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Bureau of Energy Efficiency
Government of India, Ministry of Power

STATE ENERGY EFFICIENCY ACTION PLAN

ANDHRA PRADESH

Prepared by
Confederation of Indian Industry

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AP State Energy Conservation Mission (SDA)

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सत्यमेव जयते

Azadi Ka Amrit Mahotsav

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(विद्युत मंत्रालय, भारत सरकार)
BUREAU OF ENERGY EFFICIENCY
(Ministry of Power, Government of India)

Foreword

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

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

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

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

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

October, 2024

(Dr. Srikant Nagulapalli)

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Preface

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

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

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

Acknowledgement

The Confederation of Indian Industry (CII) extends its heartfelt appreciation to Shri K. Vijayanand (IAS), Special Chief Secretary to Government, Energy Department, Govt. of Andhra Pradesh, and Shri Kumar Reddy, CEO, Andhra Pradesh State Energy Conservation Mission (APSECM), for their unwavering support and encouragement throughout the development of the State Energy Efficiency Action Plan.

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

CII expresses its deep gratitude for the consistent guidance and valuable suggestions provided by Shri Sivaram Kumar, Deputy Executive Engineer, APSECM, Shri Sumanth G, Project Engineer, APSECM, and the entire APSECM team. Their efforts and significant contributions have played a pivotal role in the development of this report.

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

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AP	Andhra Pradesh
AP TRANSCO	Andhra Pradesh Transmission Company
APERC	Andhra Pradesh Electricity Regulatory Commission
APSEB	Andhra Pradesh State Electricity Board
APSECM	AP State Energy Conservation Mission
APSRTC	Andhra Pradesh State Road Transport Corporation
ATF	Aviation Turbine Fuel
BEE	Bureau of Energy Efficiency
CAGR	Compounded annual growth rate
CEA	Central Electricity Authority
CII	Confederation of Indian Industry
CNG	Compressed Natural Gas
CPWS	Comprehensive Protected Water Supply
DAP	Di-ammonium phosphate
DISCOMS	Distribution Company
DSM	demand side management
ECBC	Energy Conservation Building Code
EE	Energy Efficient
EMS	Energy Management Systems
epi	Energy Performance Index
EV	Electric vehicle
GCV	gross calorific value
GDP	Gross domestic product
GHG	Greenhouse gases
GSVA	Gross State Value Addition
HVAC	Heating, ventilation, and air conditioning
ICE	Internal Combustion Engine
INR	Indian rupees
LDO	Light diesel oil
LED	Light Emitting Diode
LPG	Liquefied petroleum gas
MoPNG	Ministry of Petroleum and Natural Gas
MSME	Micro, Small and Medium Enterprises
MT	Million Tonne
Mtoe	Million of tonnes of oil equivalent
MU	Million Units
MW	Mega Watt
NHPC	National Hydro Power Corporation
NMEE	National Mission for Enhanced Energy Efficiency
NPK	Nitrogen, Phosphorus, Potassium
NTPC	National Thermal Power Corporation
OEM	Original equipment manufacturer
PAT	Perform, Achieve and Trade
PWS/MPWS	Piped Water Supply/Miscellaneous Public Water System

RE	Renewable Energy
RSPCB	Rajasthan State Pollution Control Board
SDA	State Designated Agency
SEC	Specific Energy Consumption
SKO	Superior Kerosene Oil
TFEC	Total Final Energy Consumption

Executive Summary

India's rapid economic expansion and urbanization have paved the way for a huge increase in energy demand. As the nation continues to evolve and urban areas expand, the need for energy to power industries, transportation, and households has grown steadily. This burgeoning demand poses a complex challenge, as it requires a delicate balance between providing access to affordable and reliable energy for all while addressing environmental sustainability and energy security.

In response to these challenges, India, in its updated Nationally Determined Contribution submitted during the 26th session of the Conference of the Parties (COP26) to the United Nations Framework Convention on Climate Change (UNFCCC) in Glasgow, United Kingdom in 2021, unveiled a strategic framework for climate action. This framework, symbolized by the "Panchamrit" (five nectar) elements, signifies India's resolute commitment to achieve net-zero emissions by 2070 and secure 50% of its energy from renewable sources by 2030. It is imperative to recognize the pivotal role that States and Union Territories (UTs) play in effecting a transition to low-carbon development pathways.

To facilitate this vital transition, the Bureau of Energy Efficiency, operating under the aegis of the Ministry of Power, Government of India, has embarked on the development of State Energy Efficiency Action Plan (SEEAP). These plans are tailored to meet the distinctive requirements of each state, ensuring that resource allocation aligns with the state's sustainable development objectives. The SEEAP project aims to contribute to India's national targets and provide a comprehensive roadmap for enhancing energy efficiency across the state and the country over next decade.

For Andhra Pradesh, SEEAP was developed by the Confederation of Indian Industry (CII), under the guidelines of Bureau of Energy Efficiency, Ministry of Power, GOI, in consultation with the State Designated Agency viz. AP State Energy Conservation Mission (APSECM) with inputs & suggestions from various government departments and sector experts. The primary objective of the State Energy Efficiency Action Plan for Andhra Pradesh is to formulate sector-specific strategies for enhancing energy efficiency in the state.

Energy Landscape and Projections:

Andhra Pradesh consumed 17.48 Mtoe of energy in FY 2020, primarily through oil (47%), electricity (28%), and imported coal (16%). With projected economic growth and considering energy intensity, total energy consumption is estimated to reach nearly 30 Mtoe by FY 2030.

Strategic Focus:

Based on factors like GSVA, energy consumption and feedback from stakeholders, four key sectors – Industry, Buildings, Transport, and Agriculture & Fisheries – were identified for targeted interventions. Dedicated strategies for each sector will optimize resource allocation and maximize impact.

Actionable Strategies:

1) **Industry:**
   - Expand and enhance the Perform, Achieve and Trade (PAT) scheme to drive energy efficiency in designated industries.
   - Promote green rating to incentivize sustainable practices and resource optimization.
2) **Transport:**
   - Accelerate the electrification of road transport to reduce dependence on fossil fuels.
   - Invest in and improve public transportation to encourage energy-efficient commuting.
   - Expand the ethanol blending program to green the fuel mix and decrease emissions.
3) **Buildings:**
   - Implement energy efficiency labelling for residential buildings to raise awareness and guide informed purchase decisions.
   - Intensify the Standard & Labelling Programme to promote energy-efficient appliances and equipment.
   - Encourage BEE Star Rating and green building practices for new and existing constructions.
4) **Agriculture & Fisheries:**
   - Facilitate the transition from conventional diesel pumps to solar-powered pumps to harness renewable energy and reduce fossil fuel reliance.
   - Promote the replacement of old or inefficient pumps with 5-star rated models equipped with smart control panels for enhanced efficiency and operational savings.

Expected Outcomes:

This action plan, depending on the implementation scenario, is projected to achieve:

Energy Savings: Reduction of 2.62 Mtoe (moderate) and 3.88 Mtoe (ambitious) by FY 2030.

Market Potential: Creation of a ₹ 8,078 crore market for energy-efficient solutions and technologies.

Emission Reduction: Decrease in CO_2 emissions by 8.11 $MtCO_2$ (moderate) and 12 $MtCO_2$ (ambitious) by FY 2030.

By focusing on strategic sectors and implementing targeted interventions, this plan seeks to drive significant energy savings, unlock market potential, and contribute to a cleaner environment for Andhra Pradesh.

1 INTRODUCTION

1.1 Background

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

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

In the transport sector, there is a need to include and promote energy efficient public transport besides policy level intervention for efficient or clean fuel vehicles. Several states have come forward with a state level incentivisation for Electric Vehicles. Policy and framework for electric vehicles at the state level needs further focus.

Though energy efficiency is a multi-dimensional subject, defining key focus areas to bridge gaps is the need of the hour. While some states may have the potential to improve efficiency in a particular sector, there may be gaps in terms of identification of these sectors. If, for instance, a state with many MSME industrial units, may focus on energy efficiency in the industrial sector alone, a large potential of achieving energy efficiency may be unearthed. This may involve activities and resource mobilization to create awareness in industry, replacement of appliances and machinery with the help of ESCOs, setting up and utilization of Revolving Investment Fund, besides others.

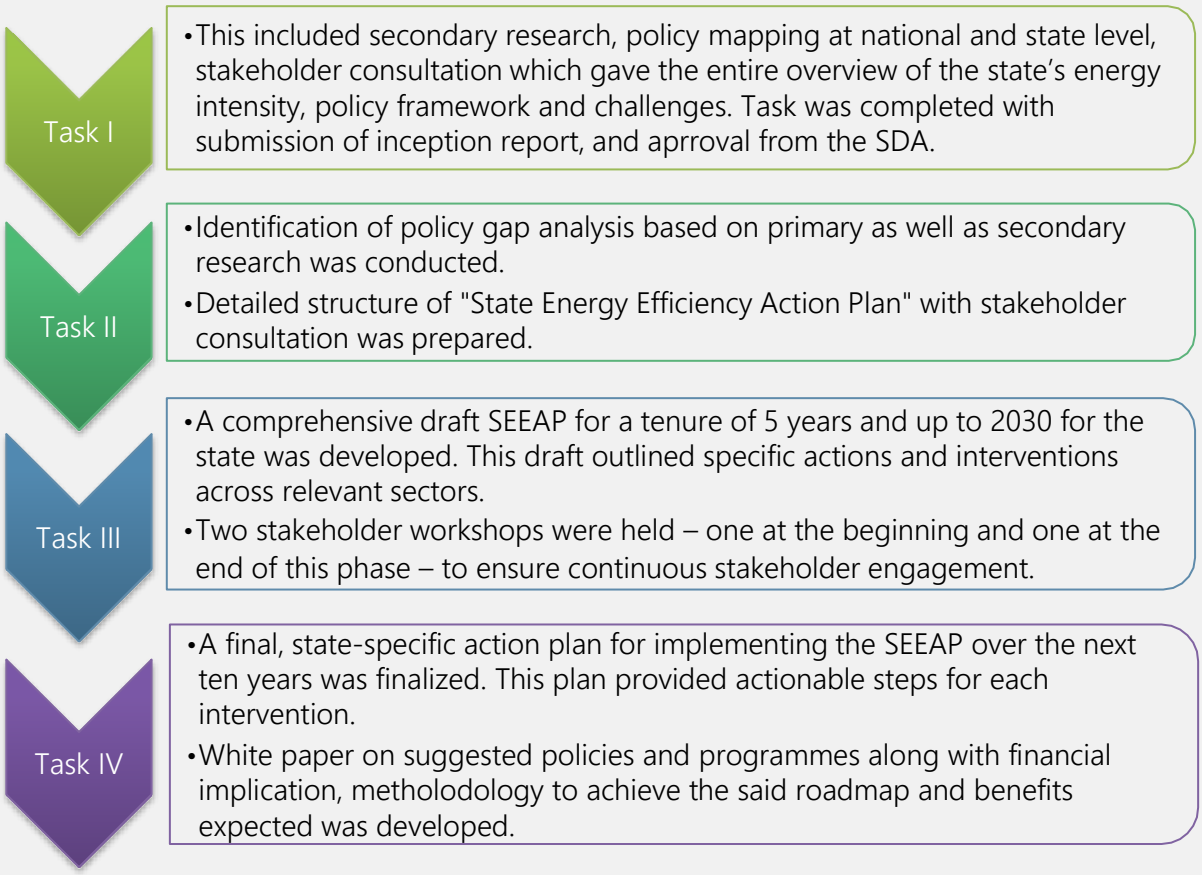
1.2 About State Energy Efficiency Action Plan

This assignment aimed to provide technical assistance for the identification of focus sectors for the **State Energy Efficiency Action Plan for Andhra Pradesh** 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 was 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.

Outcomes of the Tasks

To achieve this objective, four tasks were completed. The first involved in-depth analysis and research, including calculations using historical data from 2014-2015 to 2019-20.[1]

The project involved a phased approach with specific deliverables at each stage as shown in Figure 2.



[1] The Bureau of Energy Efficiency (BEE) established the reference period for historical data analysis as 2014-15 to 2019-20. However, due to data inconsistencies arising from the COVID-19 pandemic in 2021 and 2022, these years were excluded from the present analysis. Nonetheless, the report incorporates the latest available data for specific indicators such as Gross State Domestic Product (GSDP) and the number of electric vehicles (EVs) and wherever possible. Notably, for Andhra Pradesh, data analysis commences from 2015-16 due to the state's bifurcation in 2014 to form Telangana.

1.3 Andhra Pradesh State Profile

[2]

Andhra Pradesh is strategically located on the South-East coast of India and is considered as gateway to East & Southeast Asia. Andhra Pradesh has a geographical area of 160,309 sq. kms with population of 49.7 million. It accounts for 4.9 percent of country's geographical area and 4.0 percent of the country's population. Andhra Pradesh has bountiful natural resources (limestone, bauxite, and several minor minerals), fertile land, water, fertile river basins (Godavari, Krishna & Pennar), extensive canal system and conducive agro-climatic conditions. The state is agriculturally prosperous. It is known as the "Rice Bowl of India". The state also has the second longest coastline (974 kms) among all the states in India and it is also the largest producer of marine products with 40% share in country's exports.

Combined Andhra Pradesh was, a few years back, the third most favoured investment destination (both domestic and foreign) in the country. The bifurcation presents an opportunity for Andhra Pradesh to chart a new course and create a conducive and best in class environment for industries.

Industrial development will promote higher capital formation; raises wage incomes; and absorb surplus workforce. To realize these benefits and hasten up the socio-economic changes, industrial development is accorded top priority by the state government. The new

[2]Andhra Pradesh Socio Economic Survey 20-21

industrial policy proposes to establish a state-of the art infrastructure, advance inclusivity, foster innovation, and develop skill sets of its workforce to create employment opportunities across the state.

With support from the central government, multilateral agencies and the private players, the state government aims to make Andhra Pradesh one of the leading investment destinations of the country.

1.4 Current Energy Scenario of Andhra Pradesh

The energy sector in Andhra Pradesh is one of the most important components of an infrastructure that affects the state's economic growth, as well as one of India's largest industries. Andhra Pradesh is the third largest electricity producer in the southern region[3] and the country's 9th largest electricity producer[4].

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

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

Clean energy system deployment is gaining traction in Andhra Pradesh as a result of policy initiatives. Adopting an energy-efficient lifestyle, on the other hand, is one of the most cost-effective options accessible. Energy efficiency is gradually becoming a critical element of India's energy transformation strategy. Implementing comprehensive energy efficiency initiatives results in reduced air pollution, decarbonisation, improved energy access, better resource utilisation, and increased energy security.

If energy efficiency measures are implemented, the transition to renewable energy will be speedier and less expensive. As part of the Paris Agreement, India pledged to reduce its energy intensity (the amount of energy used per unit of GDP) by 33-35% by 2031 compared to 2005 levels. The Bureau of Energy Efficiency (BEE) has implemented numerous energy efficiency schemes, such as the National Mission for Enhanced Energy Efficiency (NMEEE), Demand Side Management (DSM), Energy Conservation Building Code (ECBC), and others, with positive outcomes.

