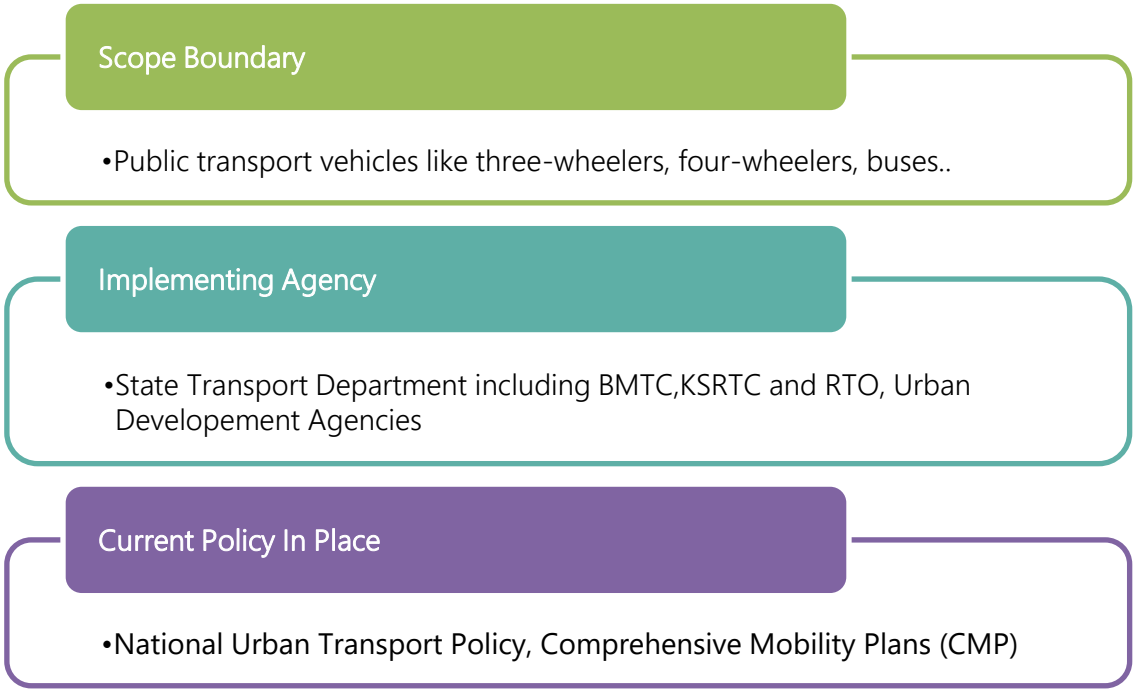
	3. Pilot projects on Hydrogen Fuel Cell Vehicles	Long Term
	4. Pilot projects on Battery Swapping stations in all model cities	Long Term
Incentive	5. Incentivising purchase of these EV through Subsidy, Tax/GST rebate.	Short Term
Safety	6. Inclusion of guidelines for judicious disposal of batteries/other parts of EV is also of higher importance to avoid negligent/ unsafe disposal	Short Term

5.2.2 Strategy: Adequate Public Transport

Karnataka has an extensive public transportation system that includes buses, trains, and auto-rickshaws. The state-owned Karnataka State Road Transport Corporation operates buses that connect various cities and towns within the state, as well as neighbouring states. KSRTC has a fleet of over 8113 vehicles.

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

The strategy and its implementation are explained below.



Saving Potential

According to the Ministry of Urban Development report[21] 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

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

congestion in the cities resulting in slow speeds and thus higher emissions. The public transport system is the most effective way to reduce the number of vehicles as well as the total emissions on the road. This is also the only way to a more equitable allocation of road space with people, rather than vehicles.

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

The energy saving potential for Karnataka is estimated by categorizing major urban agglomerates of the state based on the population, thus arriving on total fuel consumption per day by vehicles with and without public transport. The table below shows the categorization of urban agglomerates and corresponding fuel consumption.

Table 15 Energy Saving Potential based on population for Karnataka.

			Fuel consumption (KL per day)		**Savings potential in State through facilitating adequate PT by FY 2031**	
Category	**Population**	**No. of urban agglomerations**	**Without Adequate PT**	**With Adequate PT**	**KL/day**	**MTOE/year**
Cat-1	<5 Lakhs	18	18	17	18	0.01
Cat-2	5-10 Lakhs	5	559	502	285	0.09
Cat-3	10-20 Lakhs	2	2617	2112	1010	0.33
Cat-4	20-40 Lakhs	0	2802	2099	0	0.00
Cat-5	40-80 Lakhs	0	37164	38395	0	0.00
Cat-6	>80 Lakhs	1	38395	37163	1232	0.40

0.58 MTOE savings potential is estimated in moderate scenario and 0.83 MTOE under ambitious scenario by considering 70% of the total saving potential and 100% of the saving potential respectively.

Table 16 Energy Saving Potential – Facilitating adequate public transportation

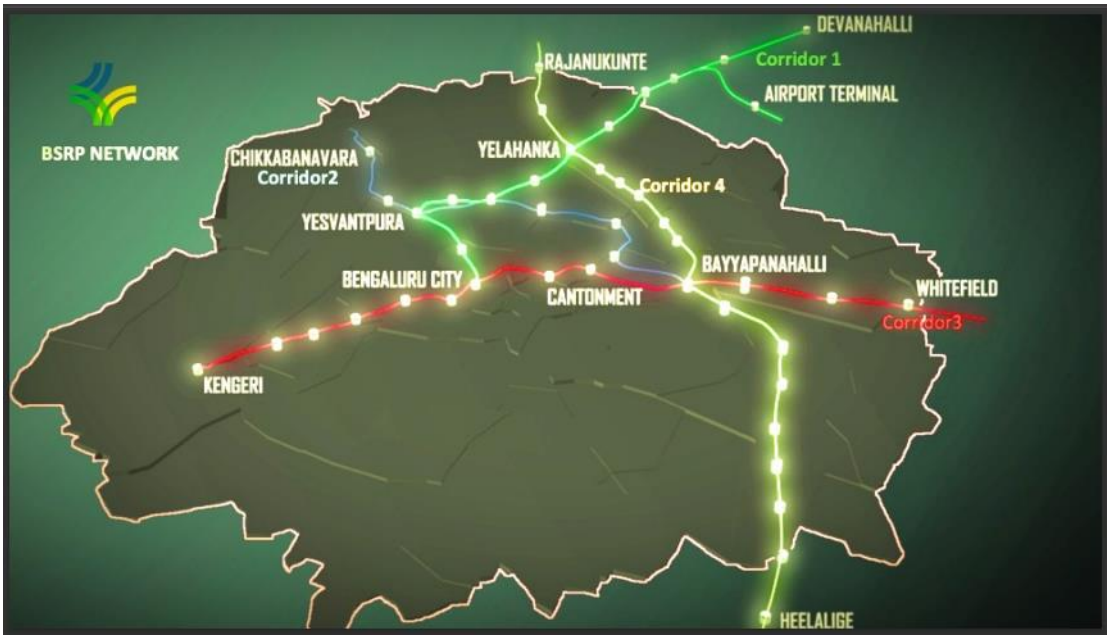
Particulars	Moderate Scenario	Ambitious Scenario
Energy Saving Potential (MTOE)	0.58	0.83
GHG Emission Reduction Potential ($MtCO_2$)	1.82	2.61

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

Policy Type/Scheme/Action	Action Plan	Timeline
Capacity Building	Mandate major urban agglomerates to have a Comprehensive Mobility Plan (CMP)	Short Term
	Conduct integrated public transport studies for major urban agglomerates	Long Term
Infrastructure Improvement	World class public transport system like 'Metro' and user friendly public transport which encourages people from all strata of society to use public transport.	Long Term
Subsidies & Technology intervention	Incentivize regular travelers for using public transport	Short Term
	Facilitate last mile public transport through electric 3-wheelers	Long Term

Case Study: Bengaluru Suburban Rail Project

K-RIDE, a joint venture of the Government of Karnataka & Ministry of Railways - are currently developing the Bangalore Suburban Rail Project (BSRP) on the existing rail tracks.



- Key objective is the urban to rural connectivity by delivering the worldclass rail infrastructure while also integrating multiple modes of transport.

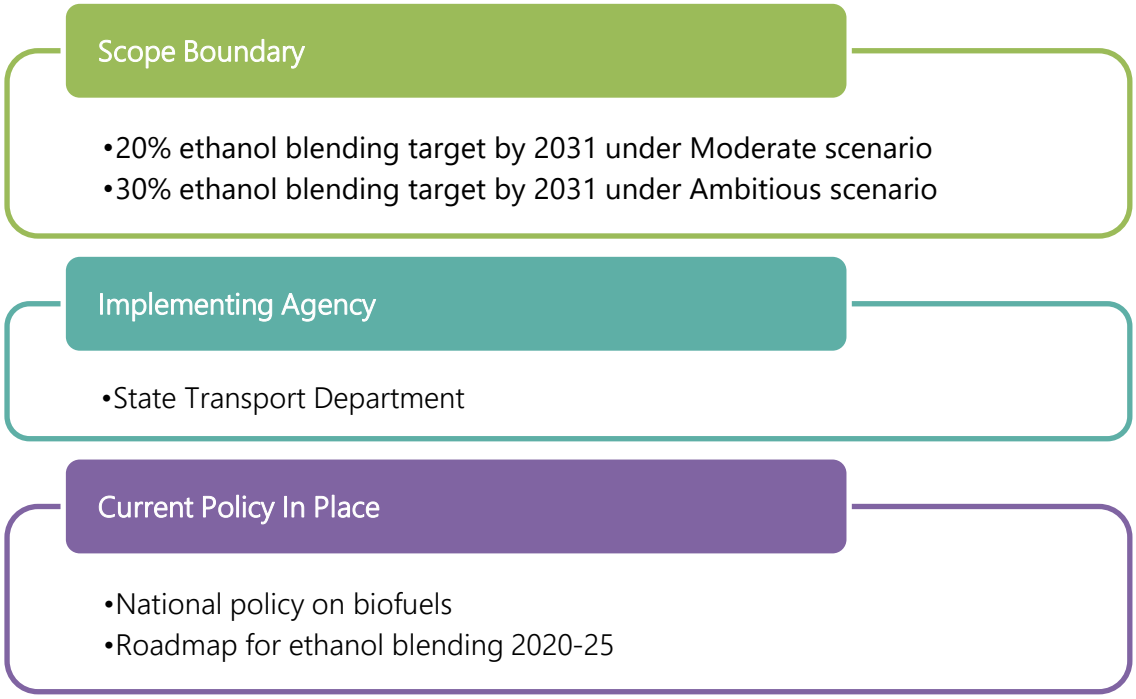
- Project will enhance rural-urban connectivity, ease traffic congestion and provide a cleaner mobility solution to about 10 lakh daily commuters thereby reducing pollution and carbon footprint
- All the 57 stations that are currently operating are either ECBC+ or IGBC certified with several green building elements implemented.
- The stations also have access to the EV charging infrastructure.

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

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

Moreover, Karnataka is an agricultural state and third largest producer of sugarcane, which is a key feedstock for ethanol production. The government has also notified a decision to allow sugar mills to manufacture ethanol directly from sugarcane juice or an intermediate product called B-molasses.

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



Saving Potential

The saving potential is estimated based on following assumptions.

Blending of fuel	FY2026	FY 2031

	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)	731	1,462	877	1,755
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)	**0.64**	**1.29**	**0.77**	**1.54**

Table 17: Energy Saving Potential – Ethanol Blended Petrol

Particulars	Moderate Scenario for 2031	Ambitious Scenario for 2031
Energy Saving Potential (MTOE)	0.77	1.54
GHG Emission Reduction Potential ($MtCO_2$)	2.41	4.72

Action Plans

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

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

5.3 Energy saving potential & monitoring mechanism

Energy saving potential of the transport sector is 3.58 MTOE and 5.67 MTOE for moderate and ambitious scenarios FY 2031 respectively as seen fromTable 18.

Table 18 Summary of energy saving from the strategies – Transport sector

Strategy	Energy Savings in FY 2031 under moderate scenario (Mtoe)	Energy Savings in FY 2031 under ambitious scenario (Mtoe)
Increased penetration of electric 2W, 3W, 4-W, Goods, Vehicles, Heavy Vehicles, Buses into EV fleet by FY 2031 in all cities	2.23	3.30
Facilitating adequate public transport	0.58	0.83
Improving supply of ethanol for Ethanol Blended Petrol (EBP)	0.77	1.54
Total	3.58	5.67

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

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

6 FOCUS SECTOR 3: BUILDINGS

6.1 Overview

The building sector is third largest consumer of electricity consumption in state and is one of the leading contributors to greenhouse gas emissions. Having regard to the fact that, the rate of growth in commercial building sector is amongst the highest and needs to be moderated in its energy consumption. In Karnataka Building sector (residential and commercial) consumed approximately 28.32% of the total energy as of FY19-20, making Building sector as third largest energy consuming sector in the state. As shown in below figure Karnataka's residential sector energy consumption grew at the rate of CAGR 5.54% while commercial sector's energy consumption grew by 1.99% CAGR over the last five years.