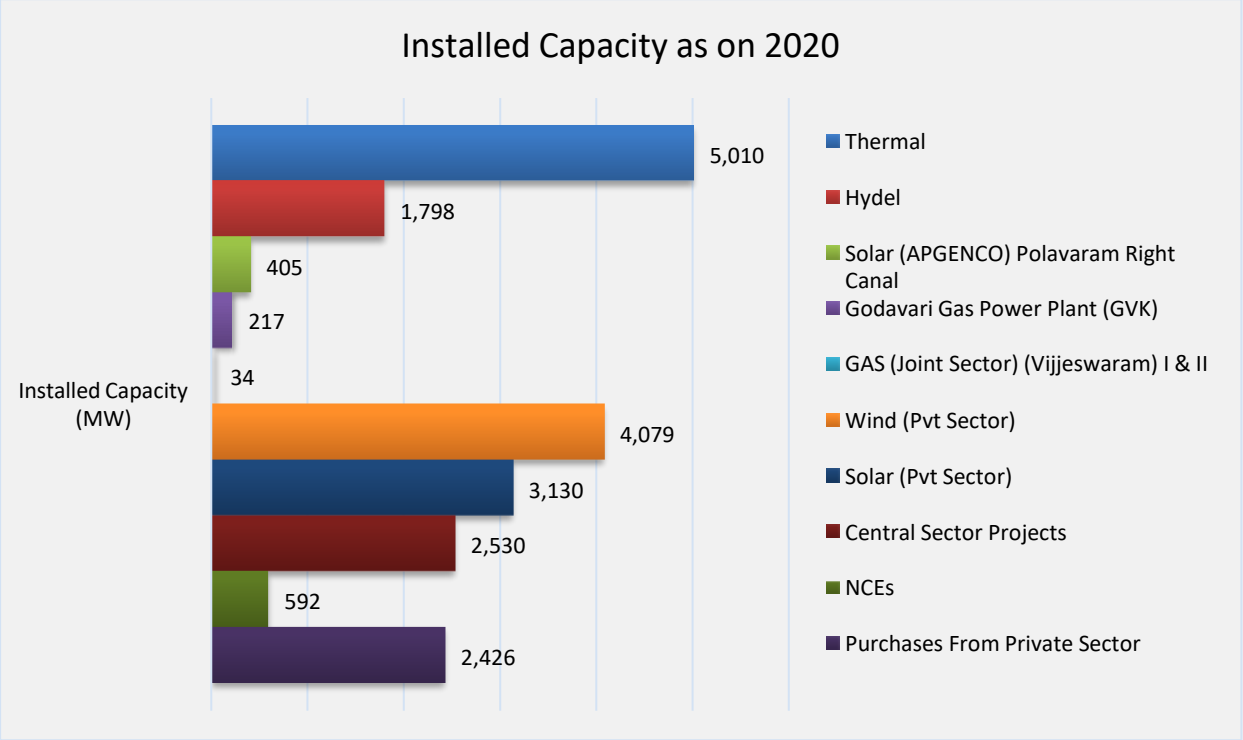
In the following section, we will glance at Andhra Pradesh's energy scenario.

[3]https://npp.gov.in/public-reports/cea/monthly/installcap/2021/DEC/capacity2-Southern-2021-12.pdf
[4]https://npp.gov.in/public-reports/cea/monthly/installcap/2022/JUL/capacity1-2022-07.pdf

Installed Capacity

The total installed capacity in the state is nearly 20,200 MW as of FY2020.[5] This capacity consists of a mix of conventional thermal power, renewable energy, and hydropower sources.

Figure 1 Installed capacity in Andhra Pradesh (MW) for FY2019-20



The renewable energy (RE) potential in Andhra Pradesh is significant, thanks to its favourable geographical conditions and natural resources. The state has vast potential for solar, wind, and biomass energy generation. The state of Andhra Pradesh has set ambitious target of achieving 10,000 MW of renewable energy by 2018 and 18,000 MW by 2022.

GMR Vemagiri, GVK Extn., GVK Gautami and Konaseema Eire stranded due to unavailability of gas.[6]

In addition to the state sector, private entities have a significant presence in Andhra Pradesh. Private power plants operating in the state utilize the transmission lines managed by Andhra Pradesh Transmission Company (AP TRANSCO). Furthermore, power plants owned by central sector entities such as National Thermal Power Corporation (NTPC) and National Hydro Power Corporation (NHPC) transmit power through AP Transco's transmission lines.

1.5 Total Final Energy Consumption (TFEC)

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

TFEC is a variable that was developed particularly to measure the progress of the Sustainable Development Goals.It aids in the analysis of the energy-saving target, which will lower the

[5] AP Statistical Abstract 2021- Table 10.1

[6]https://aperc.gov.in/admin/upload/5thcontrolperiod.pdf

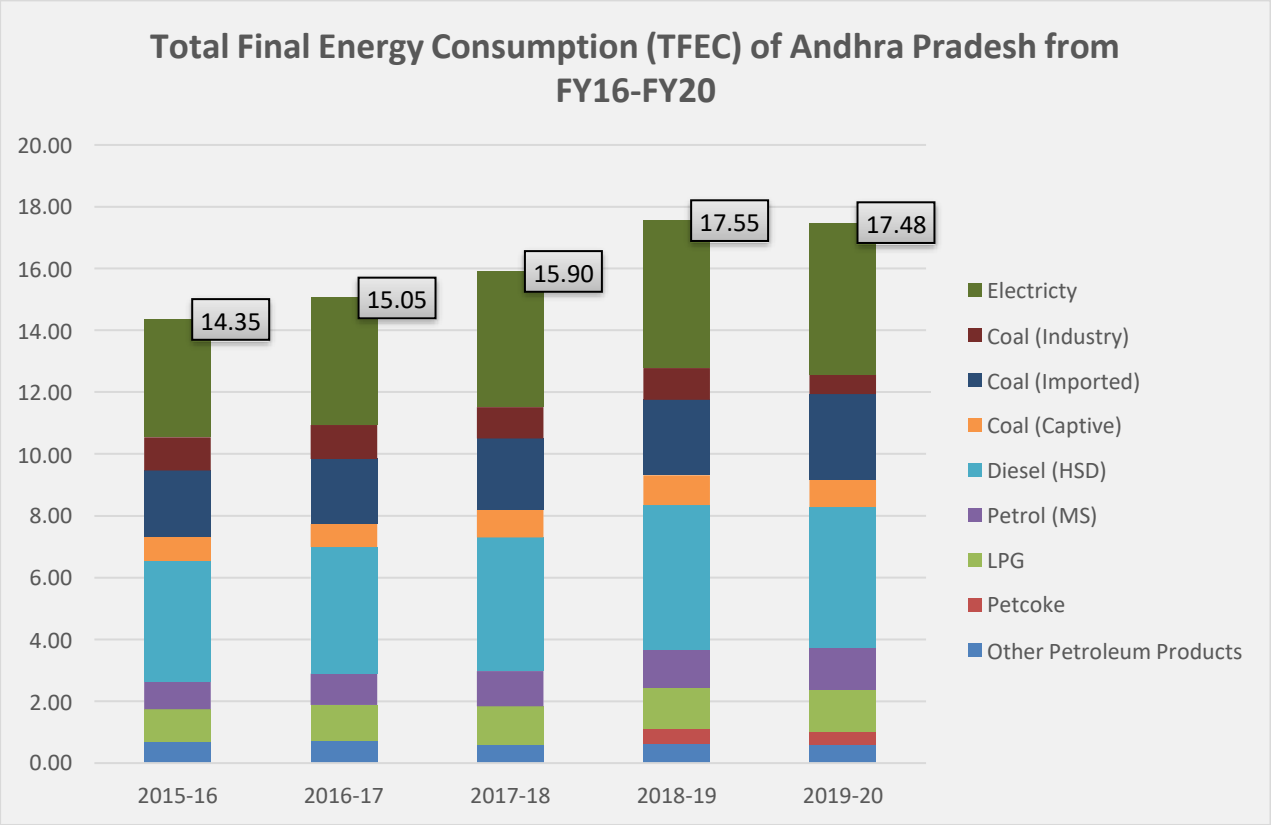
intensity of GHG emissions, and it can be reached by improving energy efficiency and reducing the usage of fossil fuels.

The essence of progress towards a long-term sustainable economy is to benefit both people and the environment. To achieve economic growth and long-term development, we must drastically reduce our environmental footprint by altering how we create and use commodities and resources.

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

The Total Final Energy Consumption (TFEC) of Andhra Pradesh for the FY2019-20 is 17.48Mtoe (Million Tonnes of Oil Equivalent). It accounts for the total energy consumed from electricityand fuel like coal, major petroleum products like LPG, diesel, ATF, furnace oil etc.[7]

Figure 2 TFEC for Andhra Pradesh state



The below figure shows the distribution of various energy sources. Oil has the highest consumption. It includes diesel and petrol which are extensively used as fuels for road transportation, LPG which is widely used for cooking purposes in residential households. Diesel and other petroleum products which are used as fuel in various industries for heating, power generation, and operating machinery. Electricity has 26% in Andhra Pradesh followed by coal. The majority of coal consumption in Andhra Pradesh is in thermal power plants.

[7]The TFEC is derived from data in CEA General Review (electricity), MoPNG's Petroleum and Natural Gas Statistics (oil), and the Coal Directory (coal).

Figure 3 Contribution of energy sources for FY2020

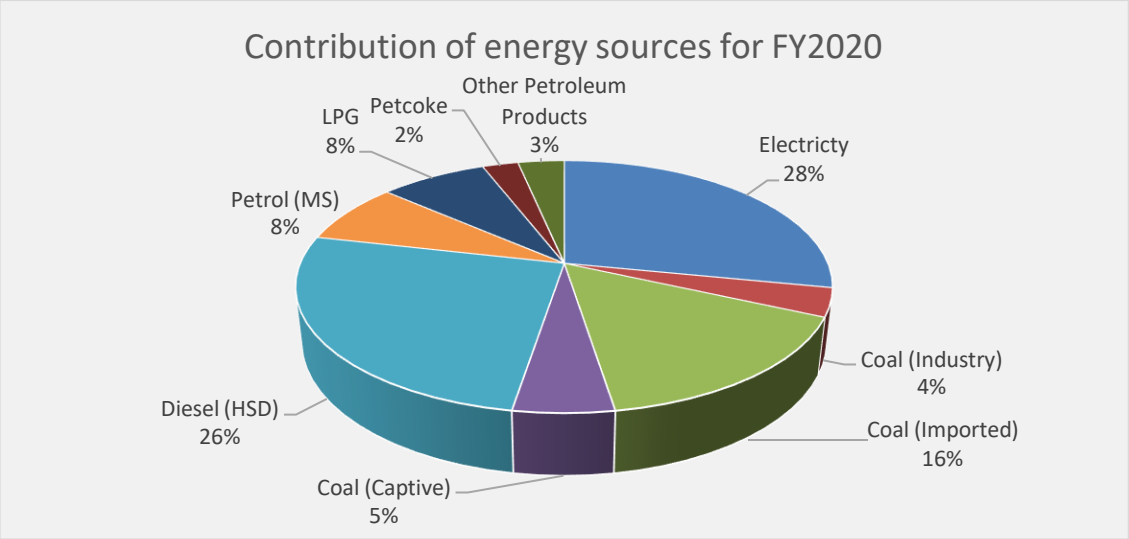


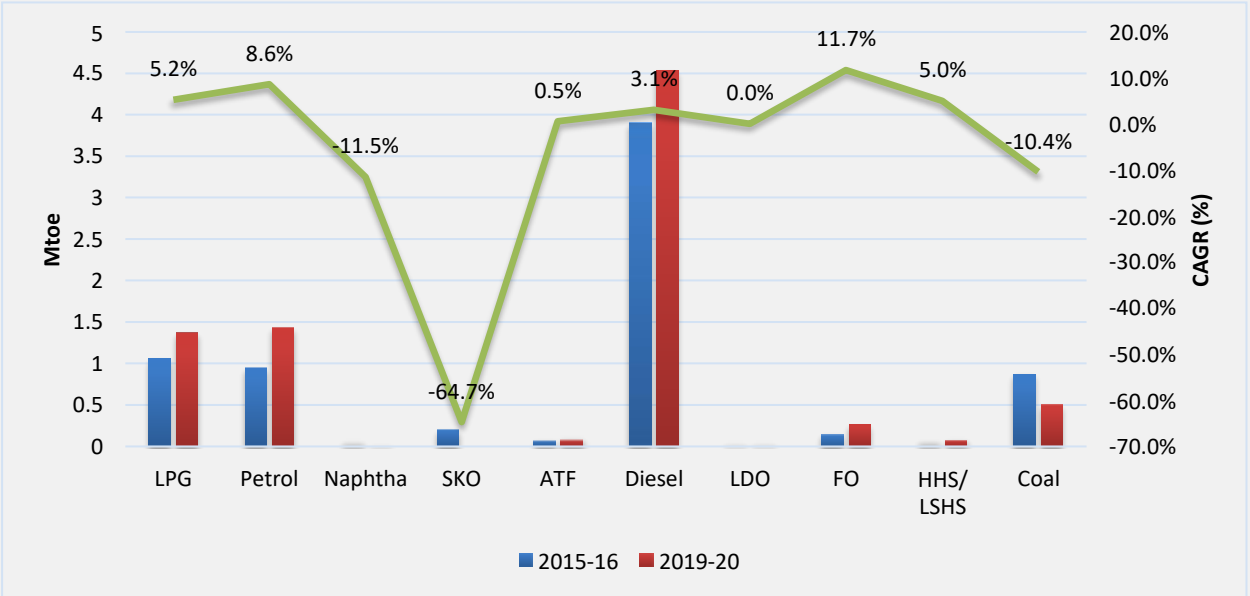
Figure 4 shows the energy supplied by primary fuels from FY 2015-16 to FY2019-20 in Andhra Pradesh. LPG, petrol, diesel, and furnace oil show an increasing CAGR growth over a period of five years. However, and coal show a negative CAGR.

Kerosene consumption in the state for the public distribution system has been declining over the years, with the rate of reduction increasing in recent years. The Ujjwala Yojana, which provides LPG connections to BPL households, has hastened the decline in kerosene usage, as it has monetary incentives provided to states for decreased kerosene off-take.

Coal scarcity has gripped not only Andhra Pradesh, but the whole country. Coal supplies have dropped to their lowest level in nine years, resulting in blackouts. Despite an increase in demand for power, supply has been impacted by the international coal crisis.

The growth was observed in LPG (3.36 %), Petrol (9.08%), Naphtha (3.85) in 2019-20 vis-à-vis 2018-19. The negative trend was observed in Kerosene, Diesel, Furnace Oil, Bitumen, LDO.

Figure 4 CAGR comparison of FY2015-2016 vs FY2019-2020



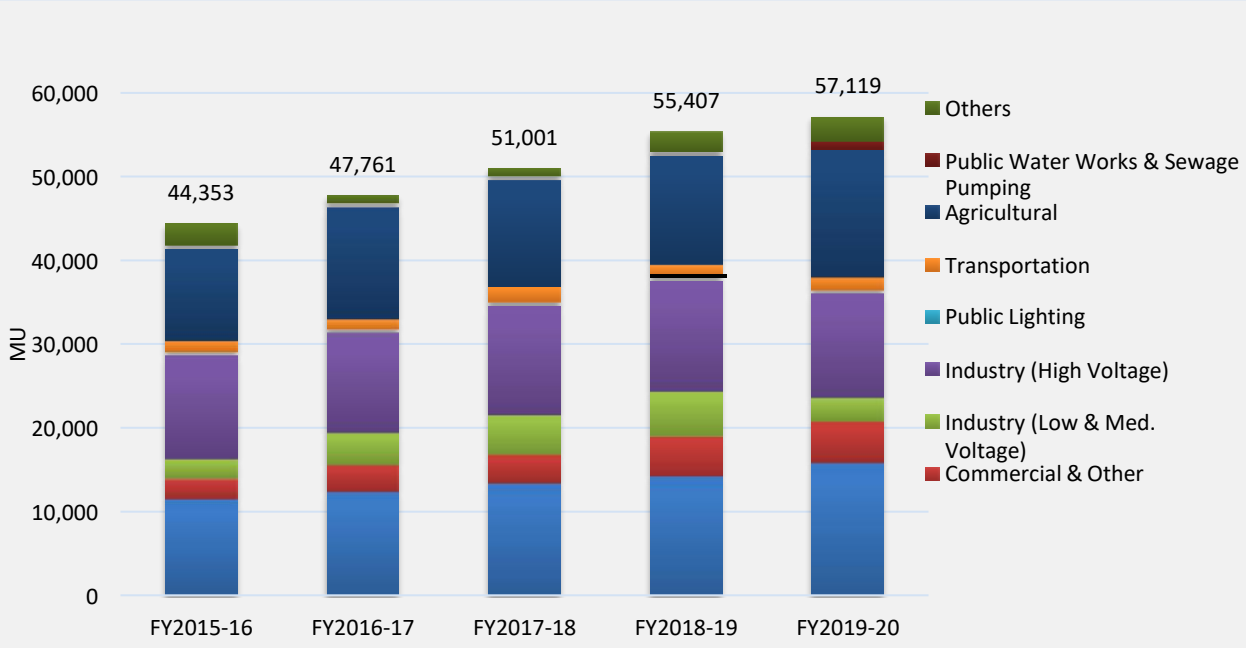
Electricity Demand

Andhra Pradesh was the first state in the country to introduce Power Sector Reforms during 1998.As a result of the reforms, the APSEB was unbundled into APTRANSCO, APGENCO and DISCOMS and independent APERC was established.[8] Significant number of investments were made for building up generation capacity, strengthening transmission and distribution network, industrial feeder segregation, loss reduction and improving quality of power supply.

The main types of loads on a system are domestic, commercial, agricultural, industrial, and municipal, traction etc. Accordingly, the consumers are categorised as domestic consumers, commercial consumers, agricultural consumers, industrial consumers (small, medium, and large), traction consumers and lastly municipal consumers which includes public lighting and public water and sewage system.

Electricity consumption in Andhra Pradesh registered a 3% increase during FY2019-20, reaching 57,119 MU. Public sector utilities remained the dominant players, distributing 98.73% (56,391.720 MU) of the total electricity, while the private sector (including cooperatives) maintained a modest 1.27% share. The following graph shows the 7 electricity consumption of Andhra Pradesh over a period of FY 2015 to FY 2020.

Figure 5 Electricity consumption of Andhra Pradesh over a period of FY 2015 to FY 2020[9]



Consumer Category Analysis:

1. **Domestic (Residential & Commercial):** This category constituted the largest consumer segment, accounting for 28% of total energy sales. This represented an 11.5% increase over FY2018-19, attributed to increased summer temperatures and higher occupancy rates during lockdown periods.

[8]https://www.ap.gov.in/wp-content/uploads/2018/12/White-Paper-on-Energy-and-Trunk-Infras-2-Final-for-Printing-with-index-page.pdf

[9] CEA General Review Reports (FY19, FY20) & CEA Dashboard (FY16, FY17, FY18)

2. **Industrial:** The industrial sector experienced a downturn, with its share of total energy decreasing from 33% to 26.78%. This decline can be primarily attributed to the overall economic slowdown exacerbated by the COVID-19 pandemic and associated lockdown measures.
3. **Commercial:** Commercial consumers maintained a stable consumption pattern, slightly increasing their share of total energy sales from 8.53% to 8.63%.

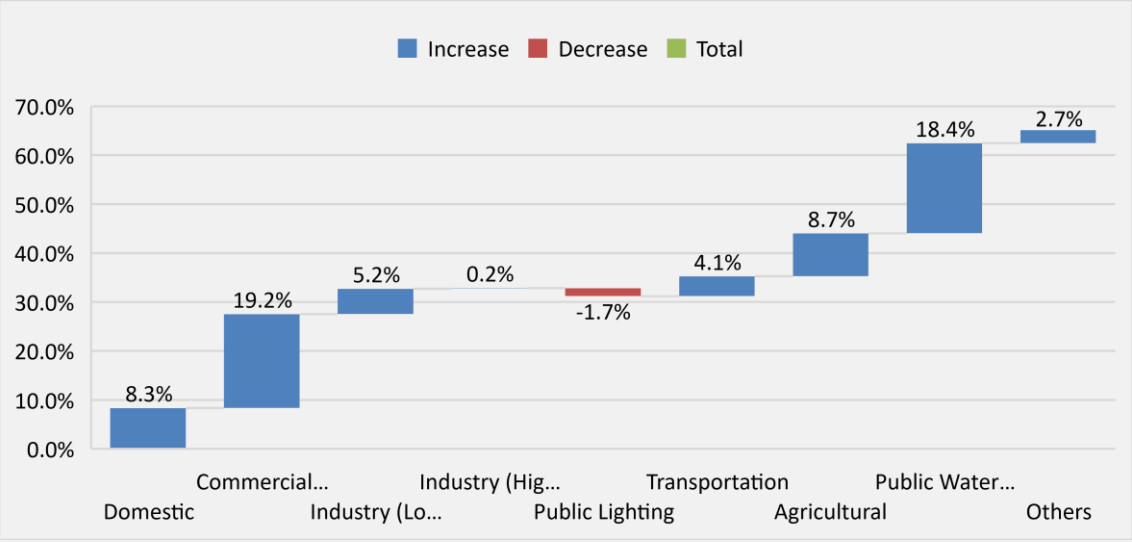
4. **Agriculture:** Agricultural consumption witnessed a significant rise, reaching 27% of total sales compared to 23% in the previous year. This can be attributed to factors such as increased land under cultivation due to favourable rainfall and the implementation of the A.P. government's "NAVARATNALU" initiative, which provided expanded daytime power supply to farmers.

5. **Public Lighting:** Public lighting consumption witnessed a substantial decrease (46.4%) to 296.710 MU due to the widespread adoption of energy-efficient LED street lighting and initiatives like the Gram UJALA program and the Street Light National Program.

6. **Public Water:** Public water consumption experienced a noteworthy surge (64.8%) to 955.320 MU, driven by factors such as increased rural pump installations, borewell/pond construction under government schemes, and the expansion of urban water supply infrastructure through new service connections and internal distribution pipelines. Additionally, the construction of village and city sewerage systems and wastewater treatment facilities contributed to the rise in water consumption.

The figure below shows the CAGR spreading across the range of FY2015-16 to FY2019-20 for all the power consuming sectors. It can be observed that almost all the sectors signify an increasing growth in terms of energy consumption.

Figure 6 Electricity Sales CAGR from FY2015-16 to FY2019-20[10]



Commercial sector shows the largest growth of 19.2% which shows the increase in energy consumption of commercial consumers.

[10]Calculated from the data taken from CEA General Review report

Transportation sector is also growing at a rate of 4% which is due to the increase in electrification of railway network in Andhra Pradesh and addition of new infrastructure in various towns.

Industrial sector (low & medium voltage) has a rising CAGR when compared to FY2015-16 and it can be linked to the industrial growth. The state's MSME profile has shifted significantly towards capital-intensive industries. MSMEs are a central element of value chain of Andhra Pradesh which has led to its massive progress.

Public lighting CAGR is the lowest and can be attributed to the replacement of streetlight to LEDs and public water supply has a positive CAGR due to the factors mentioned in the previous section.

1.6 Overview of Institutional framework and stakeholder mapping Energy

Power sector of Andhra Pradesh is divided into 4 categories namely Regulation, Generation, Transmission and Distribution. Andhra Pradesh Electricity Regulatory Commission (APERC) is the regulatory body. The following figure explains the institutional infrastructure of the power sector.The following section covers the institutional infrastructure of power sector in Andhra Pradesh segregated based on area of function[11].

Table 1 Institutional infrastructure of Generation

ORGANISATION	DESCRIPTION
AP Generation Company Limited (APGENCO)	APGENCO came into existence and commenced operations from 01.02.1999. This was a sequel to Governments reforms in Power Sector to unbundle the activities relating to Generation, Transmission and Distribution of Power. All the Generating Stations owned by erstwhile APSEB were transferred to the control of APGENCO. After reorganisation of state of the Andhra Pradesh according to Andhra Pradesh Reorganisation Act, 2014, the assets, liabilities, employees etc. of APGENCO are apportioned between the two successor states.
Andhra Pradesh Power Development Company Limited (APPDCL)	APPDCL was initially a joint venture company of APGENCO (with 50% equity) and IL&FS (50% equity) formed in 2006 to set up Krishnapatanam thermal power project (2x800 MW) at Nellore. As of now, this 3 x 800 MW station is owned by APGENCO and DISCOMs and is called Sri Damodaram Sanjeevaiah Thermal Power Station (SDSTPS).
Central and private generating stations	NTPC has a thermal power plant located in AP (Simhadri), and AP receives share from many NTPC, NLC and NPC stations. There are private generating stations based on natural gas, wind, solar, biomass and coal.

[11]https://www.prayaspune.org/peg/resources/power-perspective-portal/263-state-overview-andhra-pradesh.html

New & Renewable Energy Development Corporation of Andhra Pradesh Ltd. (NREDCAP)	Energy Development Corporation of Andhra Pradesh Ltd. (NREDCAP) NREDCAP formed in 1986, is the state nodal agency for renewable energy and energy conservation.
Andhra Pradesh Solar Power Corporation Private Limited (APSPCL)	Joint venture between SECI (Solar Energy Corporation of India), APGENCO and NREDCAP formed in 2014, for development of Solar Parks in Andhra Pradesh.
Andhra Pradesh Green Energy Corporation Limited (APGECL)	APGECL was set up in 2020, for establishing 10,000 MW of solar power capacity to supply power for agriculture. APGECL is a 100% subsidiary of APGENCO.

Table 2 Institutional infrastructure of Transmission

ORGANISATION	DESCRIPTION
AP Transmission Corporation Limited (APTRANSCO)	All the substations and transmission lines physically located in AP are within the purview of APTRANSCO. In addition, there are transmission lines of POWERGRID located in the state
AP State Load Dispatch Centre (APSLDC)	SLDC is part of APTRANSCO. Renewable Energy Management Centre (REMC) to manage renewable projects is a part of SLDC and was inaugurated in early 2020.

Table 3 Institutional infrastructure of Distribution

ORGANISATION	DESCRIPTION
AP Eastern Power Distribution Company Limited (APEPDCL) AP Southern Power Distribution Company Limited (APSPDCL)	There were four DISCOMs in the united AP state – APEPDCL, APSPDCL, APCPDCL and APNPDCL. After bifurcation, first two companies stayed with residual AP and last two with TS, with different names – TSSPDCL and TSNPDCL. Two districts – Kurnool and Anantapur – which formed part of the erstwhile APCPDCL. were transferred to APSPDCL. There are two Rural Electric Supply Cooperatives (RESCO) in APEPDCL license area (Anakapalle and Cheepurupally) and one in APSPDCL area (Kuppam).
AP Central Power Distribution Company Limited (APCPDCL)	AP Central Power Distribution Company Limited (APCPDCL) Formed in April 2020, covers Guntur, Krishna and Prakasam districts, which were part of APSPDCL.

Table 4 Institutional infrastructure of Regulation

ORGANISATION	DESCRIPTION
AP Electricity Regulatory Commission	Separate APERC was set up in October 2014
Directorate of Electricity Safety	Office of the Chief Electricity Inspector to the Government (CEIG) oversees electricity safety
AP Judicial Preview	Set up through Andhra Pradesh Infrastructure (Transparency through Judicial Preview) Act, 2019, to preview proposals for infrastructure projects by government agencies, before the tendering stage.

Table 5 Institutional infrastructure of Power Purchase

ORGANISATION	DESCRIPTION
AP Power Coordination Committee (APPCC)	As in the united AP state, power purchase is managed by APPCC on behalf of the DISCOMs. This is an internal arrangement with two sub-committees – the Power Trading Committee and the Balancing and Settlement Committee. APPCC is set up through a Government Order. It is headed by the CMD of TRANSCO with TRANSCO Directors (Finance and Commercial) and CMDs of DISCOMs as members.3 Chief General Manager – Commercial (APTRANSCO) manages the operations, including inviting tenders, though the PPAs are signed by the DISCOM CMDs.

Recognizing the importance of energy conservation activities, the Government of Andhra Pradesh established the State Energy Conservation Mission (SECM) in 2012with the Chief Secretary to the Government of Andhra Pradesh as Chairman, Secretary, Energy Department as Vice Chairman, and Principal Secretaries of various key departments such as, Agriculture, Industry, Education, Municipal Administration & Urban Development (MA&UD), Panchayat Raj etc. as members of the committee.

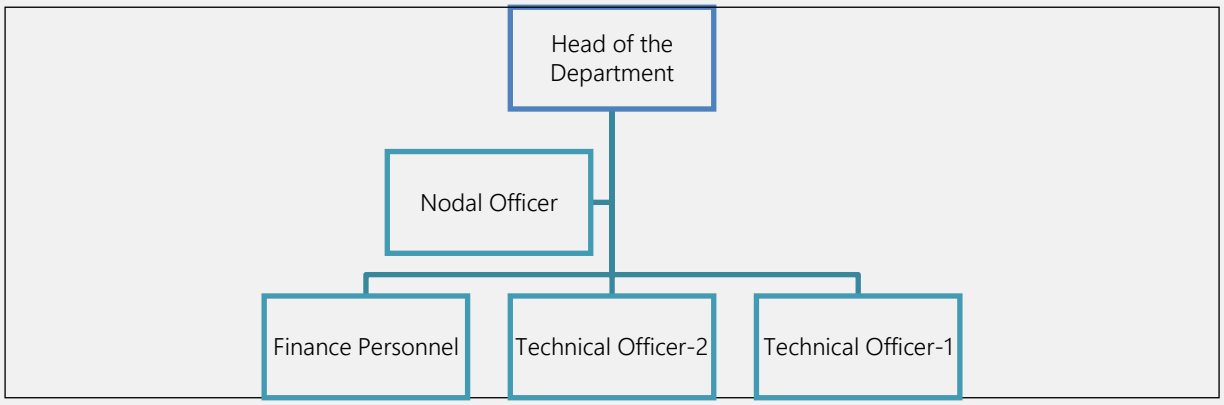
The Government of Andhra Pradesh has now made the Power Sector a primary focus, as well as the promotion of energy efficiency and conservation, which is the most cost-effective way to satisfy rising energy demand. Energy efficiency is critical for the State's cost-effective electricity and long-term growth, and it necessitates the active participation of all departments.

Given the significance of energy efficiency, it is mandated that Energy Conservation (EC) Cells be established in all State Government Heads of Department (HOD) offices, District level offices, and Corporations/Societies offices. Each Energy Conservation (EC) Cell established for this purpose will serve as a Nodal Agency, coordinating with the Chief Executive Officer (CEO), State Energy Conservation Mission (SECM), to ensure that Energy Conservation and Energy Efficiency measures are implemented effectively in each Department Organization.

The goal of Energy Conservation Cells is to integrate cost-effective, energy-efficient technology into state government departments while also promoting an energy-conscious culture that supports prudent energy use decisions.

In the long run, the reduction in overall energy demand will benefit all government departments, effectively addressing rising energy use and costs.

Figure 7 Organization Structure of Energy Conservation Cell

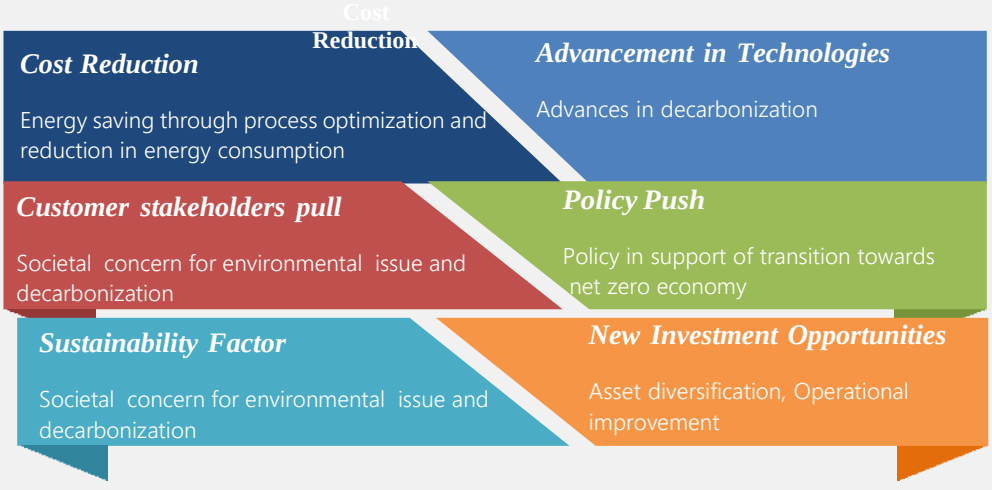


According to the estimates of the Government of India's Bureau of Energy Efficiency and the Energy Department's Andhra Pradesh State Energy Conservation Mission (APSECM), there is an estimated energy saving potential of roughly 20% against the state's annual energy need of about 66000 MU. The expected energy savings for the period 2014-2019 were just approximately 2000 MU. There is a lot of room for energy reductions, especially in government departments.