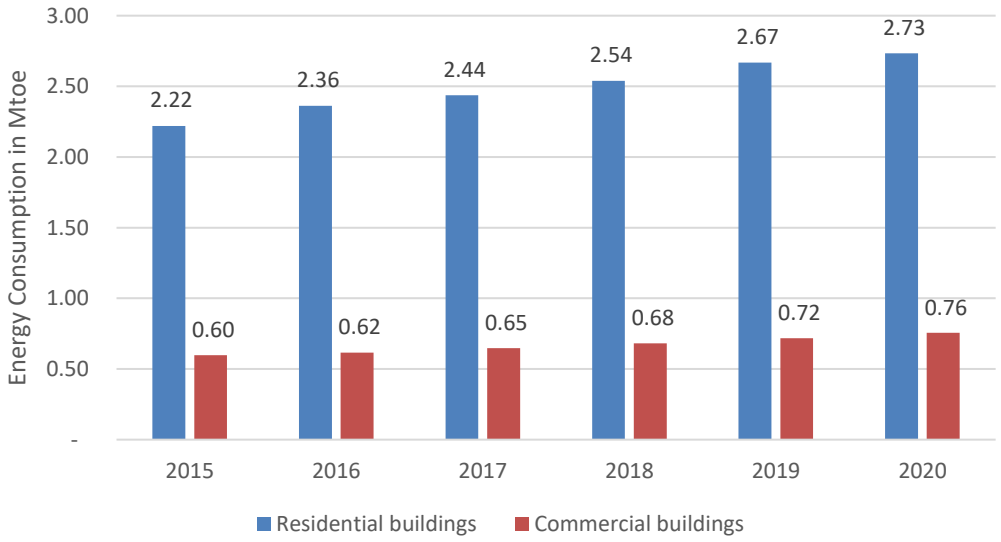


Figure 23 Karnataka Building sector energy consumption trend

Karnataka's real estate sector is expanding, and it contributes significantly to India's growing GDP. The state's property resale value has been boosted by a thriving IT sector, as well as other businesses such as exports and mining.

6.2 Energy efficiency strategies in the buildings sector

6.2.1 Strategy: Implementation of ENS

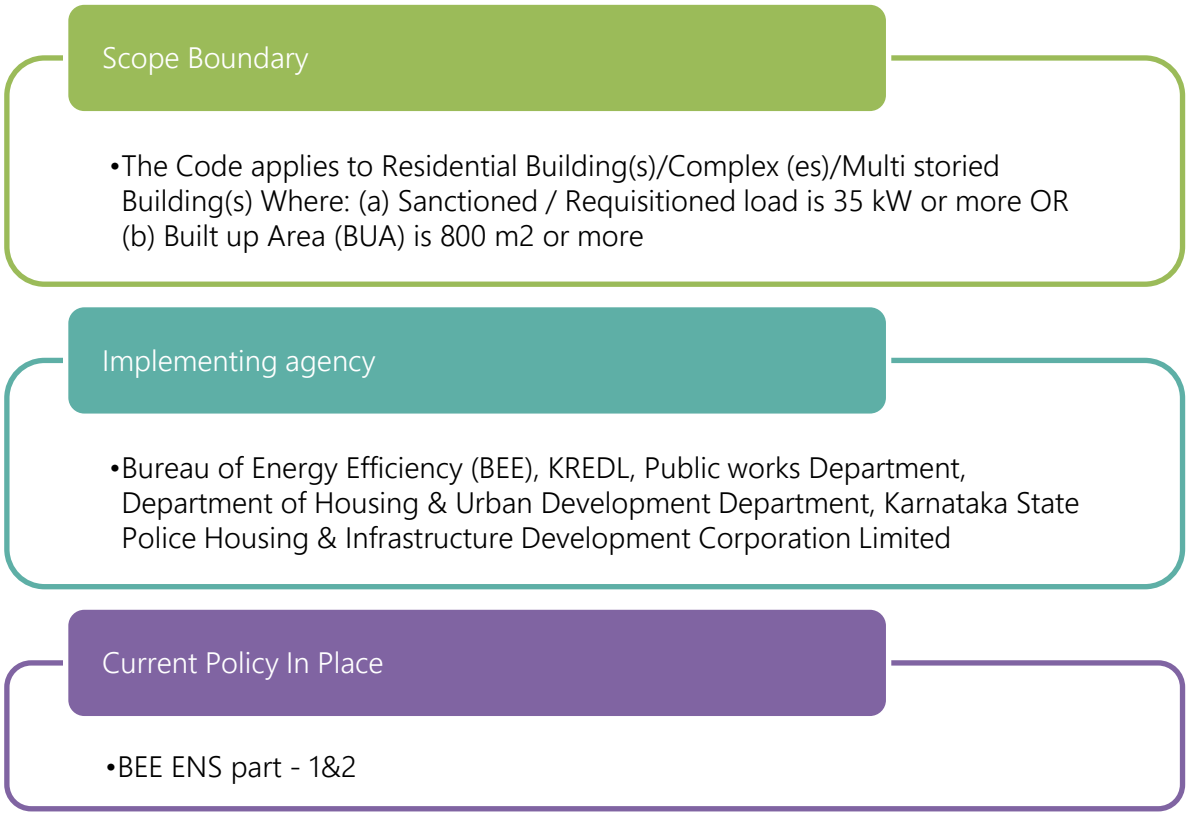
In the recent amendment to the Energy Conservation (EC) Act in 2022, a unified code called the "Energy Conservation and Sustainable Building Code" (ECSBC) has been introduced. This new code will include both commercial and residential buildings. Until the implementation of

ECSBC in State/UT, the existing Energy Conservation Building Code (ECBC) and Eco-Niwas Samhita (ENS) will be referred to as ECSBC.

Eco Niwas Samhita (ENS) is a program launched by the Ministry of Power to promote energy efficiency in residential buildings. The policy provides guidelines and specifications for energy-efficient building design, construction, and operation. The policy covers various aspects of building design and construction such as,

i. Building Envelope: orientation, insulation, Glazing, roof
ii. electro-mechanical aspects such as lighting, controls, ventilation, air conditioning and renewable energy systems.
iii. Passive Design regards the particular way to construct a building using the natural movement of heat and air, passive solar gain and cooling to maintain a good internal comfort

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



According to the housing Census 2011 of Karnataka state, there nearly 179 lakh establishments which are further categorized into residence, offices, shops, schools, hotels, hospitals, factories, etc in both urban and rural areas of the state. Total number of residential houses in urban areas were projected to 2031 as shown below:

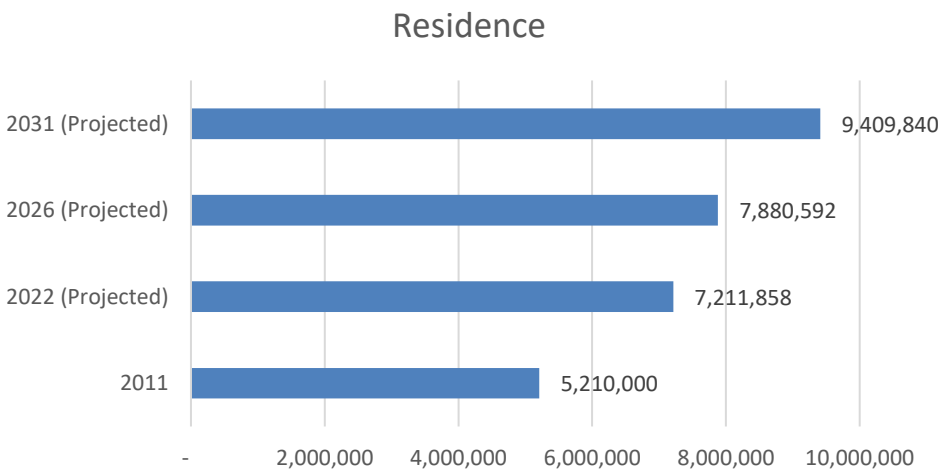


Figure 24 Projected number of households for FY2031

Energy Saving Potential

The saving potential for FY2031 is 0.004 & 0.011 MTOE which is estimated by calculating energy saving per household (kWh/household) which is then multiplied with the projected households for FY2026 and FY2031 for both moderate and ambitious scenarios. Similarly, the GHG saving potential for this strategy is 0.01 & 0.03 $MtCO_2$.

Table 19 Energy Saving Potential – Implementation of Eco Niwas Samhita

Particulars	Moderate Scenario for FY 2031	Ambitious Scenario for FY 2031
Energy Saving Potential (MTOE)	0.004	0.011
GHG Emission Reduction Potential ($MtCO_2$)	0.01	0.03

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

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

Subsidy/Incentive	1. Fiscal incentives or financial instruments to lower capex for improving house thermal performance to ENS code levels so that optimum (not too much) air-conditioning is installed[22].	Short Term
Technology Intervention	1. Development and maintenance of ENS compliance portal.	Long Term
	2. Pilot project investment for ENS as case studies.	Long Term
Mandate	1. The mandatory adoption and implementation of ENS in the State	Long Term

6.2.2 Strategy: Deepening of Standard & Labelling Programme

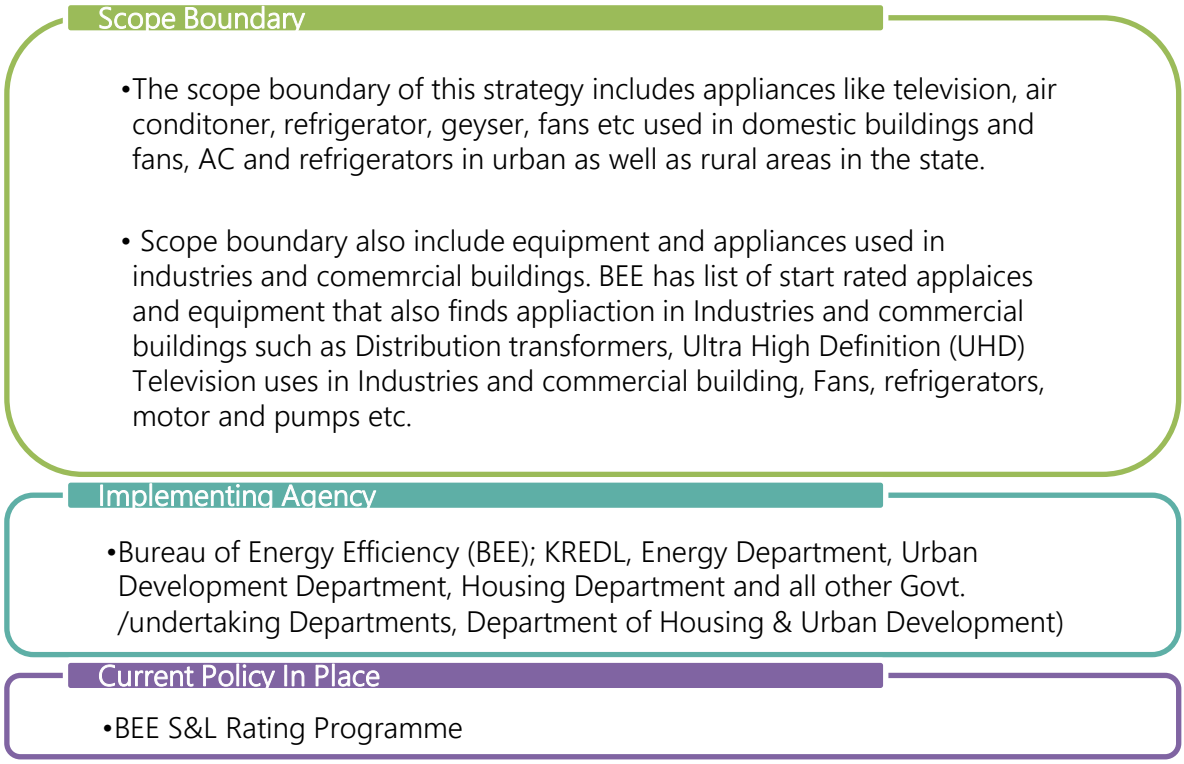
The Bureau of Energy Efficiency (BEE) in India has implemented a standard and labelling program to promote the use of energy-efficient appliances. Under this program, old and inefficient appliances are encouraged to be replaced with new ones that meet the minimum energy performance standards (MEPS) set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

The labels help consumers make informed choices, thereby reducing energy consumption and costs. In the context of domestic buildings, the S&L Programme can significantly reduce energy consumption by promoting the use of energy-efficient appliances, lighting, and other building equipment/systems. This program will in turn has a potential to capture the energy savings in commercial buildings as well.

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

The implementation of the strategy is explained below:

[22] https://beeindia.gov.in/sites/default/files/Eco%20Niwas%20Samhita%202021%20Part-%202.pdf



Saving Potential

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

Table 20 Estimated appliances addition and energy saving potential – Residential buildings

Appliance	Estimated Appliance addition between FY2022-31	Energy saving in moderate scenario (Mtoe)	Energy saving in ambitious scenario (Mtoe)
Fan	207 lakhs	0.07	0.12
AC	83 lakhs	0.07	0.11
Refrigerator	41 lakhs	0.03	0.05
Washing Machine	16 lakhs	0.002	0.003
Television	123 lakhs	0.003	0.006
Total	470 lakhs	0.175	0.289

The above-mentioned standards and labelling program can also be aggressively implemented for commercial buildings. Therefore, the relevant appliances like Pumps, Motors, Fans, ACs and Refrigerators in the commercial buildings can also be considered for potential energy savings

in the state. The table below shows the estimated appliances additions and corresponding energy saving potential in moderate and ambitious scenarios.

Table 21 Estimated appliances addition and energy saving potential – Commercial buildings

Appliance	Estimated Appliance addition between FY2022-31	Energy saving in moderate scenario (Mtoe)	Energy saving in ambitious scenario (Mtoe)
Fan	26 lakhs	0.01	0.02
AC	11 lakhs	0.01	0.02
Refrigerator	2 lakhs	0.002	0.003
Total	39 lakhs	0.022	0.043

By considering energy efficient appliances adoption for all the appliances additions between 2022-31 as shown in the table above1, 0.022 & 0.043 MTOE saving potential can be achieved in moderate and ambitious scenario.