Energy Efficiency Drivers for State

The State of Andhra Pradesh, securing a notable score of 77.5, emerged as the runner-up in the State Energy Efficiency Index (SEEI), underscoring its commitment to energy efficiency. This remarkable achievement can be attributed to several key drivers as displayed below:

Figure 8 Energy efficiency drivers of the state



These dynamic drivers, combined with Andhra Pradesh's unwavering commitment to innovation and community engagement, have laid the foundation for a comprehensive and ambitious "State Energy Efficiency Action Plan". This plan has aimed to leverage existing achievements, address potential challenges, and propel the state even further on its path towards a sustainable and energy-efficient future.

2 IDENTIFICATION OF FOCUS SECTORS

2.1 Methodology for identifying focus sectors

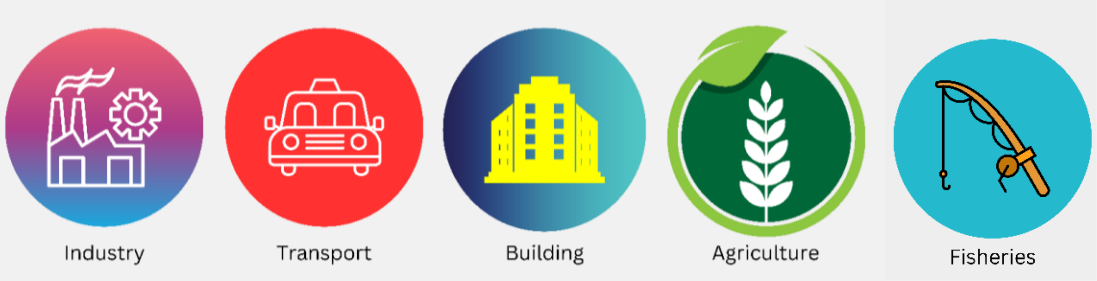
One of the key objectives of the State Energy Efficiency Action Plan (SEEAP) is the strategic allocation of resources. To ensure maximum impact and optimize energy savings, it's crucial to identify the sectors for intervention and improvement. The methodology for identifying focus sectors consisted of following factors:

- **Energy Consumption**: The first step in identifying the focus sectors involved analysing the state's energy consumption patterns. This analysis considered the overall energy consumption in Andhra Pradesh, including both primary and secondary energy sources over a period of FY 2015-2020. Understanding the sectors responsible for significant energy consumption provided insights into areas where potential improvements could yield substantial benefits.
- **Carbon Dioxide Emissions:** Simultaneously, an assessment of emissions generated by different sectors was conducted. This analysis helped in identifying sectors with higher carbon footprints and those contributing significantly to air pollution and greenhouse gas emissions.
- **Gross State Value Addition (GSVA):** The GSVA study provided an understanding of the economic contribution of different sectors to Andhra Pradesh's economy. Sectors with high GSVA were given priority as improving energy efficiency and reducing emissions in these sectors could have a more significant impact on the state's overall economic growth.
- **Policy Gap Analysis**: A thorough gap analysis of state schemes and policies was performed for each sector to identify existing challenges in these sectors. This step allowed identifying specific areas where targeted interventions and policies could yield the best results.
- **Stakeholder Inputs**: The inputs and feedback from various stakeholders and government agencies, were considered. This helped in understanding the priorities and concerns of key stakeholders in the state's energy and environmental landscape.
- **State Designated Agency (SDA) and Government Vision:** The focus sectors aligned with the state's long-term development agenda and the vision of the state government were given preference. This ensured that the selected sectors were in line with the overall strategic direction of the state.

2.2 Identified focus sectors

Above mentioned indicators and situation assessment were used to define target focus sectors and specific industries.

The following sectors are focused for the development of "State Energy Efficiency Action Plan" for Andhra Pradesh.



- **Industry:** This sector is a significant energy consumer in Andhra Pradesh, and optimizing its energy use presents substantial opportunities for savings. Additionally, the diverse range of industries within the sector allows for targeted interventions tailored to specific sub-sectors for maximum impact.
- **Transport:** Energy consumption in the transportation sector has been steadily increasing, driven by factors such as rising vehicle ownership and urbanization. Addressing energy efficiency in this sector will not only yield significant savings but also contribute to reduced air pollution and improved environmental health.
- **Buildings:** Buildings across residential, commercial, and government sectors represent a major energy sink. Implementing energy-efficient building practices and retrofitting existing structures can lead to substantial energy savings while improving occupant comfort and reducing construction costs.
- **Agriculture and Fisheries:** The agricultural and fisheries sectors play a vital role in Andhra Pradesh's economy and rely heavily on energy-intensive processes like irrigation and cold storage. By implementing energy-efficient technologies and practices in these sectors, it is possible to enhance operational efficiency, reduce production costs, and improve farmer livelihoods.

This report, by focusing on these key sectors, aspires to provide actionable insights and policy recommendations that can guide the implementation of the State Energy Efficiency Action Plan. The proposed strategies and interventions aim to drive sustainable development in Andhra Pradesh by promoting both economic growth and environmental responsibility through significant energy savings and reduced carbon emissions.

3 ENERGY DEMAND PROJECTIONS

3.1 Methodology for estimating the TFEC projection

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 Policymaking:

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 policymaking, 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.

Methodology for estimating the TFEC projection:

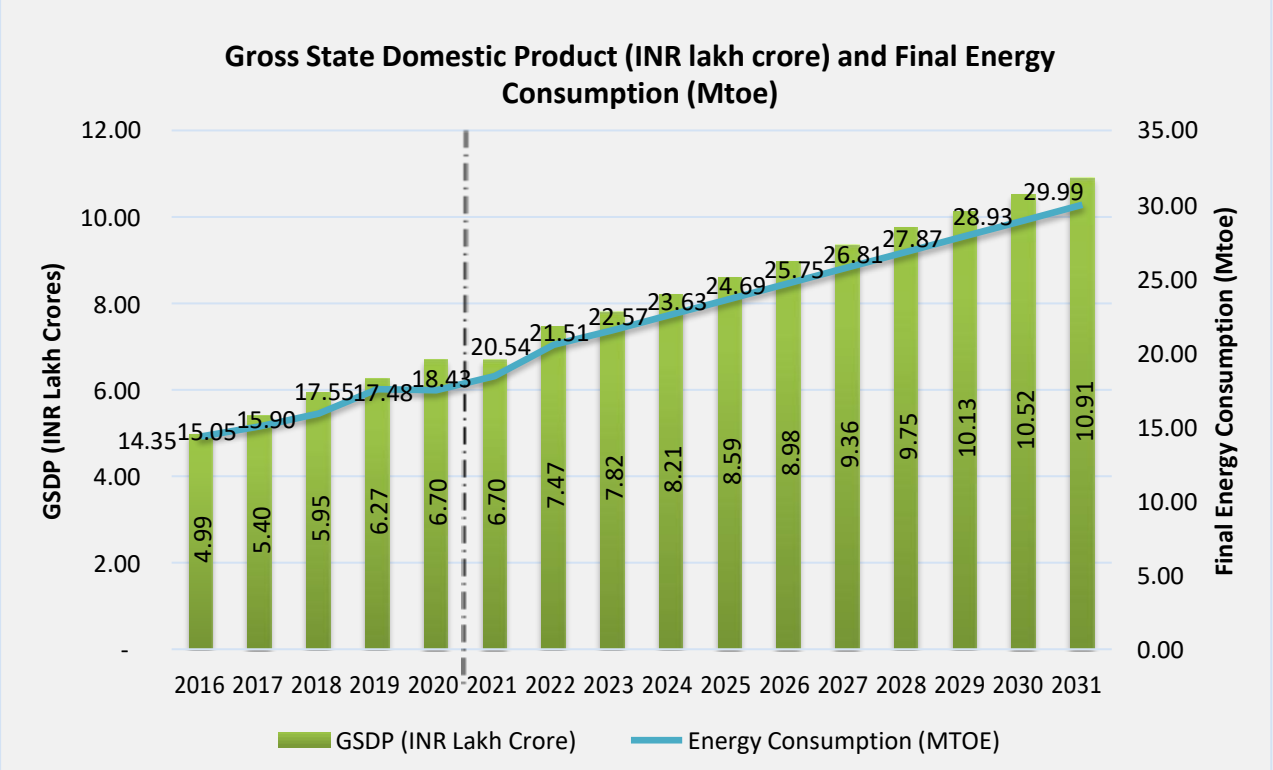
The methodology employed for estimating the TFEC projection for Andhra Pradesh involved analysing historical trends in final energy consumption and Gross State Domestic Product (GSDP) and growth of GSDP as per the state's vision.

The state GSDP was ₹7.47 lakh crore in 2022. Based on this, the GSDP is expected to reach ₹10.91 lakh crore by FY 2031. 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 2016 to FY 2021 where it observed to be decreasing by 2% year on year. By assuming a similar trend to continue till FY 2031, the expected energy intensity is about 2.75 Mtoe/ ₹ lakh crore in FY 2031 as compared to 2.88 Mtoe/₹ lakh crore in FY 2021.

Using the calculated GSDP and energy intensity, the TFEC for FY 2031 is calculated to be 29.99 Mtoe. The graph below depicts the trends of GSDP, energy intensity and TFEC between FY 2016 to FY 2031 for the state of Andhra Pradesh.

Figure 9 Gross State Domestic Product (INR lakh crore) and Final Energy Consumption (Mtoe)[12]



By examining energy consumption and intensity trends, it is possible to identify factors that influence energy demand, such as changes in economic conditions, shifts in technology, and

[12] RBI- Handbook of Statistics on Indian States- Gross State Domestic Product (Constant Prices)

alterations in government policy. Additionally, analysing energy intensity trends can provide insights into the efficiency of energy usage and the effectiveness of energy-saving measures.

3.2 Energy Scenarios

Projected total final energy consumption (TFEC) for FY 2025-26 and FY 2030-31 are assessed under three scenarios: Business as Usual (BAU), Moderate (MOD), and Ambitious (AMB). These scenarios provide strategic insights into potential energy savings within the identified focus sectors: transport, industries, buildings, agriculture, and fisheries.

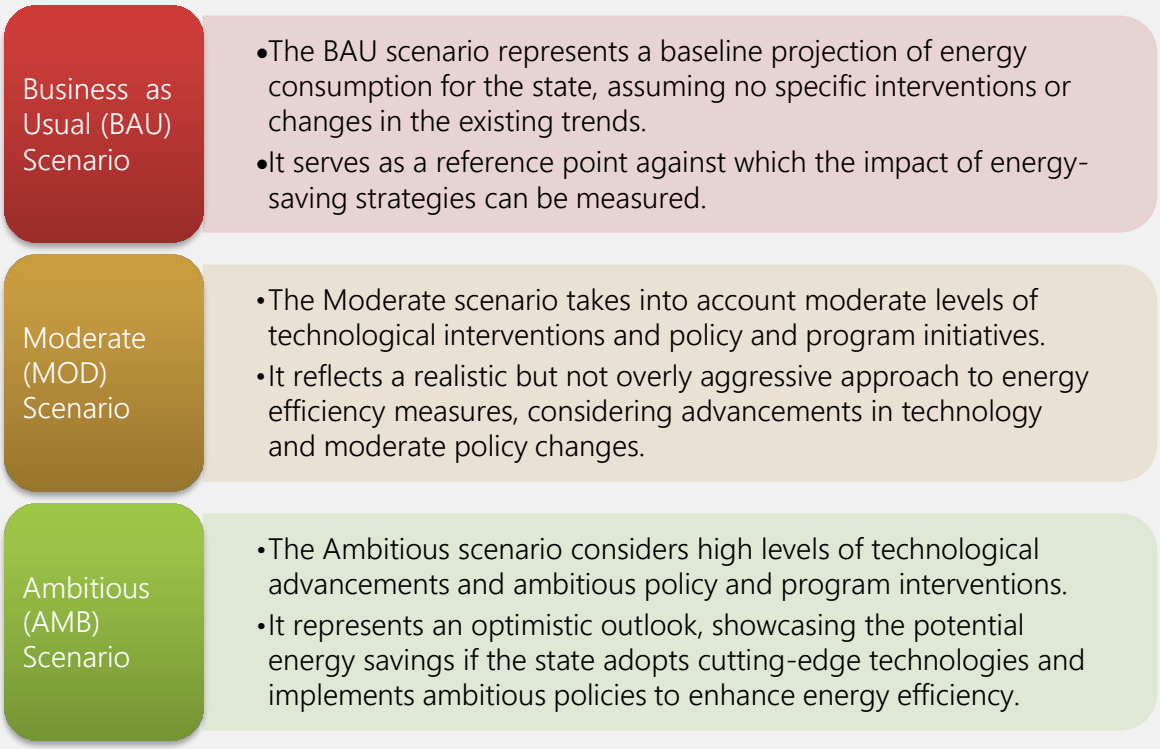


Figure 10 Description of key energy scenarios

Factors Influencing Scenarios:

Technological Interventions: The level of advancement in technologies related to energy consumption plays a significant role in shaping the Moderate and Ambitious scenarios. This includes improvements in energy-efficient appliances, industrial processes, and renewable energy technologies.

Policy Interventions: The extent of governmental policies and programs aimed at promoting energy efficiency greatly influences the outcomes of the Moderate and Ambitious scenarios. This involves initiatives such as energy conservation policies, incentives for renewable energy adoption, and regulatory frameworks.

Figure 11 Factors Influencing Scenarios

Factors Influencing Scenarios	*Technological Interventions*	*Policy Interventions*
Transport	Electric vehicles, intelligent transportation systems.	Incentives for electric vehicles, emission standards.

Industries	Energy-efficient manufacturing, Industry 4.0 technologies.	Energy efficiency standards, financial incentives.
Buildings	Smart technologies, energy-efficient HVAC systems.	Stringent building codes, green building incentives.
Agriculture	Precision farming, sustainable practices.	Sustainable farming policies, incentives for efficiency.
Fisheries	Advanced technologies in aquaculture and fishing practices.	Policies promoting sustainable fisheries and energy-efficient equipment.

These energy scenarios provide a framework for understanding the potential energy savings that can be achieved through strategic interventions in the designated sectors. It enables policymakers to make informed decisions based on a range of possibilities, from a conservative business-as-usual approach to ambitious and transformative energy efficiency measures.

4 FOCUS SECTOR 1: INDUSTRY

4.1 Overview

Andhra Pradesh has a diverse and growing industry sector that contributes significantly to the state's economy. The state is known for its focus on industrial development and has implemented various policies and initiatives to attract investments and promote industrial growth. Manufacturing is a key sector in Andhra Pradesh, contributing significantly to the state's GDP. The state has a strong presence in industries such as cement, thermal power plants, iron & steel, pharmaceuticals, textiles and garments, food processing, automotive components, electronics, and chemicals. Major industrial clusters are located in cities like Visakhapatnam, Vijayawada, Guntur, and Tirupati.

Index of Industrial Production (IIP)

The Index of Industrial Production (IIP) serves as a benchmark for assessing the growth of the industrial sector. It measures the relative change in physical production within the industry field over a specific period compared to the preceding period. On a monthly basis, the IIP is calculated for the Manufacturing, Mining & Quarrying, and Electricity sectors. Its primary objective is to gauge the Industrial sector's contribution to the Gross State Domestic Product. In the State, the IIP is compiled using the 2011-12 base year, covering 23 industrial classifications at a 2-digit level within the manufacturing sector.