Table 22 Energy Saving Potential – Deepening of Standards & Labelling program

Particulars	Moderate Scenario for FY 2031	Ambitious Scenario for FY 2031
Energy Saving Potential (MTOE)	0.022	0.043
GHG Emission Reduction Potential ($MtCO_2$)	0.069	0.135

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 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 a. The inclusion of text modules on energy conservation for 6th to 10th classes into books in the school curriculum	
	2. Energy Efficient Technology Workshops for capacity building of Technology Suppliers and Professionals	Short Term
	3. Home Energy Auditor Training	Short Term
	4. Mandating the adoption of S&L appliance/systems in the public departments of both Commercial & Residential quarters 5. Creating awareness through Ads/programmes via TV/Radio/other popular E-media regarding prudent use of power.	Short Term
Scheme for promotion of star rated appliances and equipment	1. For promotion of usage of star rated appliances, BLDC fans etc, program similar to UJALA may be introduced where in the consumers are encouraged to purchase star rated appliances at subsidized rates 2. Policy framework for mandating production of only star rated equipment over a period of time	Short Term

	and phasing out all energy efficient devices	
Subsidy	1. DSM Schemes through DISCOM for energy efficient appliances such as BLDC fans, AC 2. subsidised distribution of energy efficient LEDs	Short Term
	3. Production Linked Incentive Scheme (PLI) scheme for energy efficient appliances manufacturing	Short Term
Technology Intervention	1. Installation of sensor based / Automated switches in upcoming building projects 2. Upgrading/replacing power consuming lighting 3. Auto switch-over to low-wattage lighting system whenever necessary rather than same-wattage lighting in all places (Different MCB controls) 4. Installation of Timer/Auto-off mechanism	Short Term

6.2.3 Strategy: Implementation of ECSBC, ECBC and Energy audit for commercial and public buildings

The implementation of the strategy is explained below:

Scope Boundary

- The scope boundary of this strategy covers Commercial and Government Buildings in the state

Implementing Agency

- Bureau of Energy Efficiency, KREDL, Public works Department, Rural Development and Panchayat Raj, Architect Department, Urban Development Department including BBMP, DMA, TCP, and BDA

Methodology Adopted

- In moderate scenario, it is assumed 5% buildings will have energy audit and in ambitious scenario, it is assumed 10% of buildings will get energy audit. It is assumed that energy audit recommendations implementation will lead to 30% savings

Saving Potential

The moderate scenario assumes a 5% implementation rate of ECBC/ECBC and energy audits in buildings, achieving potential savings of 0.008 MTOE based on a 30% reduction from implemented audit recommendations. An ambitious scenario considers a 10% implementation rate, leading to 0.016 MTOE energy savings.

Table 23 Energy Saving Potential – Energy audit for commercial and public buildings

Particulars	Moderate Scenario	Ambitious Scenario
Energy Saving Potential (MTOE)	0.008	0.016
GHG Emission Reduction Potential ($MtCO_2$)	0.02	0.05

Action Plans

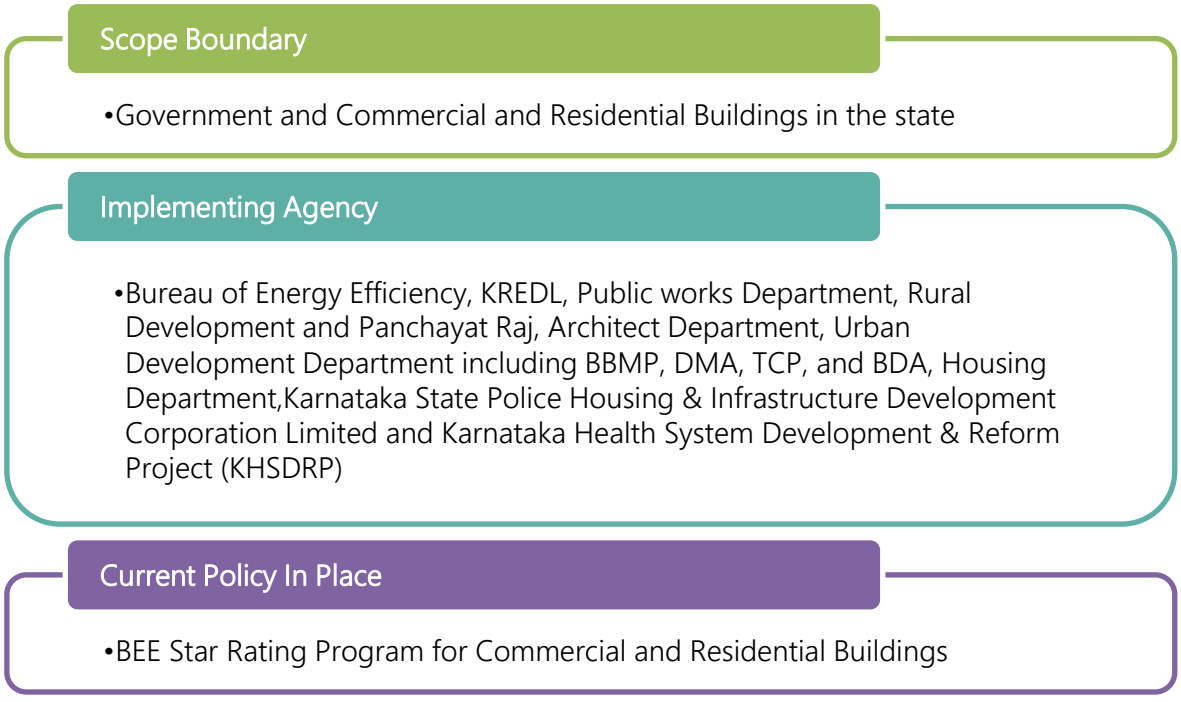
This section describes several action plans that can be implemented across the state for this strategy.

Sr. No.	Action Plan	Timeline
1)	Implementation of ECBC/ECSBC buildings in the State.	Short Term
2)	Issue directives to all government departments to conduct mandatory energy audits and target to achieve BEE Star Rating for public buildings more than 100kW connected load	Short Term
3)	Periodic energy audits for commercial buildings on load basis and incentives on achieving star rating for buildings	Long Term
4)	Capacity Building of Architects & Building Professionals and Developers	Short Term
5)	Market Outreach for ECSBC compliant products, radio jingles, social media awareness.	Short Term
6)	Transformation of iconic government buildings to Net-Zero (10 no.s)	Long Term
7)	Mandatory minimum set point of 24 degree for air conditioners in all government buildings	Long Term
8)	To avoid unnecessary usage of power; • Installation of sensor based / Automated switches in upcoming building projects • Upgrading/replacing power consuming lighting • Door access card for auto-switch off when not in usage • Creating awareness through Ads/programmes via TV/Radio/other popular E-media regarding prudent use of power in the interest of nation in 'Free Govt.	
9)	Development of ECSBC/ECBC compliance portal	Short Term

6.2.4 Strategy: BEE Star Rating of Buildings, Green buildings (Commercial and residential buildings)

This strategy includes BEE star rating for commercial and residential buildings and also green buildings. BEE star rating of residential building program aims to develop national energy efficiency label for residential buildings to enhance energy efficiency in the residential sector. In residential building segment program is applicable for all single and multiple dwelling unit in the country for residential purpose[23]. In commercial building segment presently, four typologies of the buildings are covered in the scope viz. Office buildings, BPO, Hospitals, and shopping malls. The buildings having connected loads 100kW and above are considered for the BEE star rating scheme[24].

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. This rating system also evaluates the other sustainability aspects like water conservation, loss of habitat, any harm to the environment during the construction etc. Green-rated Buildings comply with ECBC and are at least 20 - 30% more energy efficient than conventional buildings.



[23] https://beeindia.gov.in/sites/default/files/Labelling%20Flyer.pdf

[24]https://beeindia.gov.in/en/programmesenergy-efficiency-in-buildings/star-rating-for-buildings#:~:text=In%20this%20program%2C%20buildings%20are,covered%20in%20the%20scope%20viz.

Saving Potential

As per the housing census data, commercial buildings are further divided into offices, schools, hotels, lodges, factories, etc. The total number for each of the category in the state is projected to FY2026 and FY2031 and 1% penetration for star rating of buildings is assumed in moderate scenario and 2% for star rating of buildings in ambitious scenario for both FY2026 and FY2031

Table 24 Projection of commercial buildings by category - 2026 and 2031

No of Buildings Projections	Unit	2022 (Projected)	FY2026 (Projected)	FY2031 (Projected)
Shop, offices	Nos	8,48,406	8,81,286	9,50,918
School colleges	Nos	63,228	65,679	70,868
Factory	Nos	1,32,204	1,37,328	1,48,178

By considering star rating of the buildings, 0.005 & 0.021 MTOE saving potential can be achieved in moderate and ambitious scenario.

Table 25 Energy Saving Potential – Star rating of buildings and green rating of buildings

Particulars	Moderate Scenario for FY 2031	Ambitious Scenario for FY 2031
Energy Saving Potential (MTOE)	0.005	0.021
GHG Emission Reduction Potential ($MtCO_2$)	0.02	0.07

Action Plans

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

Policy Type	Action Plan	Timeline
Awareness & Capacity Building	1. Encouraging Green Education a. The inclusion of text modules on energy conservation for 6th to 10th classes into books in the school curriculum b. Create special branches in Engineering, and degree courses	Short Term
Facilitate eligible for buildings to obtain BEE star	1. Facilitate eligible buildings to obtain BEE star rating and green rating through information sharing on benefits of certification like environmental resilience,	Short Term

rating and green rating	energy security and sustainable living through web portal and webinars. 2. Mandaing Govt buildings to go for-BEE star rating/green building certification- Issue directives to all government departments to conduct comprehensive energy audits of their buildings. Set specific targets for achieving BEE (Bureau of Energy Efficiency) Star Ratings for government-owned buildings. This will serve as a leading example for energy efficiency in the state.	
Subsidy/Incentive	1. Incentives (Rebate in property Tax Additional FAR, reduction in stamp duty and faster environmental clearance for upcoming, green-rated building projects), BEE Star rated buildings 2. Transformation of government buildings to Net-Zero 3. Incentive policy support to encourage net zero buildings	Long Term

6.2.5 Strategy: Promotion of energy efficient data centers

The state has a target to have more than 200 MW capacity data centers by 2025. To sustainably achieve the target following recommendations are made. The guidelines for data centers should also focus on creating efficient distributed Content Delivery Networks (CDNs)

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

Scope Boundary

- DCs in Major cities of Karnataka, distributed CDNs

Implementing Agency

- Bureau of Energy Efficiency; KREDL; Department of Electronics Information Technology Biotechnology and Science & Technology, Urban Developement Department

Current Policy In Place

- KA Data Center Policy 2022-27

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

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

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

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

Electrical system/Power:

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

Critical cooling system:

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

IT peripherals:

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

Operation and Maintenance:

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

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

Saving Potential

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

By considering this strategy, 0.08 & 0.12 MTOE saving potential can be achieved in moderate and ambitious scenario.

Table 26 Energy Saving Potential – Promotion of energy efficient data centers

Particulars	Moderate Scenario for FY 2031	Ambitious Scenario for FY 2031
Energy Saving Potential (MTOE)	0.08	0.12
GHG Emission Reduction Potential ($MtCO_2$)	0.25	0.38

Action Plans

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

Policy Type	Action Plan	Timeline
Environment	1. Fast tracking environment clearance	Short Term
Subsidy	1. Concession in state GST for procuring energy intensive equipment such as chillers, transformers and UPS systems.	Long Term

	2. Reduction in property tax and concessional power tariff 3. Exempt, green-rated data centers for wheeling green power – there should be no restriction on usage of on-site and off-site green power (i.e. green power procurement within and outside the state).	

6.3 Energy saving potential & monitoring mechanism

Energy saving potential of the buildings is 0.266 MTOE and 0.437 MTOE for moderate and ambitious scenarios FY2031 respectively as seen from Table 27.

Table 27 Summary of energy saving from the strategies – Commercial and residential buildings sector

Strategy	Energy Savings in FY 2031 under moderate scenario (Mtoe)	Energy Savings in FY 2031 under ambitious scenario (Mtoe)
Notification And Implementation of ENS-Residential Buildings	0.004	0.011
Deepening Of Standard & Labeling Program in Domestic and Commercial Buildings	0.022	0.043
Implementation of ECSBC, ECBC And Energy Audit for Commercial And Public Buildings.	0.008	0.016
BEE Star Rating of Buildings, Green Buildings (Commercial And Residential Buildings)	0.005	0.021
Promotion Of Energy Efficient Data Centers	0.08	0.12
Total	0.1190	0.2110

6.4 Recommendation from green building experts

Note:

- ECBC is mandatory in Karnataka since 2020. The KECBC 2018 is applicable 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.

- No incentives for green buildings has been declared in the state. Green-rated Buildings comply with ECBC and are at least 20 - 30% more energy efficient than conventional buildings.

- 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.

- Implementation of Cool Roof Policy inspired from Telangana's policy.

CII-IGBC Recommendations for wider adoption of Green and Net Zero Buildings and Built Environment:

- Encourage renovation and retrofitting of existing buildings to Green Buildings through Rebate in property tax for green-rated Existing Building Projects.

    - With suitable retrofitting, the existing building stock can contribute to significant reduction in both energy and water consumption. In many cases, over a period of time, the performance level of existing buildings goes below optimum efficiency levels. If these buildings can also improve their indoor air quality and manage waste better, it will vastly optimise resource usage thereby resulting in significant benefits to the state. Greening of existing building offers immense untapped opportunities.

    - This incentive will encourage buyers to live and work out of green buildings and create demand for such projects.

- 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.

- As per the information received from Mangalore Electricity Supply Company Limited (MESCOM), commission decided to allow installation of SRTPV with capacity equivalent to 100% of sanctioned load of the respective consumer's installation based on gross or net metering. This can be reviewed in future.
- 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.

1. 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.
2. 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).
3. Miscellaneous Policy measures to encourage green, net zero energy buildings
    - Mandate PWD, Healthcare, Tourism 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

4. 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.

5. Encouraging Green Education

    - Architectural and Engineering colleges should offer specialised courses on green buildings, energy efficiency and the students should be encouraged to get professionally accredited on these subjects. This would create industry-ready professionals who can be involved in green and net zero energy projects in the future.

    - Similarly, officials from PWD, Urban Development, Town and Country Planning and other concerned departments must be encouraged to get trained and accredited by professional agencies on green and net zero energy buildings and built environment.

7 FOCUS SECTOR 4: AGRICULTURE & FISHERIES

7.1 Overview

Agriculture is one of the most significant industries in the country, accounting for 18% of GDP and employing about half of the country's workforce. As a result, accelerating agricultural output development has always been a priority for the government in order to boost not just the sector's productivity but also the income of the enormous workforce who rely on it for a living. As shown in figure 21 electricity demand in agriculture is growing at faster pace. In Karnataka electricity demand grew by 3.93% CAGR in last five years. The agricultural sector's significant increase in power consumption is largely due to rural electrification and different incentives offered to farmers in the form of electricity subsidies and free electricity for their agricultural loads.

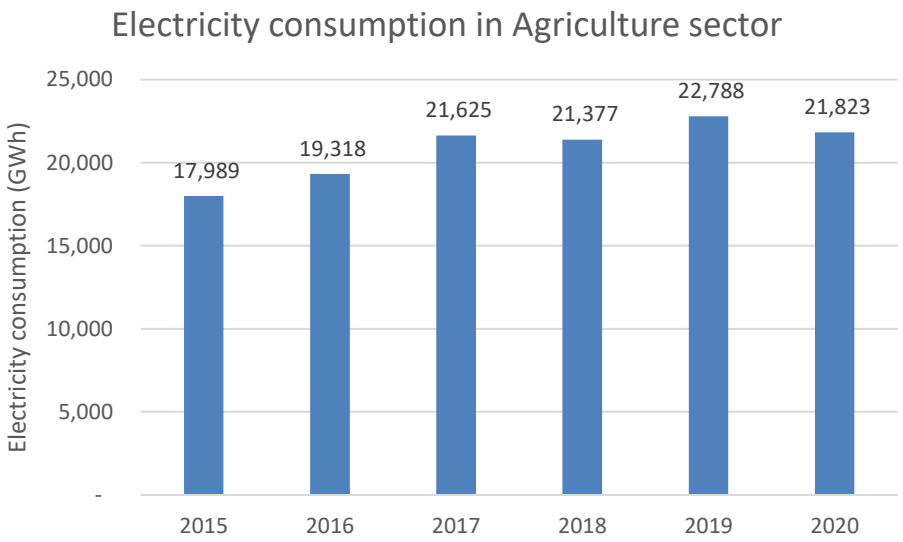


Figure 25 Agriculture sector energy consumption scenario

The PM-KUSUM scheme plays a crucial role in promoting solar-powered irrigation systems in Karnataka. Under Component B (Individual Solar Irrigation Pumps), Phase I saw the successful installation of 319 systems as of December 2nd, 2019. Phase II is currently ongoing, with 672 out of 1325 systems installed by February 14th, 2024. Additionally, Phase III received MNRE sanction for 25,000 more standalone solar pumps in December 2023. Component C (Feeder Level Solarization for Irrigation) focuses on larger-scale implementation. Phase I involved the sanctioning of 1302.31 MW solar capacity across three DISCOMs: CESC (10,000 pumps), HESCOM (65,000 pumps), and BESCOM (262,331 pumps). Bids for 766.18 MW have been received, and work orders are forthcoming. In Phase II, MNRE sanctioned the solarization of 250,000 pumps for KREDL in January 2024, with tender invitations currently being prepared.[25]

This demonstrates significant progress and continued advancements in solar-powered irrigation across Karnataka through the PM-KUSUM scheme. With ongoing phases and new

[25] Source: KREDL

sanctions, the program is poised to further expand the adoption of this sustainable and efficient irrigation technology.

7.2 Energy efficiency strategies in the agriculture sector

7.2.1 Strategy: Transition of conventional diesel and electrical pumps to Solar powered pumps by 2031 and replacement of standard pumps with energy efficient pumps

Karnataka Installed 23.2 Lakh pump sets as of 2018 and consumed and average consumption is 9,222 kWh in the same year as per Figure 26 . With increasing numbers of pump sets it is estimated that the electricity consumption in agriculture sector by pumps to reach.

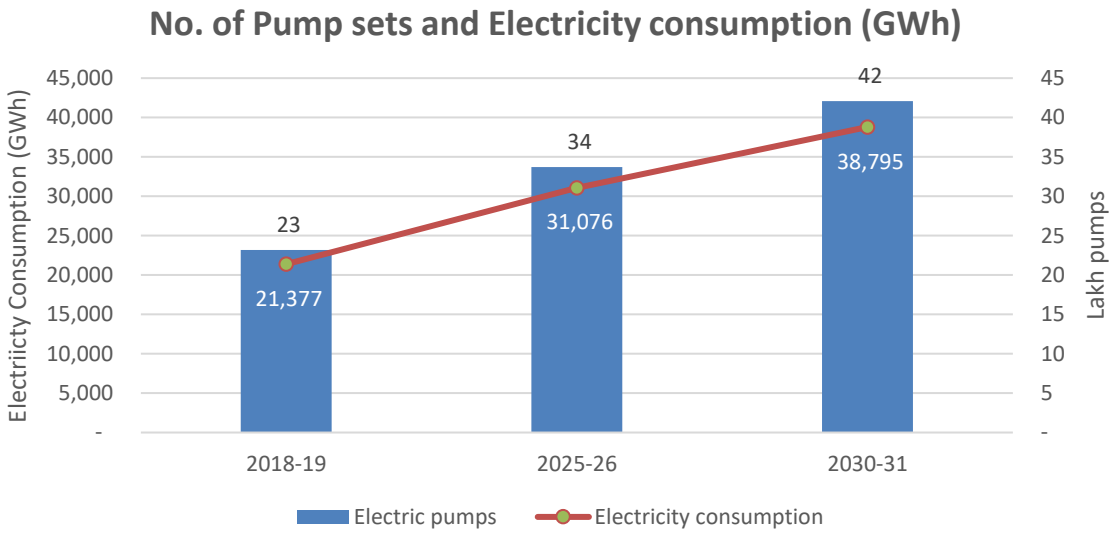


Figure 26 No. of Pump sets and average consumption (kWh)

Under PM KUSUM scheme, individual farmers will be supported to install standalone solar agricultural pumps by replacement of existing diesel Agriculture pumps or installation of new pumps in off grid areas under Component B.

Under PM-KUSUM Component C, the Irrigation pump sets of agriculture feeders will be provided power through solar plants by feeder level solarization.

The progress of KUSUM scheme so far in the state:

- 319 nos. of Solar water irrigation systems have been installed under MNRE sanction dated 02.12.2019 under component B.
- Under MNRE sanction dated 13.01.2021, implementation of 1325 nos. of Solar water irrigation systems are under progress under component B.
- Around 5000 nos. of SWP systems shall be installed under component B till FY 2026 based on funds allotted by GoK.
- MNRE has sanctioned 10,000 nos. for CESC, 65,000 nos. for HESCOM & 1,75,000 nos. for BESCOM for solarization of agricultural feeders under PM-KUSUM, Component-C. Tendering is under progress.

Scope Boundary

- Solar pump under Component B- Installation of 18,885 pumps in moderate and 28,328 pumps in ambitious scenario by FY 2031.
- Energy efficient pumps-. Transition of 42,064 pumps in moderate scenario 63,095 pumps in ambitious scenarios by FY 2031.
- Conversion of existing pumps to solar powered under component C – through solarization of agriculture feeders.

Implementing Agency

- MNRE, KREDL, BESCOM and Agriculture Department

Current Policy In Place

- PM KUSUM

Saving Potential

By considering this strategy, 0.015 & 0.031 MTOE saving potential can be achieved in moderate and ambitious scenario.

Table 28 Energy Saving Potential – Solarization and energy efficient irrigation pumps

Particulars	Moderate Scenario 2026	Ambitious Scenario 2026
Energy Saving Potential (MTOE)	0.015	0.031
GHG Emission Reduction Potential ($MtCO_2$)	0.046	0.097

Action Plans

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

Policy Type	Action Plan	Timeline
	Create awareness and help farmers realize the need for solarization of pumps. Major consumption is by free electricity for agricultural pumps, So creating awareness regarding saving energy through DD/Radio/Programmes in villages by volunteers in ZP/TP	Short Term

	Steps to integrate other agriculture loads like floor mills, hullers, shredders with solar pumps for increased utilization of solar power and restrict over pumping of water.	Long Term
	Promoting and mandating Energy Auditing at Agriculture Feeder level and pump set auditing	Short Term
	Installation of Solar based appliances/pumps by network of farmers (as initial cost is high)/ Group farming	Short Term
	Prioritize Bharat Stage VI compliant tractors: Encourage farmers to shift towards BS-VI tractors offering significant fuel efficiency improvements (20-25%) compared to older models. Promote precision farming tools: Support farmer adoption of GPS-guided tractors, variable rate technology (VRT), and yield monitors to optimize machine operations and reduce unnecessary fuel consumption. Organize farm machinery operation and maintenance training: Collaborate with agricultural universities and Krishi Vigyan Kendras (KVKs) to train farmers on fuel-efficient driving techniques, proper equipment maintenance schedules, and load management practices.	
	Consider smart agriculture initiatives: Explore partnerships with agritech startups offering data-driven solutions for optimizing fuel use based on field conditions and crop requirements. Promote drip irrigation systems due to their high water efficiency (70-90%) compared to conventional methods. Adapt recommendations to specific crops and soil types within Karnataka's diverse agroclimatic zones. Explore sprinklers for select crops: Consider sprinkler irrigation for crops like sugarcane and fodder where lower water efficiency demands may be offset by wider coverage and labor savings. Leverage the Centrally Sponsored Scheme (CSS) of Per Drop More Crop (PDMC) scheme by the Department of Agriculture & Farmers Welfare which offers financial assistance for micro-irrigation installation in various crops. Establish "model farms" and demonstration plots: Showcase successful micro-irrigation systems in	

	collaboration with progressive farmers, enabling peer-to-peer learning and knowledge exchange.	
	Integrate rainwater harvesting (RWH) into farm operations to reduce dependence on borewell pumps, leading to significant energy savings and enhanced water security in Karnataka's agricultural sector. Support installation of rooftop collection systems in farmhouses and other suitable structures, with incentives for larger capacities. Encourage creation of farm ponds, considering soil type, topography, and local rainfall patterns. Earthen bunding and micro-watershed management fo promoting traditional water conservation practices suitable for specific landscapes. Subsurface dykes and infiltration trenches implementation in recharge zones to enhance groundwater storage. Organize training programs for farmers, extension workers, and engineers on RWH design, implementation, and best practices.	
	Collaborate with agricultural extension services, media channels, and farmer associations to raise awareness about the benefits of automated spraying equipment, including reduced input costs, improved precision, and environmental advantages. Partner with manufacturers and research institutions to organize field demonstrations and trials showcasing the effectiveness of automated spraying equipment in different crop scenarios. Partner with financial institutions to offer low-interest loans or grants for farmers investing in automated spraying equipment. Collaborate with manufacturers of automated spraying equipment to offer targeted discounts or bundled packages for farmers in Karnataka, making the technology more accessible. Partner with banks and financing institutions to develop innovative financing models that cater to the specific needs of farmers looking to adopt automated spraying equipment.	Short Term

	Partner with research institutions, manufacturers, and farmers to conduct pilot projects on various solar-powered agricultural vehicles and equipment like tractors, tillers, and irrigation pumps. Organize demonstrations and field days to showcase the benefits and capabilities of solar-powered equipment to farmers and stakeholders. Modify the existing "Yantra Seva" scheme, offering upfront subsidies on solar-powered equipment purchases, specifically targeting small and marginal farmers (SMFs).	Short Term

Case Study: Strategies to Boost Components A and C Under PM-KUSUM Scheme[26]

A study was carried out by CEEW with support of Shakti Sustainable Energy Foundation where the status of PM-KUSUM across 7 states has been evaluated through discussing with key stakeholders involved. The study findings as recommendations to State Nodal Agencies (SNAs) for boosting the component A and C of the scheme include,

1. Adopt innovative models to overcome financing challenges with farmer-owned power plants: Usual means of project financing for developers are inadequate for farmer-owned power plants for two reasons.
    a. Farmers are not able to raise/contribute the 30 per cent equity for the power plant.
    b. In the absence of any track record as a developer, they cannot access loans from banks without collateral. Banks do not take agricultural land as collateral for non-agricultural purposes.

    State nodal agencies (SNAs) need to work with financial institutions to try innovative models such as the farmer-developer special purpose vehicle (SPV) piloted in Karnataka.
2. Ensure inter-departmental coordination to mitigate any issues in the planning and implementation phases:

    Multiple agencies like the discoms, SNAs and revenue departments have roles to play at different stages of implementing this component. States should form a PM-KUSUM steering committee, led by the implementing agency, with state-level representatives from all the concerned departments. Such an arrangement can anticipate any inter-department coordination issues in the planning and implementation phases and address them.
3. Discoms should lead the component's implementation:

    The study makes it abundantly clear that the implementation of the component will throw up many challenges that only the discoms can tackle. The discoms' role in Component-C is pre-eminent, and all the states should appoint the discoms as the implementing agency for the component.

[26] ceew-study-on-pm-kusum-scheme-for-solar-based-power-plants-and-grid-pumps-india.pdf

4. Pilot the model in different contexts:

   The outcome of Component-C depends on an array of localised factors like the current cropping pattern, the existing power supply conditions, and alternative options with surplus power. Given that these factors vary immensely even within states, states must carry out pilots in different agroeconomic contexts before scaling up the model. The pilots should specifically test out the following aspects:

   a. Different combinations of financing structure and metering options acceptable to farmers and assess their economic viability.
   b. Use of surplus power and impact on groundwater
   c. Engaging with the farmers in the target feeder to ensure maximum participation in a feeder, build trust, and promote community ownership of the scheme during the pilot.
   d. Comprehensive infrastructure assessment in the pilot projects to assess the infrastructure challenges and costs.

5. Complement the component with other key measures to make it viable:

   The states along with the MNRE could take some essential steps to make Component-C more feasible and sustainable with,

   a. Component C to be implemented in consonance with subsidy and tariff reform measures
   b. Testing out the overall benefit from pump replacement (efficient ones with inefficient ones) through pilot studies
   c. Framework for determining FiT (Feed in Tariff)

7.2.2 Strategy: Energy efficiency across value chain of fisheries

Karnataka have 5.96 Lakh tonne production of fish in FY 2021, grew at CAGR of 1.66% over the year 2016-17 to FY 2021 and projected production is 6.96 Lakh tonnes by 2031. The trend also shows that the marine fish production is decreasing over the years while the inland fish production is increasing.