According to the Quick estimates of IIP, during the period 2021-22 compared to 2020-21, the Mining and Quarrying sector experienced a growth rate of -0.70%, the Manufacturing sector grew by 6.8%, the Electricity sector grew by 9.4%, and the General Index grew by 6.7%. The following are the indices of IIP for the state.

Table 6 Index of Industrial Production (Base Year=2011-12)[13]

Sr	Industry Group	Weight	Growth Rate (from FY21 to FY22)
1.	Manufacture of basic metals	155.37	17%
2.	Manufacture of other non-metallic mineral products	109.69	22%
3.	Manufacture of food products	89.56	0%
4.	Manufacture of chemicals and chemical products	60.71	8%
5.	Pharmaceuticals, medicinal chemical and botanical products	54.45	-9%
6.	Manufacture of textiles	31.33	24%
7.	Manufacture of tobacco products	29.24	18%
8.	Manufacture of electrical equipment	29.10	-49%
9.	Manufacture of coke and refined petroleum	14.78	-6%

[13] Directorate of Economics & Statistics, Govt of AP

	products		
10.	Manufacture of beverages	11.81	18%
11.	Manufacture of paper and paper products	8.70	6%
12.	Manufacture of machinery and equipment n.e.c.	5.72	-23%
13.	Other manufacturing	5.46	29%
14.	Manufacture of rubber and plastics products	4.98	6%
15.	Manufacture of other transport equipment	4.44	2%
16.	Manufacture of fabricated metal products, except machinery and equipment	4.41	378%
17.	Manufacture of wearing apparel	3.06	-36%
18.	Manufacture of motor vehicles, trailers and semi-trailers	2.55	71%
19.	Manufacture of leather and related products	1.29	75%
20.	Manufacture of wood and products of wood and wood and cork	1.12	38%
21.	Manufacture of computer, electronic and optical products	0.84	-62%
22.	Printing and reproduction of recorded media	0.32	-39%
23.	Manufacture of manufacture of furniture	0.26	15%
A.	Total manufacturing	629.00	7%
B.	Mining and quarrying	194.33	-1%
C.	Electricity	176.67	9%
D.	General index	1,000.00	7%

The Index of Industrial Production (IIP) provides insights into the industrial growth of various sectors in Andhra Pradesh. Among the manufacturing industries with the highest weightage in the IIP, several are already covered under the Bureau of Energy Efficiency's (BEE) scheme called PAT (Perform, Achieve, Trade).

These industries in Andhra Pradesh have significant production levels, making energy efficiency measures essential. Implementing energy-efficient technologies, optimizing processes, adopting renewable energy sources, and promoting energy management practices can help reduce energy intensity, minimize environmental impact, and improve overall operational efficiency in these sectors. Manufacturing industries in Andhra Pradesh with the highest weightage of IIP are discussed below:

- Manufacture of basic metals (155.37): This industry plays a crucial role in Andhra Pradesh's economy, as it includes the production of iron, steel, and other metal products. It contributes significantly to the state's industrial output and provides employment opportunities. Basic metals manufacturing is typically energy-intensive due to the requirement for high-temperature processes like smelting and refining.

- Manufacture of other non-metallic mineral products (109.69): This industry encompasses the production of cement, ceramics, glass, and other non-metallic mineral-based products. It supports the construction and infrastructure sectors, contributing to economic development. Energy intensity in this industry can be high due to energy-intensive processes like kiln firing in cement production and melting in glass manufacturing.

- Manufacture of food products (89.56): The food processing industry is essential for agricultural value addition and preservation of perishable produce. It includes activities such as milling, processing, preserving, and packaging of food items. While energy intensity can vary across different food sub-sectors, certain processes like heating, drying, and refrigeration contribute to energy consumption.

- Manufacture of chemicals and chemical products (60.71): This industry involves the production of various chemicals, including fertilizers, dyes, pharmaceuticals, and industrial chemicals. It supports several downstream industries and has a significant impact on the state's economy. Implementing energy-efficient technologies, such as process optimization and waste heat recovery, is crucial for reducing energy intensity and improving overall operational efficiency.

- Pharmaceuticals, medicinal chemical, and botanical products (54.45): The pharmaceutical industry plays a significant role in Andhra Pradesh's economy, contributing to healthcare and exports. Manufacturing pharmaceutical products involves energy-intensive processes such as synthesis, purification, and formulation. Energy efficiency measures, including equipment optimization and adoption of green chemistry principles, can help reduce energy consumption while maintaining product quality.
- Manufacture of textiles (31.33): Andhra Pradesh has a strong textile industry, encompassing spinning, weaving, and garment manufacturing. Textile production involves various energy-intensive processes, including spinning, weaving, dyeing, and finishing. Implementing energy-efficient technologies, such as energy-efficient motors, heat recovery systems, and process optimization, can significantly reduce energy consumption and improve sustainability in this sector.
- Manufacture of coke and refined petroleum products (14.78): This industry includes the production of coke, petroleum refining, and related products. It supports the energy sector and contributes to the state's industrial growth. Energy-intensive processes such as refining crude oil and coke production require efficient energy management practices and technologies to reduce energy consumption, improve operational efficiency, and minimize environmental impacts.
- Manufacture of beverages (11.81): This sector involves the production of alcoholic and non-alcoholic beverages, including beverages derived from fruits, tea, coffee, and carbonated drinks. While energy intensity may vary across different beverage sub-sectors, energy efficiency measures like optimizing refrigeration systems, adopting efficient packaging methods, and managing production line operations can help reduce energy consumption and improve sustainability.

- Manufacture of paper and paper products (8.70): Energy-intensive processes such as pulp production, papermaking, and drying require efficient energy management practices. Adopting technologies like energy-efficient pulp processing, optimized drying methods, and waste reduction can contribute to reducing energy intensity and promoting sustainability in this sector.

PAT Scheme

Perform, Achieve and Trade (PAT) cycle scheme is a flagship programme of Bureau of Energy Efficiency under the National Mission for Enhanced Energy Efficiency (NMEEE). Every energy intensive industry and other establishments whose annual energy consumption is equal to or greater than the threshold limit specified in MoP, GoI notifications from time to time, shall be deemed to be Designated Consumer (DC).

SR NO	PAT CYCLE	YEAR	DCs
1.	PAT Cycle -I	2012-15	24
2.	PAT Cycle –II	2016-19	32
3.	PAT Cycle –III	2017-20	4
4.	PAT Cycle –IV	2018-22	5
5.	PAT Cycle –V	2019-22	10
6.	PAT Cycle –VI	2020-23	5
7.	PAT Cycle - VII-1	2022-25	26
8.	PAT Cycle - VII -2	2022-25	6
9.	PAT Cycle - VIII	2023-26	7
Total (PAT CYCLE IV – VIII)			59

SR NO	Sectors in PAT cycle IV - VIII	DCs
1.	Cement	22
2.	Thermal Power Plants	11
3.	Textile	7
4.	Iron & Steel	10
5.	Chlor-Alkali,	2
6.	DISCOM	3
7.	Refinery Hotels	1 1
8.	Pulp & Paper,	2

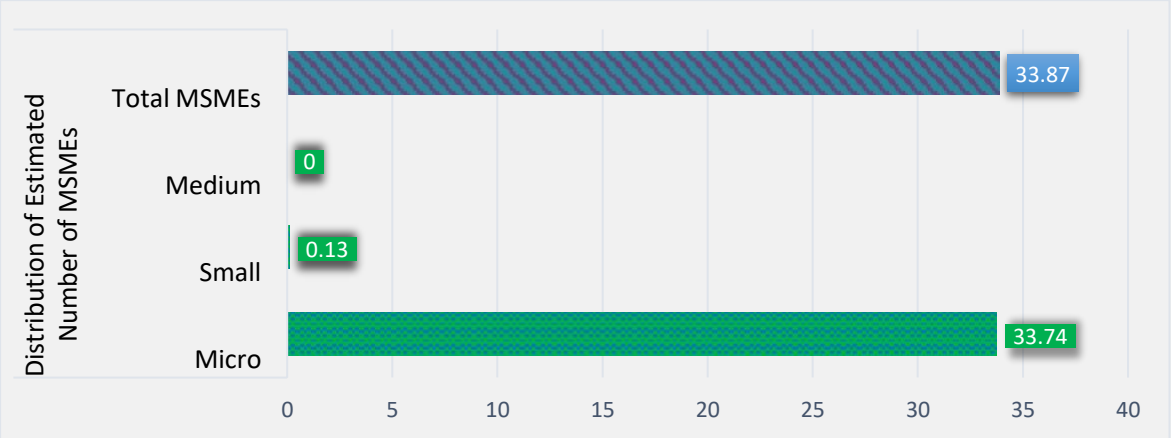
MSME

MSMEs (Micro, Small, and Medium Enterprises) play a crucial role in the economy of Andhra Pradesh, contributing to employment generation, regional development, and entrepreneurship. The number of registered MSMEs in Andhra Pradesh has been steadily increasing. As per the MSME Annual Report 2020-21 of the Ministry of Micro, Small and Medium Enterprises, Government of India, the total number of registered MSMEs in Andhra Pradesh was 33.87 lakhs[14] out of which 33.74 lakhs are micro enterprises as seen in the figure below. These enterprises operate across diverse sectors such as manufacturing, textiles, food

[14]Annual Report 2020-21, Ministry of Micro, Small and Medium Enterprises, Government of India

processing, handicrafts, and services, and they have a significant impact on the state's economy and employment landscape.

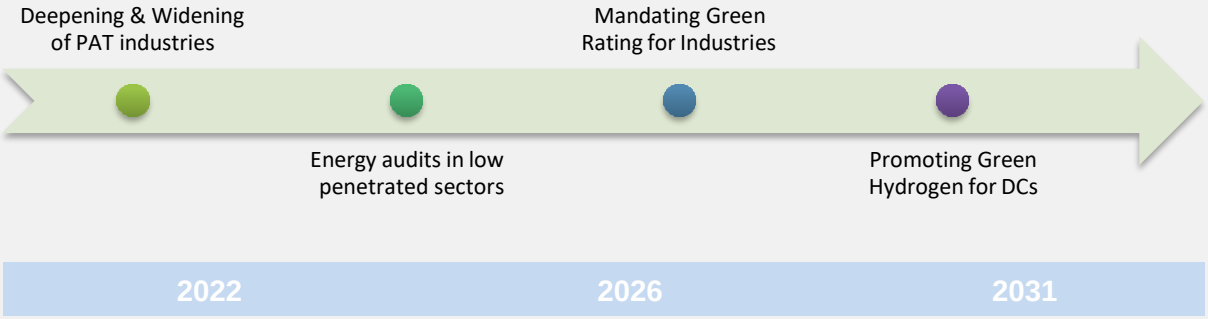
Figure 12 MSMEs in Andhra Pradesh



Energy efficiency holds immense significance for MSMEs in Andhra Pradesh. It enables these enterprises to achieve cost savings, enhance competitiveness, and contribute to environmental sustainability. Energy costs form a substantial portion of operational expenses for MSMEs, and by adopting energy-efficient practices and technologies, they can significantly reduce their energy consumption and achieve cost savings. Additionally, energy efficiency measures contribute to environmental sustainability by reducing greenhouse gas emissions, conserving natural resources, and promoting sustainable development. Moreover, energy efficiency can enhance productivity in MSMEs by optimizing energy use and improving operational efficiency.

4.2 Energy efficiency strategies in the industry sector

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



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

4.2.1 Strategy#1: Deepening of PAT Scheme

Deepening of PAT scheme involves identification of new DCs in existing sectors. Andhra Pradesh, 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 Andhra Pradesh achieve its energy efficiency and emission reduction targets by incentivizing industries to adopt energy-efficient practices and technologies.

Through deepening of PAT Andhra Pradesh 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 Andhra Pradesh.

The strategy and its implementation are explained below.

Scope Boundary
Cement, iron & steel, and paper have been considered under the purview of this strategy. (There are ten PAT sectors covered in Andhra Pradesh i.e Cement, Thermal Power plant, Textile, Iron & Steel, DISCOM, Chlor Alkali, Pulp & Paper, Fertilizer, Refinery & Hotels).
Implementing Agency
• The Bureau of Energy Efficiency (BEE) is responsible for implementing the Perform Achieve and Trade (PAT) Scheme for the industry sector. • BEE sets energy efficiency targets for industries, monitors their performance, and facilitates the trading of energy-saving certificates. • The Department of Industries can collaborate with BEE and APSECM to ensure industry compliance and create awareness about the scheme. • APSECM, the Andhra Pradesh State Energy Conservation Mission may assist BEE in identification of probable DCs who could be included under PAT and assigned mandatory SEC reduction targets.
Current Policy/Policies in Place
PAT Cycle -IV notified 28th March 2018 for the Period 2018-19 to 2021-22 with 5 DCs in Andhra Pradesh with Energy saving Target of 0.115 Mtoe. PAT Cycle – V notified 29th March 2019 for the Period 2019-20 to 2021-22 with 10 DCs in Andhra Pradesh with Energy saving Target of 0.040 Mtoe. PAT Cyle -VI notified 13th April 2020 for the Period 2020-21 to 2022-23 with 5 DCs in Andhra Pradesh with Energy saving Target of 0.084 Mtoe.
Implementation Period
Long Term

Saving Potential

According to the Bureau of Energy Efficiency (BEE), there is an energy saving potential of nearly 2.5% during every cycle of a three-year period. In 2031, for the moderate scenario, an energy reduction of 8% is considered. Similarly, an energy reduction of 12% is considered for ambitious scenario. The following table illustrates the energy saving potential resulting from the deepening of the PAT strategy.

Sector	Baseline SEC (toe/tonne)	Moderate SEC (toe/tonne)	Ambitious SEC (toe/tonne)	Energy Saving 2031-Moderate (Mtoe)	Energy Saving 2031-Ambitious (Mtoe)
Cement	0.44	0.40	0.38	0.40	0.61
Steel	0.08	0.069	0.066	0.08	0.12
Paper	0.41	0.37	0.38	0.09	0.14
			Total Savings (Mtoe):	0.58	0.87
			GHG Emission Reduction Potential (MtCO2)	1.82	2.72

Action Plans:

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

1. **High-Efficiency Electric Motor Replacement Program:**

a) Promote the adoption of high-efficiency electric motors and variable speed drives to enhance industrial energy efficiency. Mandate that all new electric motors sold in the state must conform to IE class 3 or above efficiency standards. Encourage industries to use variable frequency drives (VFDs) along with high-efficiency motors.

b) Phase out inefficient motors and minimize energy consumption in industries by providing financial incentives, such as subsidies or rebates, to industries that replace older, less efficient motors with IE class 3 or above motors and VFDs.

2. **Energy Management Systems (EnMS):**
   Encourage industries to adopt Energy Management Systems (EnMS) for continuous energy monitoring, management, and optimization.

3. **Performance Contracts and ESCOs:**
   Encourage the use of Energy Service Companies (ESCOs) and performance contracts, where ESCOs provide energy-efficient solutions and are compensated based on energy savings achieved.

4. **Green Procurement Practices:**
   Advocate for green procurement practices in both public and private sectors, prioritizing products with low carbon footprints. Establish labelling and certification programs that indicate the environmental impact of products. This helps consumers make informed choices and encourages industries to produce eco-friendly items.
   Provide incentives for businesses that supply low-carbon products to government agencies and other organizations.

5. **Electrification of Heat:**
   Implement electric heating technologies, such as induction heating and resistance heating, in industrial processes. For example, replacing conventional steelmaking processes with electric arc furnaces powered by clean electricity from renewable sources.

6. **Biomass Gasification and Co-firing:**

Implement biomass gasification and co-firing technologies in thermal power plants and industrial boilers. For example, Punjab introduced a new Public-Private Partnership (PPP) model to streamline biomass supply chain logistics.