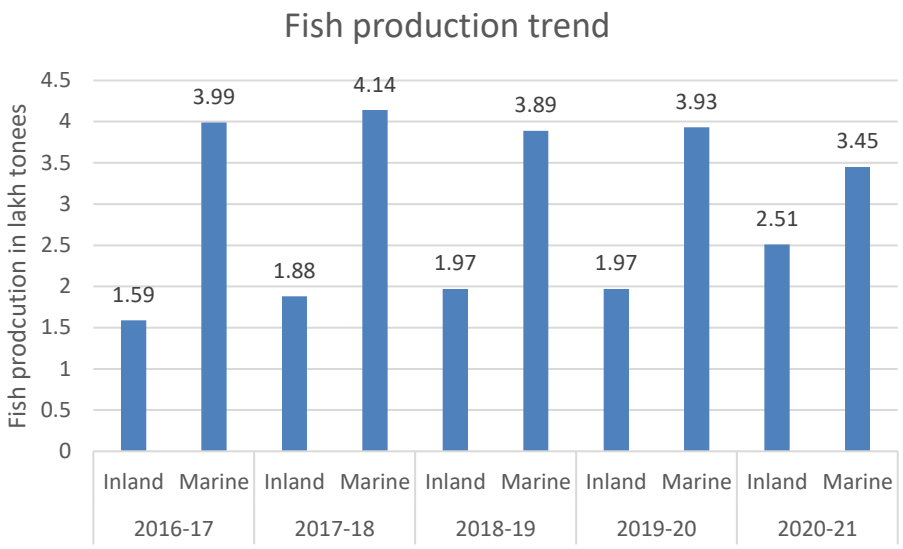


Figure 27 Fish production trend in Karnataka

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.

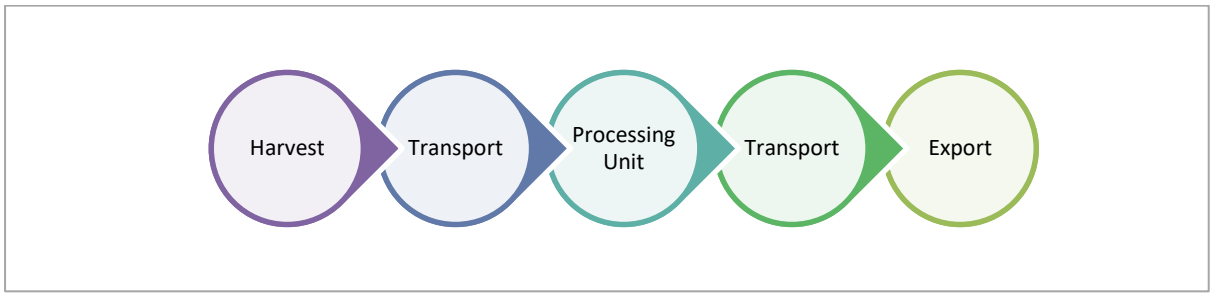


Figure 28 Fisheries Value Chain

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 fish value chain

Implementing Agency

- Department of Fisheries

Current status

- 5.96 Lakh tonne production in production FY 2021 (Baseline year), grew at CAGR of 1.66% over the year FY2017 to FY2021.

Saving Potential

By considering this strategy, 0.12 & 0.16 MTOE saving potential can be achieved in moderate and ambitious scenario.

Table 29 Energy Saving Potential – Energy Efficiency in Fish value chain

Particulars	Moderate Scenario	Ambitious Scenario
Energy Saving Potential (Mtoe)	0.12	0.16
GHG Emission Reduction Potential ($MtCO_2$)	0.38	0.51

Action Plans

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

Policy Type	Action Plan	Timeline
Awareness & Capacity Building	1. Provide skill development support. 2. Promotion of resource efficiency and cleaner refrigerant usage 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	4. Guidelines for usage of BEE star-rated products.	Long Term

	5. Partial support for conducting Energy audits in the value chain in line with the facility available for DC MSME. 6. 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. 7. Standardization of cold chain technologies and practices covering investment, RoI, energy specifications, vendor names and other operational benefits	
Technological Interventions	First and last mile transportation: • Phase Changing Materials (PCM) technology in Coolers/ Freezers • Energy Efficient Aerators • Adoption of EV (State has implemented, 150 electric 3-wheelers in Bangalore for selling the fish as per information received from Fisheries dept.)	Long Term
	Cold storage & Processing: • Solar PV System for Fishery/cold storage • Efficient Ammonia / CO2 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 • Solar aerator for aquaculture farms	Long Term

Case Study: Energy Efficiency in fisheries value chain[27]

[27] PowerPoint Presentation (unep.org)

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

Project activities:

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

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

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

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

National Design Challenge for newer ideas is also conducted, where more than 150+ participants under each category from college students, innovators, start-ups, associations

and practising officials in the sector. The main objective of the challenge was to get the best mobile kiosk for fish vending while maintaining the safety and hygiene of fish, and facilitate a circular economy based on reducing fish waste and energy efficiency.

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

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

Case Study: Solar aerator

A solar aerator catering to a two-acre pond can increase the production of an aquaculture pond by up to 20 per cent. A system consisting of a 1/3 HP, 300 Watt solar panels and a 12 V battery, 150Ah can potentially save 125-150 litres of diesel leading to a 350 to 400 kg decrease in CO, emissions annually133. However, as a thumb rule, each HP of solar aerator is estimated to impart 1.1 kg of oxygen per hour to the water body.

A solar-powered aerator has been designed and commercialized in USA. The aerator called 'SolarBee' is being manufactured by Medora Corporation. The system consists of 240 watts of solar panels, 0.5 HP pump with a brushless motor of 90 per cent efficiency. The system also includes an electronic control box, distribution dish, battery and an impeller. The system is designed to operate at 80 RPM which may be changed according to requirements

Parameter	Specification
Cost	INR 80,000
Indicative pond size	2 acre
Solar Panels	300 watt
Battery	12V, 150 Ah
Inverter	12V, 800VA
Pump Capacity	1/3 Hp
Daily hours of use	3 hours

7.3 Energy saving potential & monitoring mechanism

Energy saving potential of the agriculture & fisheries sectors is 0.395 MTOE and 0.541 MTOE for moderate and ambitious scenarios FY2031 respectively as seen from below table.

Table 30 Summary of energy saving from the strategies – Agriculture and Fisheries sector

Action Plan	Energy Savings in FY 2031 under moderate scenario (Mtoe)	Energy Savings in FY 2031 under ambitious scenario (Mtoe)
Transition of conventional diesel and electrical pumps to Solar powered pumps by 2026 and replacement of standard pumps with energy efficient pumps	0.015	0.031
Energy efficiency across value chain of fisheries	0.12	0.16
Total	0.135	0.191

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

8 MUNICIPAL SECTOR

India's municipal sector consumes around 4% of total electricity consumed in the country and is deemed to be the huge opportunity for energy conservation, accounting for 23% of energy use inefficiency in the country28. While calculating TFEC of Karnataka, Municipal sector is considered under other sector which consumes around 4% of the overall energy consumption. Municipal demand side energy management (Mu DSM) intervention is expected to reduce the burden of utilities during the peak hours and enable them to contain financial losses from high electricity consumption in the municipal sector. Therefore, in order to tap the energy savings potential of municipalities, BEE initiated nation-wide MuDSM programme to address the Energy inefficiencies in drinking water and sewage water pumping system, street lightning and public building across the urban local bodies (ULBs) and Municipalities

Scope Boundary

- Mu DSM program in street light and pumps

Implementing agency

- Bureau of Energy Efficiency (BEE), KREDL, Directorate of Municipal administration (DMA), Local bodies and Municipal authorities

Current Policy In Place

- BEE Mu DSM

8.1.1 Strategy: LEDs for streetlighting and energy efficient water pumping

Lighting load in the urban and rural areas of state is one of the major energy consuming areas under the municipal sector. The state has already did well in making the lighting loads more energy efficient by replacing the conventional lighting with LEDs. The implementation of the LED streetlights has been done in about 35 districts of the state has resulted in energy savings of about 0.02 MTOE.

Table 31 Replacement of conventional streetlights with LEDs in Karnataka

District	Quantity of Replaced LED (No.)	Savings (kWh)	Savings (TOE)
BALLARI CITY CORPORATION	20975	60,47,717	520.01
KALABURAGI CITY CORPORATION	35152	1,64,18,001	1,411.69
VIJAYAPURA CITY CORPORATION	18608	70,61,963	607.22
BAGALKOT DUDC	32689	1,00,97,901	868.26
BANGALORE RURAL DUDC	23114	1,01,62,077	873.78

[28]https://beeindia.gov.in/en/programmesdemand-side-management/municipal-demand-side-management-programmemudsm

BELAGAVI PACKAGE 1	26817	74,36,806	639.45
BELAGAVI PACKAGE 2	24159	93,83,824	806.86
BIDAR	25872	90,48,238	778.01
CHAMARAJANAGAR	9231	46,11,464	396.51
CHIKKABALLAPUR	17118	70,76,250	608.45
CHIKKAMAGALUR DUDC	16319	70,70,237	607.93
CHITRADURGA	25340	1,17,57,370	1,010.95
DAKSHINA KANNADA DUDC	34442	55,02,910	473.16
Dharward DUDC	6938	17,64,380	151.71
GADAG DUDC	25076	76,60,988	658.73
HASSAN DUDC	21882	1,06,98,574	919.91
KALABURAGI DUDC	13909	46,03,181	395.80
KODAGU DUDC	10359	28,79,940	247.63
KOLAR DUDC	18505	1,19,68,919	1,029.14
MANDYA DUDC	21670	1,23,39,840	1,061.03
RAICHUR DUDC	19230	90,62,811	779.26
TUMKUR DUDC	27307	89,61,899	770.58
VIJAYAPURA DUDC	11418	34,69,325	298.31
YADGIRI DUDC	10328	51,77,832	445.21
UDUPI CMC	12682	18,50,465	159.11
Uttara Kannada DUDC	26772	89,36,862	768.43
MYSURU DUDC	15074	56,56,712	486.39
BALLARI DUDC	7327	18,28,832	157.25
BANGALURU URBAN DUDC	11235	47,81,895	411.17
KOPPAL DUDC	10493	38,10,779	327.67
RAMANAGARA DUDC	15834	59,56,804	512.19
SHIVAMOGGA DUDC	20538	77,99,139	670.61
HAVERI DUDC	19922	59,26,330	509.57
DAVANAGERE DUDC	8379	26,78,666	230.32
HUBBALI CITY CORPORATION	8855	1,39,21,332	1,197.02
MYSURU CITY CORPORATION	50639	2,22,92,727	1,916.83

The savings shown in the table are the cumulative annual savings achieved since the implementation of LED street lighting started in 2018. Continuing similar efforts to replace more of the conventional street lighting with LEDs has a potential to save energy consumption in municipal sector.

Saving Potential

By considering same level of replacements till FY2031 in moderate scenario and additional 25% replacements in ambitious scenario, the energy saving potential is 0.02 MTOE in moderate scenario and 0.025 MTOE in ambitious scenario.

Table 32 Energy Saving Potential – Energy Efficiency in Municipal sector

Particulars	Moderate Scenario	Ambitious Scenario
Energy Saving Potential (Mtoe)	0.02	0.025

GHG Emission Reduction Potential ($MtCO_2$)	0.063	0.078

Pumping of water is also a major load for municipalities. It is important to look for energy efficiency interventions in municipal water pumping. Key activities to be performed include,

1. Auditing of existing pumping infrastructure – water distribution network
2. Inclusion of energy efficiency standards in tender documents

Action Plans

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

Policy Type	Action Plan	Timeline
Data collection	1. Electrical distribution single line diagram of the distribution networks and the lighting details. 2. Layout the transformers indicating their sizes, capacities, connected loads, etc. 3. Sketch the distribution system indicating the type of lamps, approximate distance between two poles, type of poles, conductor material and size	Short Term
Technology intervention	4. The proper auto On/Off control like timer/sensor/radio frequency based/any other smart control systems shall be provided in the street light circuits to avoid un-necessary burning of street lights. o Installation of radio frequency-based street lights with centralised control and monitoring system in the major cities; o Installation of street light with Supervisory Control and data acquisition. 5. Centralised Control and Monitoring System (CCMS) may be implemented for real-time monitoring and control of the entire street lighting system in the city. 6. The CCMS should be capable of switching ON and OFF the lights of a particular switching point and/or networked switching point from Central Control Station instantaneously or automatically throughout the year on the basis of sunrise and	Short term

	sunset time depending on the geographical location of the switching point. 7. The CCMS should be able to communicate to Smart Energy meters on GSM and/or RF proven technology based remote streetlight monitoring system. 8. The energy efficiency standards shall be included as part of tender document and the evaluation of DPR should consider the Specific Energy Consumption for pumping calculated for the geography. ## Technical Action Plan for Power Factor Improvement in Karnataka Municipality Sector	
	1. Utilize load profiling tools to capture dynamic load variations and inform optimal capacitor bank deployment strategies. 2. Implement intelligent APFCs (Advanced Power Factor Controller) (APFC) integrated harmonic mitigation capabilities for facilities with dynamic loads or stringent power factor requirements. Utilize SCADA systems for comprehensive network monitoring and data-driven decision-making regarding power factor correction strategies.	
Policy & Regulatory	Policies to be formulated for production of star rated equipment only. Establish a dedicated monitoring agency: This agency, potentially under the purview of the local Urban Local Body (ULB) or in collaboration with the DISCOM, will be responsible for overseeing streetlight installations and energy consumption.	

8.2 Energy saving potential & monitoring mechanism

Energy saving potential of the municipal sector is 0.02 MTOE and 0.025 MTOE for moderate and ambitious scenarios FY2031 respectively as seen from Table 33.

Table 33 Summary of energy saving from the strategies – Municipal sector

Action Plan	Energy Savings in FY 2031 under moderate scenario (Mtoe)	Energy Savings in FY 2031 under ambitious scenario (Mtoe)
Replacement of conventional streetlights with energy efficient LED lighting	0.02	0.025

Policy Type	Monitoring Mechanism
Data collection	• SDA to coordinate with DISCOMs and monitor the data collection of Electrical distribution single line diagram of the distribution networks and the lighting details
Implementation	• SDA to coordinate with the ESCO like EESL for continued monitoring of the replacement of streetlights against the set targets

9 General recommendations

Following general recommendations received from the stakeholders;

1. Study of power management in countries which have adopted Energy-efficient system and implementing the same
2. Machine control system for escalator/Auditorium/Halls in public places Timer/Automated/Motion-sensor based) provide unnecessary energy consumption.

3. Encouraging solar based appliances by providing incentives

4. Well-designed tax policy to levy CO2/GHG tax, Penalty on industries/vehicles emitting CO2/GHG beyond limits

5. Give-up option to 'Contribution to Nation' in free Govt. schemes. Creating awareness through Ads/programmes via TV/Radio/other popular E-media regarding this option.

6. Study of impact of Metro (Decongestion of traffic, reduced dependency on fossil fuels, Air quality index)

7. R&D (Regarding generation of energy by Bio-waste)

3. Optimum utilisation of solar/wind energy in the area where it's abundant, thereby reduced dependency on fossil fuel in that area.

10 FINANCING MODELS FOR ENERGY EFFICIENCY

Energy efficiency is one the most effective strategies to meet rising energy demand, reduce green house gas emissions and provide socio-economic benefits. Unlocking the potential of energy efficiency requires investments which can spur the technology availability in the market and adoption of energy efficiency among the end consumers. Many developed

country has unlocked energy efficiency financing potential through innovative financing models and some of such models are also being explored in India such as the Energy Service Companies (ESCOs) model. The present study analysed few popular financing models which can be helpful in commercial, residential as well as Industrial sector. Few financing strategy which are generally common in India are as given below;

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

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

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

10.1 On bill financing model

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

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



Figure 29 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.

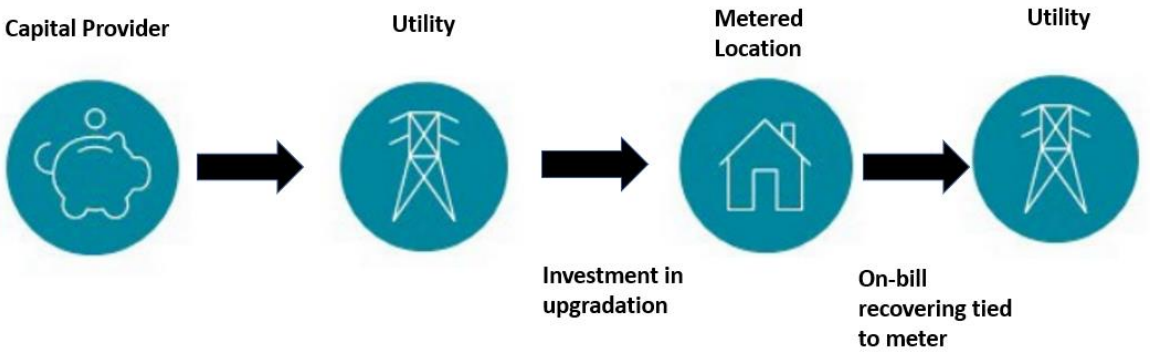


Figure 30 Modality of financing energy efficiency projects through on bill financing model

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.

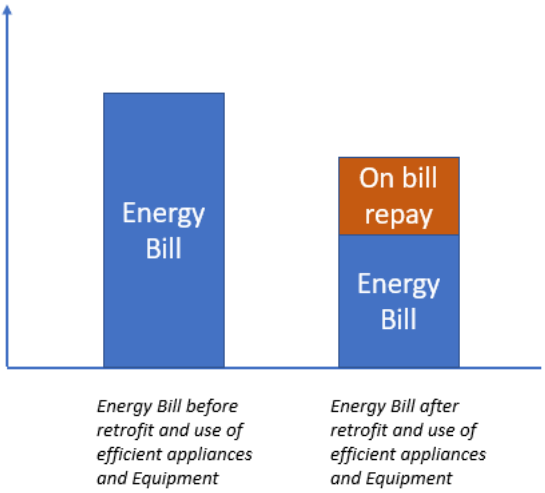


Figure 31 On bill financing structure

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

Case Study: ECOFRIDGE-On bill financing

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

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

10.2 Energy service companies (ESCOs) Model of financing

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

The utility might be able to reach economies of scale that would further reduce costs with strong user acceptance and bundling that offers a kind of "mass customisation." To guarantee programme success, the utility would keep handling billing, quality control, monitoring, and reporting. Customers' invoices would show the improvement measures' net energy cost reductions versus service fees. Customers may think about upgrading for extra services like new windows or a refrigerator when the initiative started to show benefits.

- ESCO in Industry

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

Ownership of the energy asset or infrastructure may lie with the ESCO (or even a third party) rather than the energy end user, depending on the contracting arrangement. Energy performance contracting (EPC), which aids in reducing the financial and performance risk associated with energy efficiency projects, is being used by an increasing number of ESCOs.

Although an equipment replacement or retrofit tries to lower total energy consumption, the energy savings that the end user actually experiences may differ from what was anticipated or promised for a variety of technical reasons.

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

- Guaranteed Saving Model of ESCO

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

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

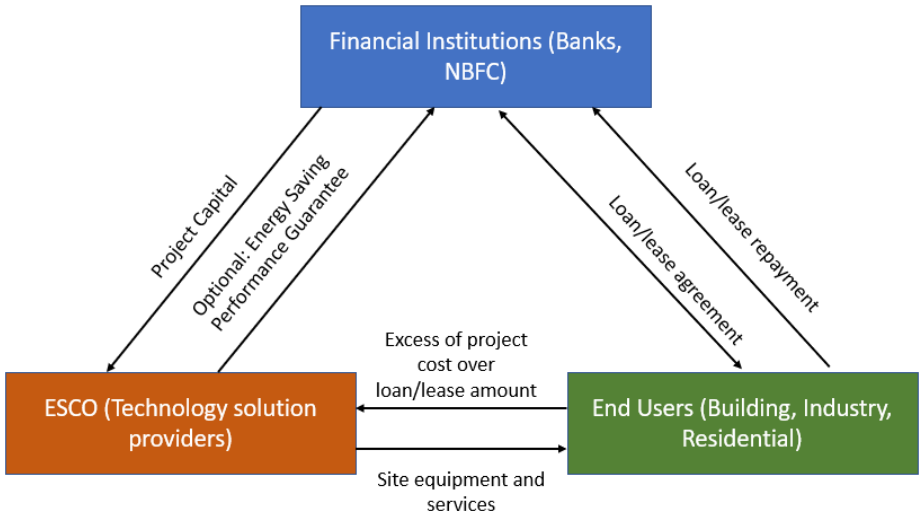


Figure 32 Guaranteed Saving Model

- 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.

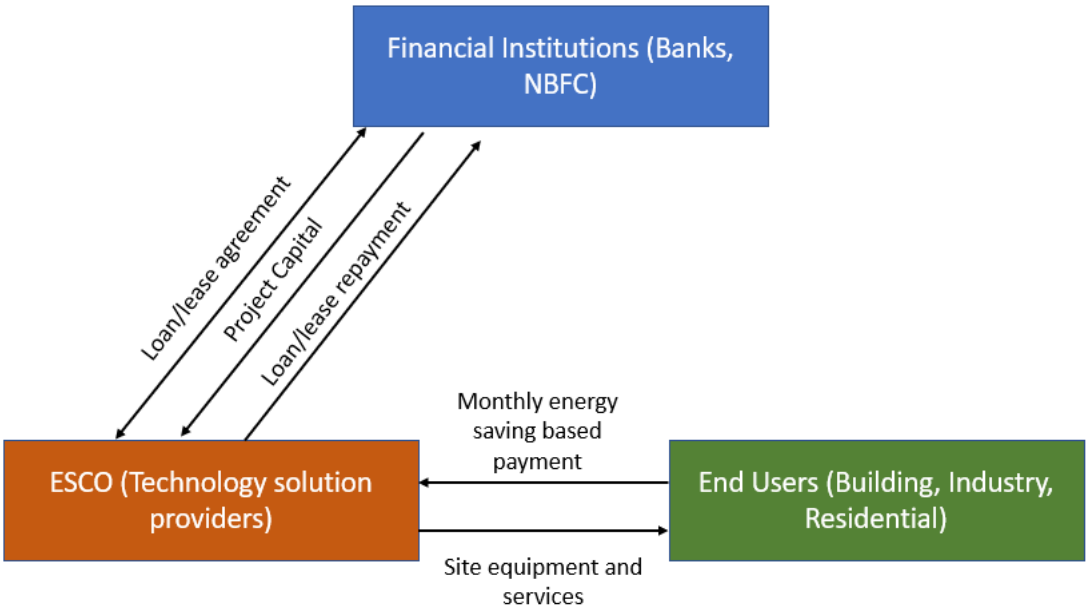


Figure 33 Shared ESCO saving Model

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

Table 34 Various Risk in ESCOs Models

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

Source: Climate Policy Initiative, 2021

10.3 Dealer or retailer financing model

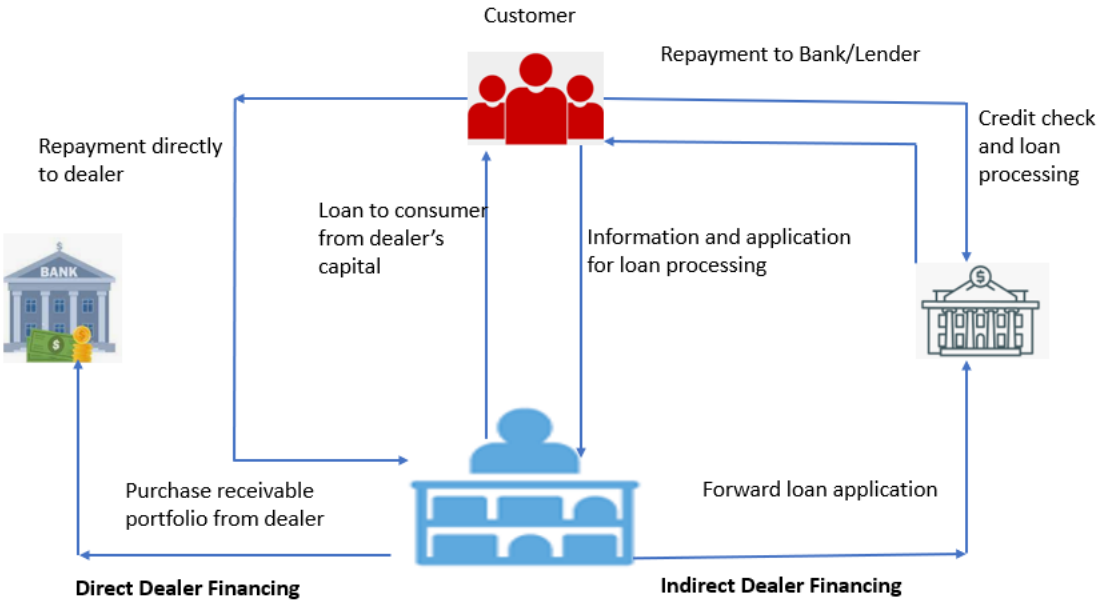


Figure 34 Dealer and retailer financing model

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.

Find matching washers & dryers from $1,619.98 **$34.30/mo for 60. mo.*** for both.
Shop now >

Get a $100 instant rebate on efficient gas ranges from $854.99 or **$18.10/mo. for 60 mo.***
Shop now >

10.4 Leasing financing model

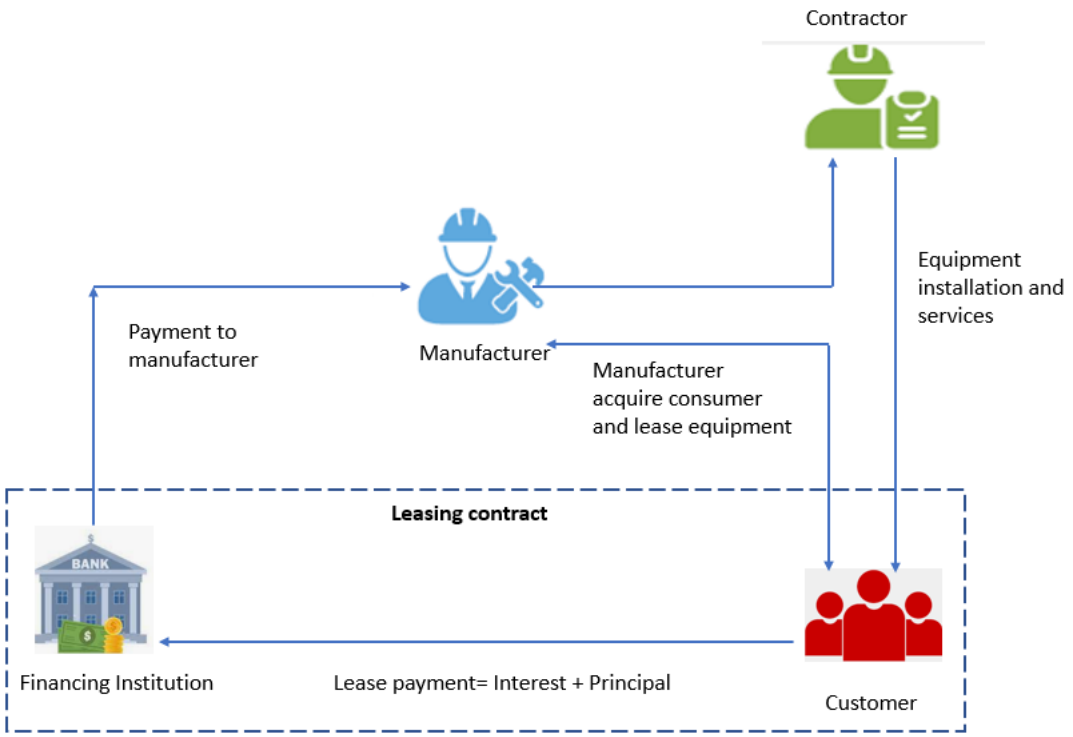


Figure 35 Leasing financing model

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

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

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

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

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

10.5 Utilization of green finance

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

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

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

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

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

And key outcome of the project is as given below;