7. **Transition from Furnace Oil (FO) to LNG for Industrial Boilers:**
   Collaborate with industries to facilitate the transition from FO to cleaner and more efficient liquefied natural gas (LNG) for industrial boilers by offering technical assistance, financial incentives, and guidance on fuel switch planning.

8. **Waste Heat Recovery Program (WHRP**):
   Enforce mandatory installation of advanced waste heat recovery systems, particularly Organic Rankine Cycle (ORC) turbines, in industrial facilities above a certain capacity or energy consumption threshold.

Case Study: PAE guidelines by BEE
Objective Perform Achieve Earn (PAE) scheme is the new scheme that BEE is envisaging to unlock PAT like schemes for MSME which will help in improving SEC of energy-intensive industries and help in cost saving making industries more competitive. In the long-term BEE may also explore synergizing the emission Savings / Reduction by MSMEs to Evolving National Carbon market.
Key Features: Key features include the following:
Benefits to MSMEs: • MSMEs will receive comprehensive hand-holding support throughout the scheme's implementation, including guidance on identifying and adopting efficient technologies and measures, as well as collecting, analyzing, and reporting energy statistics. • MSMEs will have the opportunity to monetize the ESCerts earned during the scheme, providing an additional financial incentive on top of the energy savings achieved. This mechanism encourages MSMEs to actively pursue energy efficiency

measures.

- The scheme will generate a substantial amount of first-hand, measured, and verified data on industrial energy consumption. This will promote the adoption of Energy Management Systems (EMS) and ISO 50001 certification, leading to improved efficiency, productivity, and profitability for MSMEs.

4.2.2 Strategy #2: Widening of PAT Scheme

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

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

The strategy and its implementation are explained below.

Scope Boundary

Sectors like pharmaceutical, food and fisheries, ceramics, foundry, 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

- The Bureau of Energy Efficiency (BEE) is responsible for implementing the Perform Achieve and Trade (PAT) Scheme for the industry sector.
- BEE sets energy efficiency targets for industries, monitors their performance, and facilitates the trading of energy-saving certificates.
- The Department of Industries can collaborate with BEE and APSECM to ensure industry compliance and create awareness about the scheme.
- APSECM, the Andhra Pradesh State Energy Conservation Mission may assist BEE in identification of probable DCs who could be included under PAT and assigned mandatory SEC reduction targets.

Current Policy/Policies in Place

PAT Cycle -VII notified 26th October 2021 for the Period 2022-23 to 2024-25 with 26 DCs in Andhra Pradesh with Energy saving Target of 0.3714 Million TOE

PAT Cycle – VII New notified 26th September 2022 for the Period 2022-23 to 2024-25 with 6 DCs in Andhra Pradesh with Energy saving Target of 0.0825 Million TOE

PAT Cyle -VIII notified 27th June 2023 for the Period 2023-24 to 2025-26 with 7 DCs in Andhra Pradesh with Energy saving Target of 0.023 Million TOE.

Implementation Period

Long Term

Saving Potential

There are already ten PAT sectors in Andhra Pradesh i.e Cement, Thermal Power Plants, Textile, Iron & Steel, DISCOM, Chlor Alkali, Pulp & Paper, Fertilizer, Refinery, and Hotels. However, the potential for increased energy savings exists through the widening of the PAT scheme to include the refractory cluster established in East and West Godavari, the food cluster in Chittoor, Guntur, and Anantapur, and the pharmaceutical sector in Visakhapatnam and Atchutapuram, etc.

To calculate the energy saving potential, the Specific Energy Consumption (SEC) values for these newly considered sectors were determined based on production and fuel consumption data from the Annual Survey of Industries for the year 2019-2020.

According to the Bureau of Energy Efficiency (BEE), each three-year cycle within the PAT scheme holds an energy saving potential of nearly 2.5%. To operationalize this potential, specific energy reduction targets were defined for both moderate and ambitious scenarios, translating into energy reduction percentages of 8% and 12% respectively.

Sector	Baseline SEC (toe/tonne)	Moderate SEC (toe/tonne)	Ambitious SEC (toe/tonne)	Energy Saving 2031-Moderate (Mtoe)	Energy Saving 2031-Ambitious (Mtoe)
Manufacture of refractory products	4.59	4.22	4.04	0.01	0.02
Manufacture of ceramic products	4.00	3.68	4.04	0.03	0.07
Food Products	0.40	0.37	0.35	0.04	0.09
Pharmaceuticals	0.76	0.70	0.67	0.05	0.12
			Total Savings (Mtoe):	0.15	0.25

The table below shows the total energy saving potential and CO_2 emission reduction potential for this strategy.

Table 7: Energy Saving Potential

Particulars	*2026*		*2031*	
	Moderate	Ambitious	Moderate	Ambitious
Energy Saving Potential (Mtoe)	0.05	0.10	0.15	0.25
CO_2 Emission Reduction Potential ($MtCO_2$)	0.15	0.32	0.48	0.79

Action Plans

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

1. **Workshops on Technology Interventions:**

   Organize workshops focused on technology interventions for energy conservation in refractory, ceramics, food processing units and manufacturing sectors to educate MSMEs on the latest energy-efficient practices and technologies.

2. **Technical Assistance:**

   Provide technical assistance to help MSMEs transition from inefficient to efficient motors, upgrade their technology in boilers, and implement other Energy Conservation Measures (ECMs).

3. **Demonstration Projects:**

   Implement demonstration projects showcasing the latest Energy Efficiency Technologies within SME clusters to encourage MSMEs to adopt innovations like advanced waste heat recovery systems, energy-efficient refrigeration and cooling technologies, digital process optimization tools, solar drying systems for food and fisheries.

4. **Standardized Energy Audits:**

   Conduct periodic standardized energy audits for MSMEs based on their load and reimburse the cost of these energy audits up to a maximum cap.

5. **Capacity Building:**

   Organize capacity building and technical training programs that offer BEE Energy Auditor Courses to train local experts within the state in energy efficiency practices.

6. **ISO 50001 Implementation:**

   Issue directives for the implementation of ISO 50001, Energy Management Systems, in organizations based on their load, promoting a standardized approach to energy efficiency.

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

Objective

The objective of the UNIDO-BEE project "Promoting EE/RE in selected MSME Clusters in India" was to provide support and assistance to Micro, Small, and Medium Enterprises (MSMEs) in implementing Energy Efficiency (EE) and Renewable Energy (RE) technologies. The project aimed to enhance energy efficiency, reduce greenhouse gas (GHG) emissions, and promote sustainable practices within the MSME sector.

Project Activities:

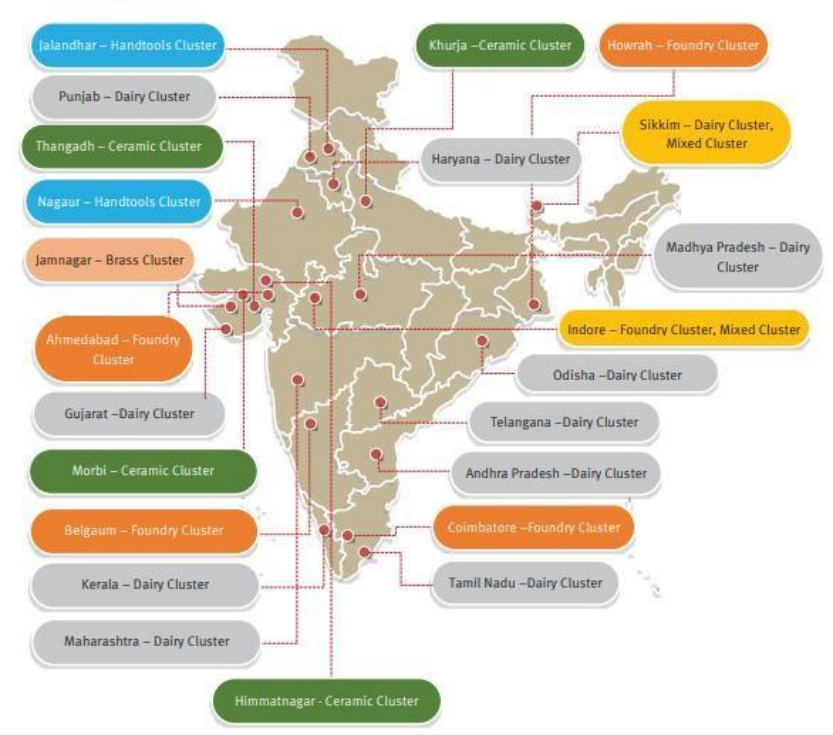
- Organizing awareness programs and enterprise identification.
- Conducting walk-through audits.

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

- Preparing cluster-specific EE & RE-based technology compendium.
- Implementation support to participating units.

Impact

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.



Strategy: Promoting Green Hydrogen for DCs

Green hydrogen refers to hydrogen gas produced through electrolysis using renewable energy sources, such as solar or wind power. The process involves splitting water molecules into hydrogen and oxygen, with the only by-product being water vapor. Green hydrogen is considered an environmentally friendly and sustainable energy carrier as it does not produce carbon emissions during its production or use.

The potential applications of green hydrogen are vast. It can be used as a clean fuel for transportation, particularly in fuel cell vehicles, reducing reliance on fossil fuels and contributing to decarbonization efforts. Green hydrogen can also be utilized in industrial processes, such as the production of chemicals, fertilizers, and steel, replacing carbon-intensive feedstocks and fuels. Additionally, green hydrogen has the potential to support energy storage and grid balancing, helping to integrate intermittent renewable energy sources into the grid.

Andhra Pradesh has a significant potential for renewable energy, particularly solar and wind power. The state's geographical location and abundant solar radiation make it conducive to solar energy generation. According to the Andhra Pradesh Solar Power Policy, the state aims to achieve a total solar power capacity of 5,000 MW by 2024. Furthermore, Andhra Pradesh has a substantial wind energy potential, especially along its coastline.

The following table describes the current scenario of industries where green hydrogen can be facilitated and its impact on those industries.

Sector	Intervention
Andhra Pradesh is home to several fertilizer industries that contribute to the agricultural sector and the state's economy. These industries produce a range of fertilizers, including urea, DAP (Di-ammonium phosphate), NPK (Nitrogen, Phosphorus, Potassium), and other complex fertilizers.	Hydrogen is a key ingredient in the production of ammonia, which is a primary component of nitrogen-based fertilizers. The conventional method of producing hydrogen for ammonia synthesis is through natural gas-based steam methane reforming, which results in carbon dioxide emissions. Transitioning to hydrogen produced from renewable sources can help fertilizer industries reduce their carbon emissions and contribute to sustainable agriculture.
As per Annual Survey of Industries (Factory Sector), 2017-18Andhra Pradeshcontributed3.4%) for the Chemical & Chemical products Sector(Industry Division 20 of NIC 2008) in the Value of Output. The state's pesticide consumption stands at 1559 MT during FY2020. There are 368 number of factories registered under "Chemicals and Chemical Products" in the state as on 2017-18.[16]	• Hydrogenation Processes: Green hydrogen can be used as a cleaner alternative to traditional hydrogen sources in hydrogenation processes. Hydrogenation is a common chemical reaction used in the production of various chemicals, such as ammonia, methanol, and hydrogenated oils. By utilizing green hydrogen, the chemicals and petrochemicals industries can reduce their carbon footprint and achieve more sustainable production processes. • Fuel and Energy Source: Green hydrogen can be utilized as a fuel or energy source in the chemicals and petrochemicals industries. It can be used for heating, power generation, and process energy requirements. Fuel cells, which use hydrogen as a fuel to generate electricity, can also be employed to meet energy needs in these industries. By using green hydrogen, the reliance on fossil fuels can be reduced, leading to lower emissions and improved environmental performance. • Feedstock for Synthesis: Green hydrogen can serve as a cleaner feedstock for various synthesis processes in the chemicals and petrochemicals industries. It can be used in the production of

[16]https://cpmaindia.com/pdf/1676970500-1.pdf

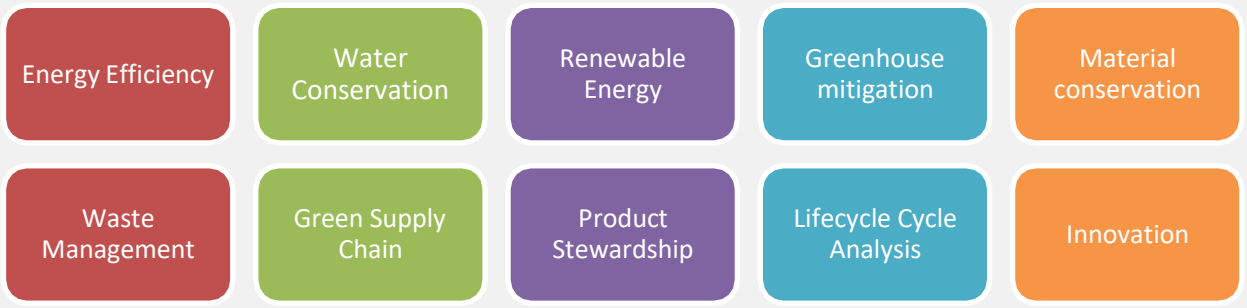
	organic compounds, polymers, and specialty chemicals. By substituting fossil fuel-derived hydrogen with green hydrogen, the environmental impact of these processes can be significantly reduced, contributing to a more sustainable and circular economy.

4.2.3 Strategy #3: Promotion of Green Rating for Industries

A green rating system for industries which provides a standardized methodology to measure and benchmark the environmental performance of industries across different sectors can serve as a valuable tool for industries and the state to assess, improve, and promote environmental sustainability. It facilitates the adoption of energy-efficient practices, encourages resource conservation, and aligns with the state's energy and environmental goals, ultimately leading to reduced energy consumption, improved environmental performance.

The rating system evaluates green features of companies against the following performance parameters[17]:

Figure 13 Parameters for green rating of industries



A case study to illustrate the implementation of this strategy is explained below.

Case of Rajasthan State Pollution Control Board (RSPCB)[18]
RSPCB launched the 'Green rating scheme for Industries in Rajasthan', on 7th July 2021. The program is aimed at enhancing and motivating the environmental performance of companies in Rajasthan, thereby enabling them to compete globally, in addition to achieving resource conservation and cost benefits. To ensure maximum participation of the industries in the scheme and to provide financial and other benefit to the green rated industries, the State Board has decided to provide the following incentives and recognition to the Green Rated industrial units:

[17]Based on 'Green Company Rating system' (GreenCo rating) which is a comprehensive evaluation framework developed by the Confederation of Indian Industry (CII).

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

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

Implementing a green rating system that evaluates these parameters and promotes sustainable practices in the industrial sector can contribute to improving energy efficiency and sustainability in Andhra Pradesh. By incentivizing and recognizing industries that adopt environmentally friendly practices, the state can foster a culture of sustainability and promote the adoption of greener technologies and practices.

Saving Potential

The energy saving potential is calculated by analysing the projected growth of large industries. Based on the Socio-Economic Survey of 2021-22, around 500 large industries were approved in that year. The potential energy savings were estimated by considering percentages of projected large industries: 5% and 10% for the moderate and ambitious scenarios in 2026, and 10% and 15% for the respective scenarios in 2031. This approach quantified the potential benefits of the program in enhancing energy efficiency and conservation across large and mega industries.

Particulars	*2026*		*2031*	
	Moderate	Ambitious	Moderate	Ambitious
Projected Industries	608		776	
% of Industries	5%	10%	10%	15%
Industries for Green Rating	30	61	78	116
Energy Saving Potential (Mtoe)	0.03	0.07	0.09	0.13
GHG Emission Reduction Potential ($MtCO_2$)	0.11	0.21	0.27	0.41

4.3 Energy saving potential of the sector& monitoring mechanism

Summary of energy saving potential and emission reduction potential of the industry sector is shown in the table below.