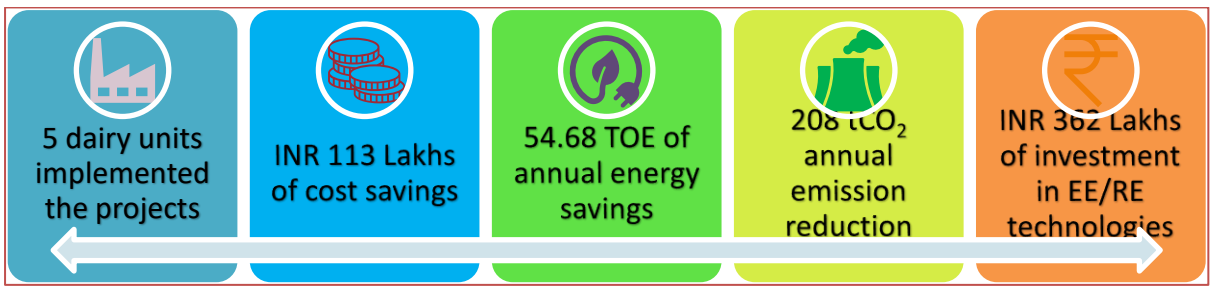


Figure 36 Key outcome of GEF funded Dairy Project

10.6 Carbon credit mechanism for energy efficiency projects

(1) India has been at the forefront of climate action to meet the global climate goals through its ambitious Nationally Determined Contributions (NDC). To facilitate the achievement of India's enhanced NDC targets, the Government has initiated the development of the unified carbon market mechanism 'Indian Carbon Market' (ICM) which will mobilize new mitigation opportunities through demand for emission reduction credits by private and public entities.

(2) ICM is envisioned to accelerate decarbonisation and mobilize finance and technology towards achieving India's NDCs. A single market at the national level, as opposed to having multiple sectoral market instruments, would reduce transaction costs, improve liquidity, enhance a common understanding and targeted capacity development, and streamline the accounting and verification procedures.

(3) The challenge of meeting future NDC goals makes it imperative that market measures are promoted to facilitate gradual decarbonisation of the economy. The proposed carbon market mechanism will enable active participation of the private sector in decarbonisation efforts, in all potential sectors. The creation of a unified ICM can help to create eligible carbon credits, increase the liquidity of credit trading, and thus lay the foundations for a good price discovery mechanism and incentivising carbon emission reduction in India.

(4) ICM is established under the purview of the Energy Conservation Act, 2001, and the Environment (Protection) Act, 1986. The Energy Conservation Act, 2001 empowers the Government of India to specify the Carbon Credit Trading Scheme (CCTS), where any entity, including the designated consumers, registered for carbon credit trading scheme will be the "registered entity". The act empowers the Central Government to issue the "Carbon Credit Certificates" to the registered entities under different mechanisms. While the Environment (Protection) Act, 1986 empowers the Government of India to specify standards for emission or discharge of pollutant for the obligated sectors.

(5)The Central Government has notified the Carbon Credit Trading Scheme, 2023 vide S.O. 2825(E) dated 28th June 2023 under the powers conferred by clause (w) of section 14 of the Energy Conservation Act, 2001 (52 of 2001) which defines the Indian carbon market where a national framework is established with an objective to reduce or remove or avoid the greenhouse gases emissions from the Indian economy by pricing the greenhouse gases emission reduction through trading of the carbon credit certificates.

10.7 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.

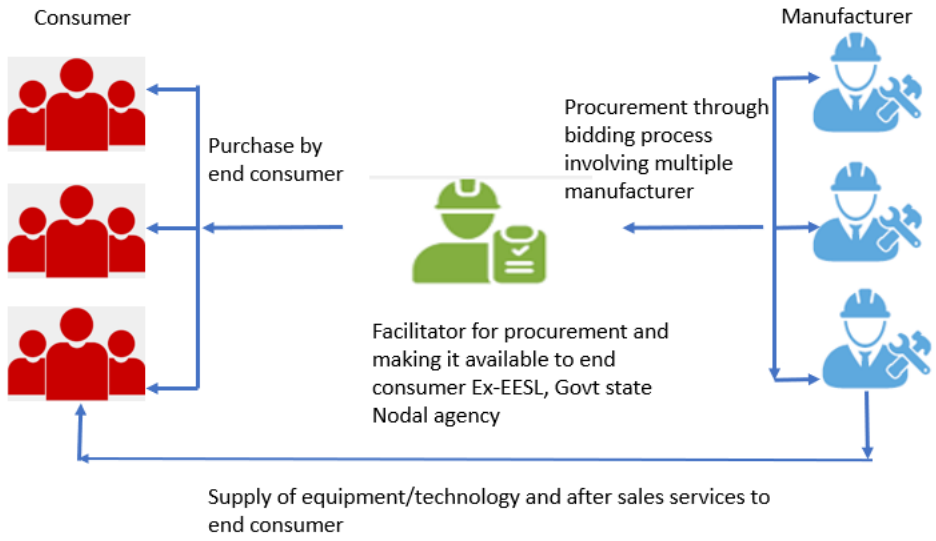


Figure 37 Bulk procurement model

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 35 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

Motor specification (IE-3)	No of motors procured. (Nos Lakh)	Market price of Motor (Rs Lakh)	EESL Procured price (Rs Lakh)
7.50	0.15	0.23	0.16
11	0.10	0.47	0.25
15	0.10	0.49	0.31
22	0.10	0.65	0.40

11 INVESTMENT POTENTIAL

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

Table 36 Investment potential

Sector	Emissions Reduction (MtCO2) - FY2031		Energy Consumption Reduction (Mtoe) - FY2031		Investment Potential (INR Crores)[29]
	Moderate	Ambitious	Moderate	Ambitious	
	MtCO2 reduction	MtCO2 reduction	Mtoe Reduction	Mtoe Reduction	
Industry	10.31	14.68	3.30	4.69	₹ 8,631
Buildings	0.37	0.66	0.12	0.21	₹ 388
Transport	11.20	17.74	3.58	5.67	₹ 10,434
Agriculture & Fisheries	0.42	0.59	0.14	0.19	₹ 350
Municipal	0.06	0.08	0.02	0.03	₹ 55
Total	22.36	33.75	7.16	10.79	₹ 19,858

The energy saving investment potential of the state is estimated to be ₹19,858 crores by FY 2031, under the ambitious savings scenario, with the transport sector constituting highest energy saving investment potential followed by industry sector.

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

12 WAY FORWARD

The "State Energy Efficiency Action Plan" report for Karnataka 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's targets in line with the NDCs. Moving forward, 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.

As a first step, moving forward 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 in moving forward is to secure funding for the implementation of the action plan. The state should explore various funding options, including grants, loans, and public-private partnerships, to ensure that adequate resources are available to support the implementation of the plan. Additionally, the state should consider developing innovative financing mechanisms, such as energy efficiency bonds, to attract private investment in energy efficiency projects. By taking these steps, state 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.

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

13 ANNEXURES

13.1 List of green rated companies in Karnataka

Company	Sector	Location	State	Rating Level
ACC Ltd	cement	Kudithini	Karnataka	Silver
ACC Ltd	cement	Thondebhavi	Karnataka	Silver
ACC Ltd	cement	Wadi	Karnataka	Gold
ACE Designers Limited	Engineering	Bengaluru	Karnataka	Bronze
ACE Manufacturing Systems Ltd	Engineering	Bangalore	Karnataka	Gold
Aditi Power Pvt Ltd	Renewable	Tumkur	Karnataka	Silver
AMR Power Pvt. Ltd	Renewable	Perla	Karnataka	Silver
AMR Power Pvt. Ltd. (Small Hydro - GreenKo Group)	Renewable	Perla	Karnataka	Silver
Carriage Repair Workshop	Railways	Hubli	Karnataka	Bronze
Carriage Repair Workshop, Southwestern Railway	Railways	Hubballi	Karnataka	Silver
Carriage Workshop	Railways	Mysore	Karnataka	Gold
Central Workshop, South-Western Railway	Railways	Mysore	Karnataka	Gold
E-Parisaraa Pvt Ltd (E Waste Recycler)	Recycler	Bengaluru	Karnataka	Gold
Hindustan Unilever Limited	FMCG	Mysore	Karnataka	Silver
Honda Motorcycle and Scooter India Pvtd Ltd	Automobile	Narsapura	Karnataka	Platinum
Honda Motorcycle and Scooter India Pvtd Ltd	Automobile	Narsapura	Karnataka	Platinum Plus
Indian Oil Corporation Ltd - Devangunthi Bottling Plant	Petroleum Marketing	Devangunthi	Karnataka	Gold
JK CEMENT WORKS, MUDDAPUR	cement	Muddapur	Karnataka	Gold
JK CEMENT WORKS, MUDDAPUR	cement	Muddapur	Karnataka	Platinum
JK Tyre & Industries Ltd, VIkrant Tyre Plant	cement	Mysore	Karnataka	Silver
JK Tyre & Industries Ltd, VIkrant Tyre Plant	cement	Mysore	Karnataka	Platinum
Kempegowda International Airport	Airport	Bengaluru	Karnataka	Silver
Kempegowda International Airport	Airport	Bengaluru	Karnataka	Platinum
Kennametal India Limited	Engineering	Bangalore	Karnataka	Gold
Kesoram Industries - Vasavadatta Cement	cement	Sedam	Karnataka	Gold
Kesoram Industries - Vasavadatta Cement	cement	Sedam	Karnataka	Platinum
Kesoram Industries Ltd [Cement Division], Unit: Vasavadatta Cement	cement	Sedam	Karnataka	Platinum
Mphasis	IT	Mangalore	Karnataka	Bronze
Natural Remedies Pvt Ltd	Pharma	Bangalore	Karnataka	Gold

Rail Wheel Factory, Yelahanka	Railways	Bangalore	Karnataka	Silver
Rail Wheel Factory, Yelahanka	Railways	Bangalore	Karnataka	Gold
TATA MOTORS LTD	Automobile	Dharwad	Karnataka	Gold
Vyshali Energy Pvt Ltd	Renewable	Bijapur	Karnataka	Silver
Wipro Ltd	IT	Bengaluru	Karnataka	Silver

14 REFERENCES

Sr No.	Description
1.	CEA General Review Report
2.	Indian Petroleum & Natural Gas Statistics
3.	Coal Directory of India
4.	Energy Statistics India 2021, Ministry of Statistics and Programme Implementation (MoSPI)
5.	NITI Aayog: India Energy Dashboards
6.	Karnataka Statistical Abstract
7.	Annual Survey of Industries
8.	BEE PAT Cycle
9.	Vaahan Dashboard
10.	Census of India 2011

14.1 Comments received after 3rd Stakeholder workshop

Sl. No.	Department	Mode of comments received	Comments on SEEAP	CII Remarks	Page No and section of the report
1	**Municipal**	**Email**	Municipal Sector - Energy Efficiency in Lighting Centralised Control and Monitoring System (CCMS) may be implemented for real-time monitoring and control of the entire street lighting system in the city. The CCMS should be capable of switching ON and OFF the lights of a particular switching point and/or networked switching point from Central Control Station instantaneously or automatically throughout the year on the basis of sunrise and sunset time depending on the geographical location of the switching point. The CCMS should be able to communicate to Smart Energy meters on GSM and/or RF proven technology based remote streetlight monitoring system.	Comments incorporated in the report	Under section-8.1.1 on page No-82
2	**DGMDSM <dgmdsm@cescmysore.org >**	**Email**	The comments/ suggestion on draft Karnataka "State Energy Efficiency Action Plan (SEEAP) is as follows: 1. Replacement of conventional bulbs by LED lights along with street light control wire/ Timer switches/ Centralized Control and Monitoring System to ON/OFF. 2. Policies have to be formulated for the production of only Star rated equipment.	Comments incorporated in the report	Under section-8.1.1 on page No-82

Sl. No.	Department	Mode of comments received	Comments on SEEAP	CII Remarks	Page No and section of the report
3	**PWD Bangalore**	**Email**	Inputs/Observations "Money saved is Money Earned", So as "Energy saved is Energy Generated". **INDUSTRY** 1. Constituting Energy Management Team: Creating a plan to monitor energy consumption (Power down idle machines, Turn-off conveyors, Switch off lights etc). 2. Strategically scheduling machinery operation (Peak energy usage) 3. Well-designed machine control system (Adjust speed to match demand) 4. Creating an industrial energy productivity Road-Map (Future focus on Decarbonisation of grid, Clustering of Industries etc). 5. Efficient Maintenance of Equipment to reduce energy wastage or transmission loss (Proper insulation) **TRANSPORT** 1. World class public transport system like 'Metro' and user friendly public transport which encourages people from all strata of society to use public transport. 2. Ease of purchase of EV through ease of availing ban not only 2-wheelers,cars and also 3-wheelers (Public and goods vehicle) 3. Incentivising purchase of these EV through Subsidy, Tax/GST rebate. 4. Creating awareness/ wide publicity through social media, other communications regarding prevalent subsidy system, Govt. schemes/ Incentives for purchasing EV. NOTE: Inclusion of guidelines for judicious disposal of batteries/other parts of EV is also of higher importance to avoid negligent/ unsafe disposal) **BUILDINGS** To avoid unnecessary usage of power; 1. Installation of sensor based / Automated switches in upcoming building projects 2. Upgrading/replacing power consuming lighting 3. Door access card for auto-switch off when not in usage 4. Creating awareness through Ads/programmes via TV/Radio/other popular E-media regarding prudent use of power in the interest of nation in 'Free Govt. Schemes' like Gruhajyothi. 5. Auto switch-over to low-wattage lighting system whenever necessary rather than same-wattage lighting in all places (Different MCB controls) 6. Installation of Timer/Auto-off mechanism 7. Green building/Smart building in upcoming projects 8. Subsidised distribution of energy efficient bulbs in the free scheme region **AGRICULTURE** 1. Major consumption is by free electricity for agricultural pumps, So creating awareness regarding saving energy through DD/Radio/Programmes in villages by volunteers in ZP/TP	Comments incorporated in the report	Industry: Section-4.2.1 on page No: 27 Section-4.2.2 pn page no-32 Transport: Section 5.2.2 on page no-45 section-5.2.1 on page-42, 43 **Building:** under section-6.2.2 on page no 56 under section: 6.2.4 page no-59 **Agriculture: section-7.2.1** on page-71

Sl. No.	Department	Mode of comments received	Comments on SEEAP	CII Remarks	Page No and section of the report
			2. Installation of Solar based appliances/pumps by network of farmers (as initial cost is high)/ Group farming **GENERAL** 1. Study of power management in countries which have adopted Energy-efficient system and implementing the same 2. Machine control system for escalator/Auditorium/Halls in public places (Timer/Automated/Motion-sensor based) provide unnecessary energy consumption. 3. Encouraging solar based appliances by providing incentives 4. Well-designed tax policy to levy CO2/GHG tax, Penalty on industries/vehicles emitting CO2/GHG beyond limits 5. Give-up option to 'Contribution to Nation' in free Govt. schemes. Creating awareness through Ads/programmes via TV/Radio/other popular E-media regarding this option. **OBSERVATIONS** 1. Study of impact of Metro (Decongestion of traffic, reduced dependency on fossil fuels, Air quality index) 2. R&D (Regarding generation of energy by Bio-waste) 3. Optimum utilisation of solar/wind energy in the area where it's abundant, thereby reduced dependency on fossil fuel in that area. "Any recommendations/suggestions of a study/plan is incomplete unless it's Implemented/ Practised".		

Sl. No.	Department	Mode of comments received	Comments on SEEAP	CII Remarks	Page No and section of the report
4	MESCOM, Electrical (Tech)	Email			
5	Industry	Stakeholder consultation meeting	1. The latest industry policy discontinued the subsidies against conducting audits. It can be recommended to bring back the subsidies for conducting energy audits a. Existing industry policy provides interest subsidy on technology upgradation loans. This can be extended to energy efficiency projects as well 2. Currently state energy and industry policies are formulated with different objectives and there is gap between two. There is need to bridge this gap 3. The existing Zero defect and Zero effect (ZED) rating can be integrated with Green rating of companies to make it easy for the companies to adopt 4. Incentives/ subsidies can also be provided for RE projects in MSMEs	Comments incorporated in the report	Section-4.2.1 on page no-27 section-4.2.2 on page no-32
6	BESCOM (EV sector)	Stakeholder consultation meeting	• By March 2024, 1300 electric buses would be plying in the state. • The major challenge with EVs is the sustainability issues in battery supply chain. So, it is important to have the battery disposal rules/ regulations	Comments incorporated in the report	Section-5.2.3: page no 43
7	Transport, KRIDE	Stakeholder consultation meeting	• Steps shall be taken in the state to promote usage of public transportation • K-RIDE, a joint venture of the Government of Karnataka & Ministry of Railways - are currently developing the Bangalore Suburban Rail Project (BSRP) using the existing rail tracks, o Key objective is the urban to rural connectivity by delivering the worldclass rail infrastructure while also integrating multiple modes of transport. o All the 57 stations that are currently operating are either ECBC+ or IGBC certified with several green building elements implemented. o The stations also have access to the EV charging infrastructure. • Currently no restriction on the sugarcane juice that can be used for producing ethanol, by encouraging the development of distilleries in the state	Comments incorporated in the report	Section-5.2.2 on page no-45 Section-5.2.3 on page no-47
8	Building	Stakeholder consultation meeting	Encouraging implementation of green building techniques is important to achieve energy efficiency, • Rain Water: The water can be collected and stored at top of the houses during rains and the potential energy of water can be used. o As per the building bylaws, the buildings with >100 sq.m. are mandated to have rain water harvesting • Natural ventilation	Comments incorporated in the report	Section-6.4 page no-65 section-6.2.1 page no-50

Sl. No.	Department	Mode of comments received	Comments on SEEAP	CII Remarks	Page No and section of the report
			• Passive cooling techniques – avoiding the energy consumption for cooling • Building audits in commercial buildings		
9	**Supritending engineer (Elec) Tech, MESCOM, Mangalore**	**Email**	For promotion of usage of star rated appliances, BLDC fans etc, program similar to UJALA may be introduced where in the consumers are encouraged to purchase star rated appliances at subsidized rates Policy framework for mandating production of only star rated equipment over a period of time and phasing out all energy efficient devices	Comments incorporated in the report	Section-6.2.2 on page no-55
10	**Supritending engineer (Elec) Commercial, MESCOM, Mangalore**	**Email**	Removing the cap on installed capacity of onsite renewable power generation system, might lead to potential revenue loss of ESCOMs because as per hon'ble KERC gross metering which allows both ESCOMs and consumer benefit, is restricted only to Domestic , Educational Institutions & Hospitals. whereas other high yielding tariff consumer opting net metering which benefits consumer only, effect the ESCOM business expenses like transmission costs which in turns make ESCOMs difficult in continuing operations without generating revenue & ultimately affect the entire distribution power infrastructure.	As of now comments have been considered as it is KER guideline, however in future the scheme can be relooked	Section-6.4 page no-66
11	**Fisheries**	**Stakeholder consultation meeting**	• The stakeholders suggested to include energy efficiency for the aquaculture also. The key areas suggested by them include, o Pumping and aerating o Cold chain o Feed mills • Implemented, 150 electric 3-wheelers in Bangalore for selling the fish	Comments incorporated in the report	Section-7.2.2 on page no-77, 75
12	**Municipal**	**Stakeholder consultation meeting**	• Remote monitoring/ control of lighting should be promoted to avoid lights running during day time • Model tender document to include the aspects on energy efficiency in pumping at the tender or DPR stage before implementation of SEC for pumping should be mentioned as part of the tender document • Carbon credit generation for energy efficiency projects implemented- framework and methodology to register the project should be included	Comments incorporated in the report	Section-8.1.1 on page no-82
13	**KREDL (SDA)**	**Email**	Hukkeri Rural Electric Co-operative Society Ltd has to be added	Incorporated on page No-20	Section-1.6 page no-20

Sl. No.	Department	Mode of comments received	Comments on SEEAP	CII Remarks	Page No and section of the report
14	**KREDL (SDA)**	**Email**	Implementation of Energy Conservation Building Code (ECBC) to be added as a 2nd Strategic plan	Strategy 6.2.3 is actually for ECBC only. We have re-written heading as **Strategy: Implementation of ECBC and Energy audit for commercial and public buildings**	Section-6.2.3 on page no-56
15	**KREDL (SDA)**	**Email**	Provide detail for-2. Compliance structure and rebates onenergy savings for first few residentialprojects.Provide strategies to include in commercial	Suggestion incorporated	Section-6.2.1 page no-51
16	**KREDL (SDA)**	**Email**	Remove Town planning and add Energy Department, Urban Development Department, Housing Department and all other Govt. /undertaking Departments	Suggestion incorporated	Section--6.2.2 page no-53
17	**KREDL (SDA)**	**Email**	Request to consider Pumps and motors as well	Suggestion incorporated	Section--6.2.2 page no-53
18	**KREDL (SDA)**	**Email**	PLI-Mention with Expansion	Added as-Production Linked Incentive Scheme (PLI)	Section--6.2.2 page no-56
19	**KREDL (SDA)**	**Email**	The Explanation should also contains the BEE star rating Building programme for Commercial and Residential	Suggestion incorporated	Section--6.2.2 page no-59
20	**KREDL (SDA)**	**Email**	Under scope boundary-Government Commercial and Residentials Buildings in the State	Suggestion incorporated	Section--6.2.2 page no-59
21	**KREDL (SDA)**	**Email**	Implementing agency-Energy and KREDL	Suggestion incorporated	Section--6.2.2 page no-59
22	**KREDL (SDA)**	**Email**	BEE Star rating programme for Commercial and Residential Building	Suggestion incorporated	Section--6.2.2 page no-59
23	**KREDL (SDA)**	**Email**	Action plan should include residential star rating with some suggestion of mandatory action on Public commercial and residential buildings	Suggestion incorporated	Section--6.2.4 page no-61
24	**KREDL (SDA)**	**Email**	The Energy Saving potential should included the following i. ECBC implementation ii. S & L in Commercial iii. Residential building Star rating	In explanation it was not included but while working no of buildings considered includes both BEE-star as well as green rating. It is considered while	Section--6.2.3 page no-64

Sl. No.	Department	Mode of comments received	Comments on SEEAP	CII Remarks	Page No and section of the report
				calculation of energy saving	
25	**KREDL (SDA)**	**Email**	The Strategy 6.2.4 BEE star rating with building has not mentioned	It is mentioned now	Section--6.2.4 page no-59
26	**KREDL (SDA)**	**Email**	Action plan may includes policy Development of the following i. guidelines/regulations to incorporate EE/EC measures integrated cold chain infrastructure. ii. integrated water and energy savings in the agriculture sector in the state	Suggestion incorporated	Section--7.2.1 page no-71
27	**KREDL (SDA)**	**Email**	Request to provide the overview in Municipal Sector	Suggestion incorporated	Section--8 page no-79
28	**KREDL (SDA)**	**Email**	In Municipal sector-Kindly provide Scope of boundary, Implementing agency and Current policy in Place details, as maintained in the earlier sector.	Suggestion incorporated	Section--8 page no-79
29	**KREDL (SDA)**	**Email**	It has to be Energy Efficiency in replacement of LED street light and not Fish value chain	Corrected	Section--8.1.1 page no-81
30	**KREDL (SDA)**	**Email**	CDM is no more valid. New carbon mechanism under Article 6.4 of Paris agreement will be starting from Jan-24 by UNFCCC.. CDM needs to be removed. Otherwise voluntary mechanisms may be mentioned.	Earlier mentioned detail of CDM is replaced with Indian Carbon Market	Section--10.6 page no-93
31	**KREDL (SDA)**	**Email**	With ₹ 18,402 per TOE cost, for the ambitious saving of 11.02 MTOE, total amount arrived at is ₹ 20,280 crore. Please check the assumption of 3 years payback	This assumption is given by BEE	Section--11 page no-96

- Comments Received on 27-12-23 Validation Workshop- SEEAP Karnataka

Sl. No.	Sector	Comments on SEEAP	CII Remarks	Reference
1	Industry	Extend subsidies on energy audits and ISO 50001 to MSMEs.	Already addressed in the report.	4.2.1 Strategy: Deepening and widening of PAT Scheme

Sl. No.	Sector	Comments on SEEAP	CII Remarks	Reference
2		Accelerate the shift from captive power plants to alternative energy sources for large industries.	The purview of the report is on reducing energy demand through improved consumption practices, rather than exploring changes to the supply infrastructure.	
3		Solar to be incentivised for MSMEs.	Already addressed in the report.	4.2.2 Strategy: Decarbonising MSMEs through cluster approach
1	Buildings	Formulate a cool roof policy similar to Telangana.	Added.	6.4 Recommendation from green building experts
2		Promote sustainable construction alternatives to reduce cement demand	Already addressed in the report.	6.4 Recommendation from green building experts
3		Raise awareness on passive design and planning.	Already addressed in the report.	6.4 Recommendation from green building experts
4		Mandate inclusion of ECSBC in building byelaws.	Already addressed in the report.	ECBC is mandatory in Karnataka since 2020.
5		Subsidize sustainable building materials.	Already addressed in the report.	6.4 Recommendation from green building experts
1	Transport	Explore carbon market mechanisms to promote EV manufacturing.	The report is centred on the subject of energy efficiency, the scope excludes considerations related to the carbon credit mechanism.	-
1	Agriculture	Address fuel consumption in tractors and other equipment.	Added.	Under action plans for agriculture sector
2		Incentivize micro-irrigation to reduce pump load and save water.	Added.	Under action plans for agriculture sector
3		Rainwater harvesting to reduce electrical consumption of borewell pumps.	Added.	Under action plans for agriculture sector
4		Encourage adoption of automated spraying equipment to reduce fertilizer and pesticide use.	Added.	Under action plans for agriculture sector

Sl. No.	Sector	Comments on SEEAP	CII Remarks	Reference
5		Prioritize renewable energy integration and energy-efficient technologies in storage facilities.	Already addressed in the report.	
7		Conduct pilot projects on deploying solar panels on tractors and farm equipment.	Added.	Under action plans for agriculture sector
1	Municipal	Address issues in STP and municipal water supply pumps as the power factor is quite low, in the range of 0.6.	Added.	Under action plans for municipal sector
		Monitoring agency to monitor streetlight installations to avoid excess usage.	Added.	Under action plans for municipal sector
2		Interventions needed for low power factor in pumping stations.	Added.	Under action plans for municipal sector
3		Explore solid waste utilization for bio gasification.	Covered in Karnataka State Urban Solid Waste Management Policy. http://municipaladmn.gov.in/sites/municipaladmn.gov.in/files/pdf/Notifications/Govt-Circulars/SWM-SBM/SWM/SWM%20Urban%20Policy%20final-10-2-213.47pm.pdf	
4		Introduce a solid waste management policy.	Karnataka already has a State Urban Solid Waste Management Policy. http://municipaladmn.gov.in/sites/municipaladmn.gov.in/files/pdf/Notifications/Govt-Circulars/SWM-SBM/SWM/SWM%20Urban%20Policy%20final-10-2-213.47pm.pdf	

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