Table 8 Summary of energy saving from the strategies

Strategies	*Energy Saving Potential in 2031 (Mtoe)*	
	Moderate	Ambitious
1. *Deepening of BEE's Perform Achieve & Trade (PAT) Scheme*	0.60	0.96
2. *Widening of BEE's Perform Achieve & Trade (PAT) Scheme*	0.15	0.36
3. *Green Rating of Industries*	0.09	0.13
Total	0.82	1.25
Emission Reduction Potential (mTCO2)	2.57	3.92

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

Policy Type	Monitoring Mechanism
Regulatory	The Andhra Pradesh State Electricity Regulatory Commission (APERC) is responsible for regulating the power sector in the state, including the implementation of energy policies for industries. The APERC can monitor compliance with these policies through inspections, audits, and other enforcement measures.
Industry associations	Industry associations can play a key role in monitoring energy policies for their members.
SDA (State Designated Agency)	The APSECM can monitor industry compliance with energy policies through data collection and analysis, as well as through partnerships with industry associations and other stakeholders.
Audits	Energy audits can be conducted by independent third-party providers to assess the energy consumption and efficiency of industrial facilities. These audits can help identify areas for improvement and track progress towards energy policy goals.
Reporting	Mandatory reporting requirements or through voluntary reporting programs that incentivize companies to disclose their energy use and emissions data.

5 FOCUS SECTOR 2: TRANSPORT

5.1 Overview

The state has a total road length of around 1, 32,868 kms, out of which 6,669 km are national highways and 46,235 km are state highways. The state also has a well-connected network of district and rural roads.[19]

Andhra Pradesh State Road Transport Corporation (APSRTC) providing bus services across the state. APSRTC operates a fleet of around 11,600 buses and carries millions of passengers annually.[12]

In terms of vehicle categories, Andhra Pradesh has a significant number of two-wheelers, followed by cars and commercial vehicles. As per the latest statistics, the state has over 1.4 crore registered vehicles, out of which 81% are two-wheelers, 14% are cars, and the remaining 5% are commercial vehicles.

The most commonly used fuel for vehicles in Andhra Pradesh is petrol, followed by diesel and CNG (compressed natural gas). The state also has a few electric vehicle charging stations in major cities.

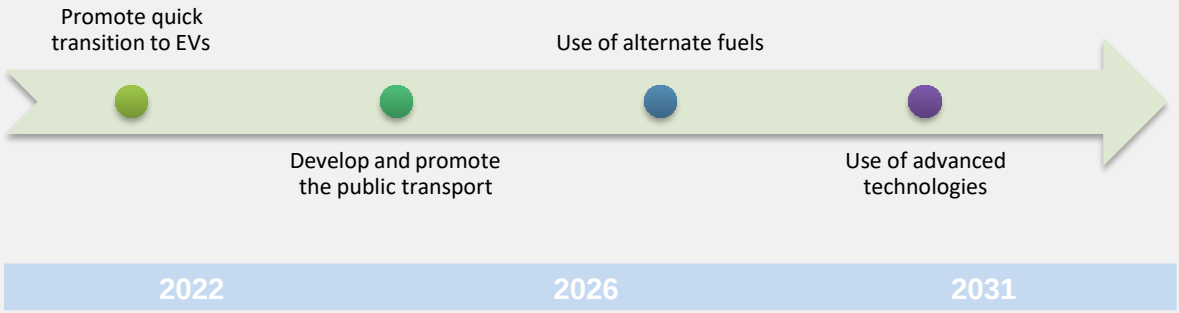
One of the key initiatives taken by the Andhra Pradesh government is the creation of an EV policy that provides a framework for the development of the EV ecosystem in the state. The policy includes measures such as tax exemptions, incentives for EV manufacturers and buyers, and the establishment of charging infrastructure. In addition to these initiatives, the Andhra Pradesh government has also launched several pilot projects to test EV technology and infrastructure. For example, the state-run public transportation agency APSRTC has introduced a fleet of electric buses in various cities across the state. Similarly, the state government has partnered with private players to set up charging stations at strategic locations across the state.

However, In Andhra Pradesh, the number of registered vehicles has increased significantly over the past decade, with over 1.4 crore registered vehicles as of 2021. This increase in vehicles has led to a corresponding rise in air pollution, particularly in urban areas. By increasing the adoption of electric vehicles, Andhra Pradesh can reduce its carbon footprint and improve air quality. Additionally, the state has set a target of achieving 100% electrification of the public transport system by 2030, and increasing the electrification of road transport will be crucial in achieving this goal.

[19]Statistical Abstract 20-21

5.2 Energy efficiency strategies in the transport sector

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

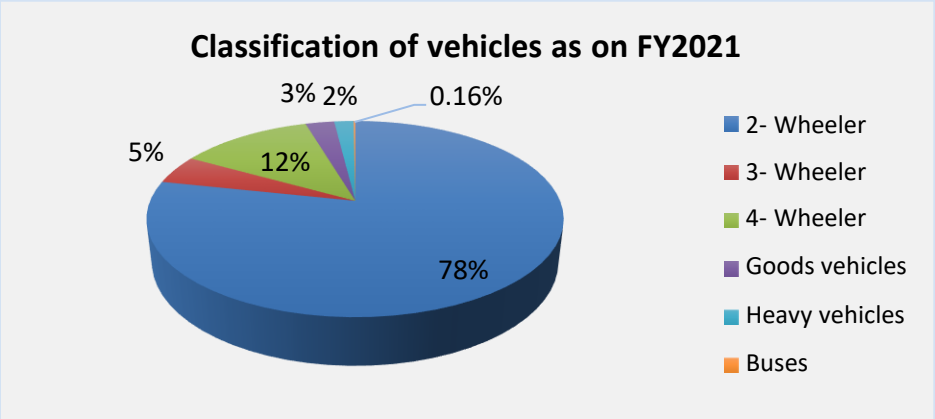


The policy interventions required for reducing the energy consumption of the transport sector are discussed in the subsequent section.

5.2.1 Strategy #1: Facilitating Electrification of Road Transport

Electric vehicles are significantly more efficient than their petrol or diesel counterparts. While electric vehicles can convert around 60% of the electrical energy from the grid to power the wheels, petrol or diesel cars can only convert 17%-21% of the energy stored in the fuel to the wheels, resulting in a wastage of around 80%. Thus, electrification of road transport is a good way to reduce energy consumption and emissions, particularly as the grid becomes greener with increased use of renewables.[20]

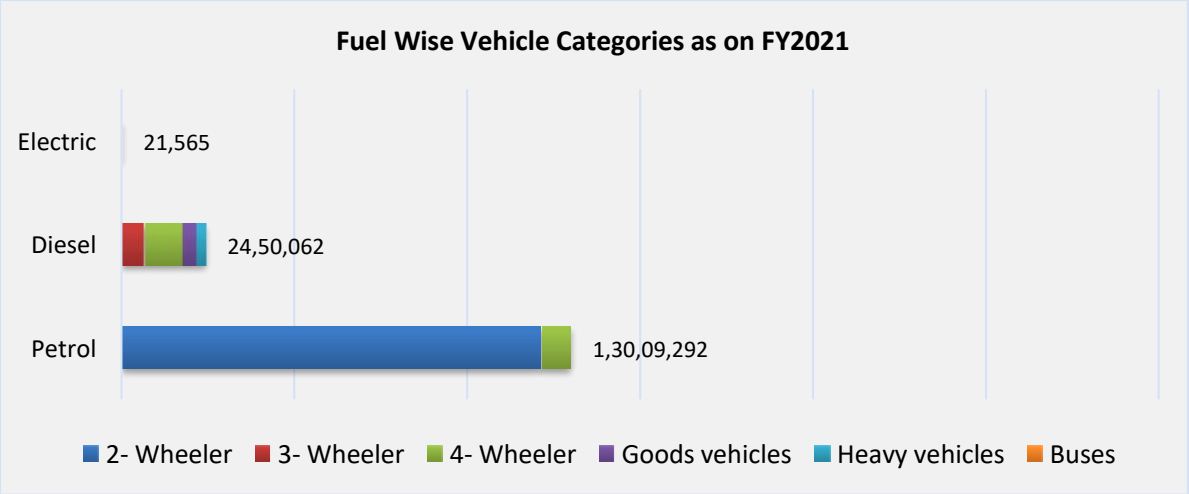
Table 9: Classification of vehicles as on FY 2022



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, Andhra Pradesh still has a long way to go to transition from ICE vehicles to electric vehicles, with only 0.15% of registered vehicles being electric.

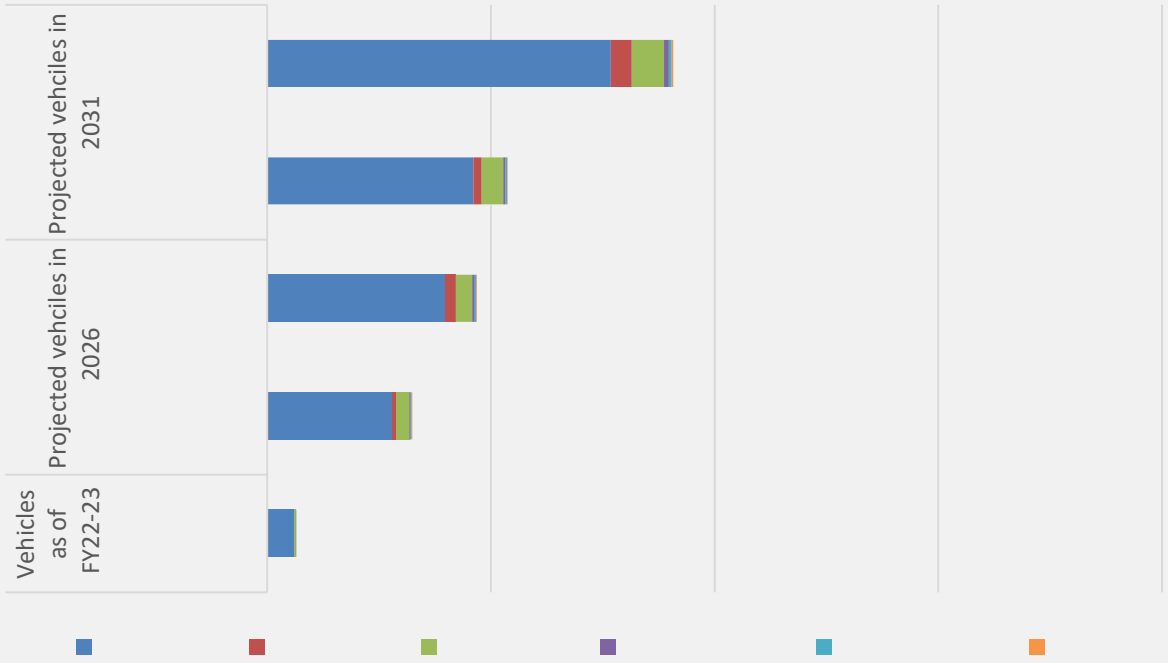
[20]https://e-amrit.niti.gov.in/benefits-of-electric-vehicles

Table 10 Fuel Wise Vehicle Categories as on FY2021



Projected number of vehicles for 2031 is estimated by projecting electric vehicles currently.

Figure 14 Number of Electric Vehicles Projected for FY26 and FY31[21]



The strategy and its implementation are explained below.

Scope Boundary
It will be applicable to all categories of road transport, including two-wheelers, three-wheelers, four-wheelers, buses, and commercial vehicles.
Implementing Agency

[21]Latest EVs in Andhra Pradesh from Vahan Dashboard

- Andhra Pradesh Transport Department
- Andhra Pradesh State Road Transport Corporation (APSRTC)
- DISCOMs
- New & Renewable Energy Development Corporation of Andhra Pradesh Ltd.
- Deptartment of Industries
- Andhra Pradesh Pollution Control Board (APPCB)
- Municipal Corporations and Urban Development Authorities

Current Policy/Policies in Place

The state government has introduced "Electric Mobility Policy 2018-23".

Key Objectives:

- Target the complete conversion of the entire APSRTC bus fleet, consisting of more than 11,000 buses, into electric buses (BEVs/FCEVs) by 2029. The initial phase will involve 100% conversion of the bus fleet in the top 4 cities by 2024.
- Phase out all fossil fuel-based commercial fleets and logistics vehicles in the top 4 cities by 2024 and extend this initiative to all cities by 2030.
- Transition all government vehicles, including those used by government corporations, boards, and ambulances, to electric vehicles by 2024.
- Aim to have 10 lakh electric vehicles across all segments by 2024.
- Establish a network of 1,00,000 slow and fast charging stations by 2024.

Implementation Period

- Short-term (1-2 years): Focus on building charging infrastructure in urban centers and along major highways, creating awareness campaigns, and introducing initial incentives for EV buyers.
- Medium-term (3-5 years): Expand charging infrastructure to semi-urban and rural areas.
- Long-term (6-10 years): Achieve significant electrification of road transport, establish a comprehensive charging network, encourage local EV manufacturing and battery production, and closely monitor the environmental impact.

Saving Potential

By increasing the share of EVs in the vehicle stock of Andhra Pradesh with nearly 5 lakh EVs in moderate scenario and 9 lakh EVs in ambitious scenario by 2031, additionally 12,500 charging stations and battery swapping infrastructure by 2026 and 22,500 charging stations and battery swapping infrastructure by 2031, with Level-1, Level-2 and Level-3 (DC) chargers across all cities will result into energy saving of 1.08 Mtoe by 2031.

Table 11: Energy Saving Potential

Particulars	*2026*		*2031*	
	Moderate	Ambitious	Moderate	Ambitious
Energy Saving Potential (Mtoe)	0.21	0.33	0.36	0.65
GHG Emission Reduction Potential ($MtCO_2$)	0.7	1.0	1.1	2.0

Action Plans

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

1. **Awareness**

   a) Launch public awareness campaigns about the benefits of electric vehicles and the environmental impact of electrified road transport, following the model of Delhi's "Switch Delhi" campaign.
   b) Manufacturer Engagement: Collaborate with EV manufacturers to educate them about the benefits of High Energy Lithium-Ion Traction Battery Packs and Systems, etc and incentivize their adoption.

2. **Setting target thresholds for ICE vehicles**

   a) Setting target thresholds for ICE vehicles: The government of Andhra Pradesh can establish target thresholds for ICE vehicles in different categories, such as two-wheelers, sedans, hatchbacks, buses, etc.

   b) These targets can be based on emission levels, fuel efficiency, or other relevant criteria. The targets should gradually become more stringent over time to encourage a shift towards zero-emission vehicles.

3. **Licensing restrictions for ICE vehicles**

   a) Once the target thresholds are defined, the government can enforce licensing restrictions for ICE vehicles that exceed the established targets. Beyond a certain threshold, ICE vehicles would not be eligible for registration or license renewal in Andhra Pradesh. This approach will create a clear market signal for manufacturers to prioritize the production and sale of zero-emission vehicles.

4. **Credit allocation for OEMs**

   a) For every zero-emission vehicle produced and registered in Andhra Pradesh, the OEMs (Original Equipment Manufacturers) will be credited with points or trade credits. The number of credits assigned to each OEM can be based on the vehicle type, size, range, or other relevant factors. These credits can be used by OEMs to meet their compliance obligations or traded with other manufacturers who require additional credits to meet their targets.

5. **Adoption of Battery Swapping for 2 & 3 Wheelers**

   a) Pilot Projects: Identify ten model cities for launching pilot battery swapping projects. Collaborate with EV manufacturers and service providers.

   b) Infrastructure Investment: Allocate funds for the setup of battery swapping stations and ensure they meet safety and technical standards.

   c) Consumer Incentives: Offer incentives such as reduced swapping fees or subscription-based packages to encourage adoption.

6. **Extending Subsidies to Various EV Segments**

   a) To diversify the EV market, Andhra Pradesh should consider offering subsidies to other segments such as electric tractors, e-cycles, and strong hybrids. For example,

Haryana, provides subsidies for electric tractors and other alternative fuel vehicles, can promote innovation and sustainability in the transportation sector.

7. State Govt Fleet Electrification

a) Electrify the state government's fleet of vehicles, following the lead of Himachal Pradesh, which has announced electrification of all its official vehicles.

8. Promoting Retrofitting

b) Encourage vehicle retrofitting by providing incentives for retrofit kits. For instance, in Rajasthan, 15% of the retrofit kit cost (including taxes) is reimbursed, up to ₹10,000 per vehicle. This can motivate individuals and businesses to convert their existing vehicles into electric ones, reducing the carbon footprint.

9. Cab Aggregator Fleets to Electric

a) Due to urbanization, cab aggregators and delivery service providers have become a popular mode of transport in Andhra Pradesh, offering convenience and affordability to citizens. By adopting a well-defined strategy, tailored incentives, and a collaborative approach, Andhra Pradesh can effectively model after Delhi's goals in transitioning its cab aggregator fleet to electric vehicles, contributing to a cleaner, greener, and more sustainable transportation system for the state. Delhi's Aggregator Policy is explained below.

Delhi Case Study: Aggregator Policy

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

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

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

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

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

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

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

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

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

10. Scrap Policy

a) Establish a "Cash for Clunkers" program, modelled after Delhi's initiative, to provide incentives for replacing old, polluting vehicles with electric ones.

11. Pantographs for EV Charging:

a) Infrastructure Integration: Include pantograph charging infrastructure in the design and development plans for the greenfield highway projects.
b) Public-Private Partnerships: Collaborate with private charging infrastructure providers for seamless implementation.

12. Green Hydrogen Programme for Transport:

a) Establish a Green Hydrogen Fund to provide low-interest loans and grants for domestic hydrogen fuel cell technology manufacturing.

b) Offer priority sector lending with favourable interest rates to companies engaged in hydrogen fuel cell production.

c) Develop a comprehensive plan for establishing a network of hydrogen fuelling stations, prioritizing strategic locations along transportation.

5.2.2 Strategy #2: Adequate Public Transport

While Andhra Pradesh strives towards ambitious decarbonization goals, the current state of the electricity grid dominated by fossil fuels limits the immediate environmental benefits of widespread electric vehicle (EV) adoption. Therefore, in the short term, prioritizing improvement and expansion of public transport emerges as a more effective strategy for rapid emissions reduction. Enhancing the accessibility, efficiency, and reliability of bus rapid transit systems, existing bus and rail networks, and integrated ticketing systems can deliver impactful and immediate decreases in per-passenger emissions. This approach requires lower upfront investment compared to EV infrastructure development and fosters social inclusion by providing mobility options for a wider range of citizens.

Meanwhile, continuous efforts in scaling up renewable energy generation, building convenient charging infrastructure, and crafting affordable EV financing mechanisms should pave the way for sustainable and long-term transition to electric mobility in Andhra Pradesh. By prioritizing public transport for immediate emissions reduction while concurrently laying the groundwork for responsible EV adoption, the state can effectively navigate the path towards decarbonization. Additionally, promoting modal shift from private vehicles to public transport offers substantial energy savings across the transport sector.

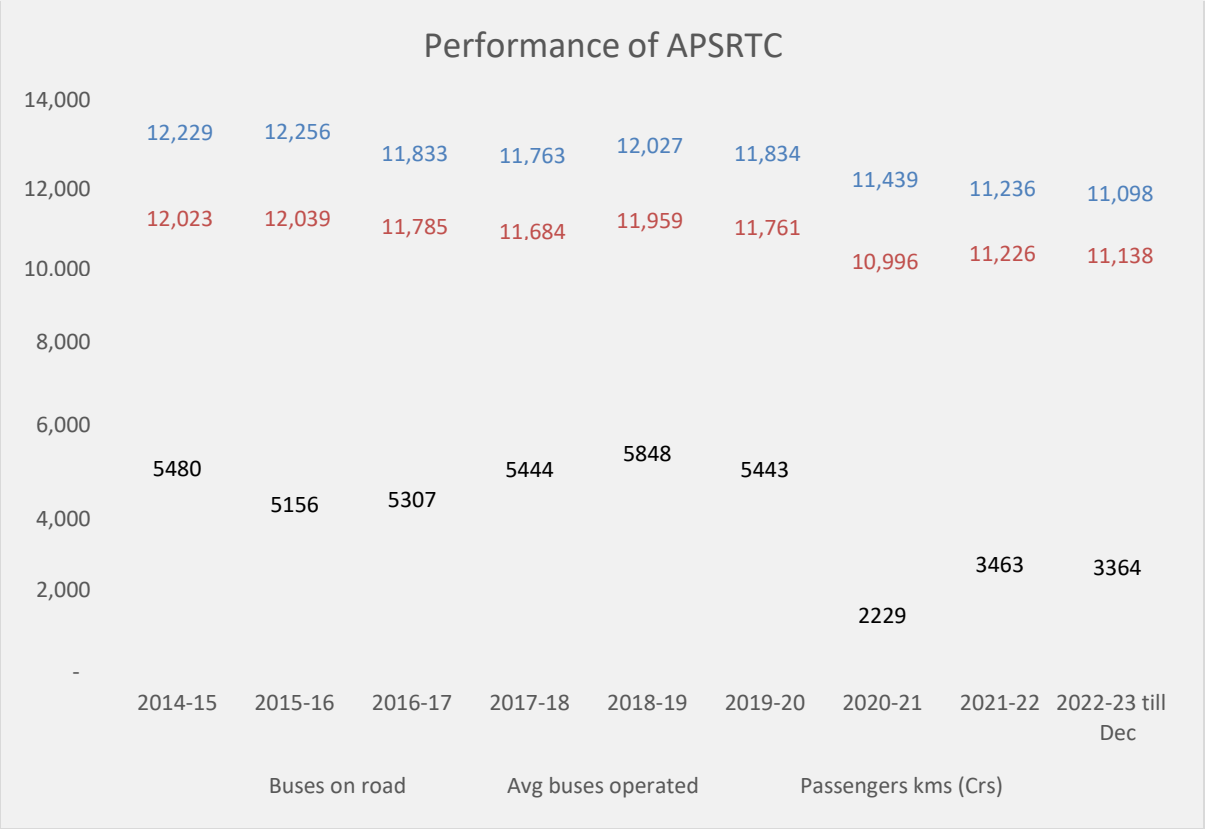
Andhra Pradesh has an extensive public transportation system that includes buses, trains, and auto-rickshaws. The state-owned Andhra Pradesh State Road Transport Corporation (APSRTC) operates buses that connect various cities and towns within the state, as well as neighbouring states. APSRTC has a fleet of over 11,000 buses and operates over 4000 routes across the state. APSRTC carries around 64 lakh passengers per day.

According to the data from Socio Economic Survey of Andhra Pradesh, the fleet size of AP SRTC has declined over the past few years. In 2014-15, there were 12,229 buses on road, which decreased to 11,098 buses in 2022-23.

The decline in fleet size has also affected the ridership of APSRTC. The total number of passengers carried by APSRTC has decreased from nearly 232 crores passengers transported per day in 2014-15 to 98.34 crores in 2021-22. The occupancy ratio declined from 70% in

2014-15 to 64% in 2021-22. The decline in ridership can be attributed to the lack of investment in new buses, resulting in a decrease in the frequency of buses and the quality of service provided to the passengers.

Figure 15 Performance of APSRTC[22]



The declining fleet size and ridership of APSRTC highlight the urgent need for massive scaling up of public buses in cities like Vijayawada, Amravati etc. According to the World Bank, the ideal bus-to-population ratio in a city is 1:1,000. However, in Vijayawada, the ratio is currently 1:2,200, which is significantly lower than the ideal ratio. To meet the growing demand for public transportation, the city needs to increase the number of buses significantly. The government needs to invest in new buses, improve the frequency of buses, and provide better infrastructure for public transportation, such as bus shelters and dedicated bus lanes.

The strategy and its implementation are explained below.

Scope Boundary
The policy aims to optimize fuel utilization and reduce carbon emissions by encouraging the adoption of fuel-efficient buses, hybrid technologies, and alternative fuels. It will cover various aspects such as fleet modernization, route optimization, fuel management, and integrated model of transport.
Implementing Agency
• State Department of Transport • Andhra Pradesh State Road Transport Corporation (APSRTC) • State Pollution Control Board • Urban Development Authorities and Municipal Corporations

[22] Annexure 7.6 https://apfinance.gov.in/downloads/FINALBOOKSES-2023FINAL.pdf

Current Policy/Policies in Place
Andhra Pradesh Electric Mobility Policy 2018-2023: This policy aims to promote the adoption of electric vehicles (including buses) to reduce pollution and dependency on fossil fuels. It includes incentives and support for the deployment of electric buses in the state.
Implementation Period
Short-term (1-2 years): Conduct a comprehensive assessment of existing public transport services, identify gaps in coverage, and prioritize areas with the highest demand for bus services. Medium-term (3-5 years): Procure additional buses, upgrade the existing fleet, and establish new bus routes based on demand patterns and urban development plans. Long-term (6-10 years): Invest in innovative technologies to enhance the overall efficiency of the public transport system.

Energy Saving Potential

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

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

			Fuel consumption (kL/day)		Savings Potential	
Sr No.	Population	No. of Urban Agglomerations	Without Adequate PT	With Adequate PT	kL/day	Mtoe/year
1.	<5 Lakhs	28	18	17	28	0.01
2.	5-10 Lakhs	2	559	502	114	0.04
3.	10-20 Lakhs	1	2617	2112	505	0.17
4.	20-40 Lakhs	1	2802	2099	703	0.23

0.31 Mtoe saving is estimated in moderate scenario and 0.44 Mtoe under ambitious scenario by considering 70% of the total saving potential and 100% saving potential respectively.

Table 12: Energy Saving Potential

Particulars	*2026*		*2031*	
	Moderate	Ambitious	Moderate	Ambitious

Energy Saving Potential (Mtoe)	0.13	0.15	0.31	0.44
GHG Emission Reduction Potential ($MtCO_2$)	0.41	0.48	0.97	1.38

Action Plans

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

1. **Expand Bus Rapid Transit (BRT) System**
   a) Implement BRT corridors in major cities like Visakhapatnam, Vijayawada, and Tirupati, prioritizing high-density areas and integrating with existing bus and rail networks.
2. **Improve Intermodal Connectivity**
   a) Develop seamless integration between bus, rail, and metro systems through common ticketing platforms, coordinated schedules, and convenient transfer points, as demonstrated by Kochi's "Integrated Metro-Bus Transportation System" case study.

Case of Kochi- Development of an Integrated Metro-Bus Transportation System
Kochi, a major port city in the Indian state of Kerala, has been facing significant traffic congestion and air pollution due to the rapid increase in the number of vehicles on the roads. To provide efficient and sustainable mobility solutions, the Kochi Metro Rail Limited (KMRL) has been developing a multimodal transport system that integrates the metro, buses, informal transport, and ferries. The following are the key features of the multimodal integration between metro, buses, informal transport, and ferries of Kochi.
Integrated Fare System The KMRL has implemented an integrated fare system that enables commuters to use the metro, buses, and ferries with a single ticket. The integrated fare system has reduced the transaction time for the commuters and increased the efficiency of the system.
Last Mile Connectivity: The KMRL has established last-mile connectivity solutions, such as feeder buses and auto-rickshaws, to provide seamless connectivity from the metro stations to the final destinations. The last-mile connectivity solutions have reduced the travel time and increased the accessibility of the system.
Smart Card System: The KMRL has implemented a smart card system that enables commuters to use the metro, buses, and ferries with a single card. The smart card system has reduced the dependence on cash and increased the efficiency of the system.
Real-time Passenger Information (RTPI) System: The KMRL has implemented a RTPI system that provides real-time information on the arrival and departure of the metro, buses, and ferries. The RTPI system has increased the convenience of the commuters and reduced the waiting time.
Intermodal Transfer Facilities:

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

Multi-Level Parking:

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

Bicycle Sharing System:

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

3. **Introducing a Subsidy for E-Buses**

   a) In addition to the incentives offered under the FAME II scheme, Andhra Pradesh can allocate subsidies for electric buses. For example, the state can consider a subsidy model similar to Bihar, which provides ₹10,000 per kWh of battery capacity subsidy, subject to a maximum of ₹25 lakh per vehicle. This will encourage the adoption of electric buses in public transportation, reducing emissions and improving air quality.

4. **Light Rail Transit Systems**

   a) Identify potential cities: Assess passenger demand, urban density, and existing infrastructure in key cities like Kakinada, Rajahmundry, Nellore, and Anantapur to prioritize deployment based on feasibility and impact.

   b) Conduct detailed feasibility studies: Analyze route alignments, station locations, ridership projections, and cost-benefit assessments for light rail systems tailored to each city's specific needs.

5. **Mass Rail Transit Systems**

   a) Conduct detailed feasibility studies: Assess passenger demand, identify optimal routes, and analyze technical and financial viability for metro or light rail systems in key cities like Visakhapatnam, Vijayawada, Tirupati.

   b) Develop preliminary design plans: Outline station locations, alignments, depot requirements, and integration with existing bus networks and other transport modes.

   c) Secure funding and partnerships: Explore opportunities for public-private partnerships (PPP) with national and international investors, along with potential funding from central government initiatives like Smart Cities Mission and National Urban Transport Mission (NUTM).

5.2.3 Strategy #3: Ethanol Blending Programme

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

Moreover, Andhra Pradesh is an agricultural state with a surplus production of sugarcane, which is a key feedstock for ethanol production. The state can leverage its agricultural resources to promote the production of ethanol and create new job opportunities. In fact, the central government has set a target of achieving 20% ethanol blending in petrol and 5% in diesel by 2025, which will create an additional demand of 1,000 crore litres of ethanol.[23]

The strategy and its implementation are explained below.

Scope Boundary
Production, distribution, and utilization of ethanol-blended fuels in the transportation sector.
Implementing Agency
• Ministry of Petroleum & Natural Gas (MoPNG) • Transport Department • Department of Industries
Current Policy/Policies in Place
Andhra Pradesh Electric Mobility Policy 2018-2023: This policy aims to promote the adoption of electric vehicles (including buses) to reduce pollution and dependency on fossil fuels. It includes incentives and support for the deployment of electric buses in the state.
Implementation Period
Medium-term (1-5 years): Develop infrastructure for the storage, transportation, and distribution of ethanol, encourage investment in ethanol production facilities, and progressively increase the ethanol blending ratio. Long-term (6-10 years): Achieve higher blending ratios as per national and state targets, monitor the environmental and economic impacts of the program. Medium-term (3-5 years): Procure additional buses, upgrade the existing fleet, and establish new bus routes based on demand patterns and urban development plans. Long-term (6-10 years): Invest in innovative technologies to enhance the overall efficiency of the public transport system.

Saving Potential

The saving potential is estimated based on following assumptions.

	2026		2031	
Blending of fuel	Moderate	Ambitious	Moderate	Ambitious
Utilization of Vehicles	80%	80%	80%	80%
Fuel Blending %age	20%	30%	20%	30%
Already Blending in Fuel%	10%	10%	10%	10%
Incremental Fuel Blending	10%	20%	10%	20%
Amount of fuel blended (Mn Lit)	492	984	574	1,147
GCV of Oil (Kcal/Kg)	10,350	10,350	10,350	10,350

[23]https://www.niti.gov.in/sites/default/files/2021-06/EthanolBlendingInIndia_compressed.pdf

Density (Kg/lit)	0.85	0.85	0.85	0.85
Energy Saved (Mtoe)	0.43	0.87	0.50	1.01

Table 13: Energy Saving Potential

Particulars	*2026*		*2031*	
	Moderate	Ambitious	Moderate	Ambitious
Energy Saving Potential (Mtoe)	0.11	0.27	0.50	0.63
GHG Emission Reduction Potential ($MtCO_2$)	0.34	0.84	1.57	1.96

Action Plans

While the promotion of ethanol in the "National Policy on Biofuels" falls under the purview of the Ministry of Petroleum and Natural Gas at the national level, the state of Andhra Pradesh can play a supportive role in implementing and encouraging the policy within its jurisdiction. Here are a few ways the state can support the promotion of ethanol:

1. Establishing Ethanol Production Infrastructure: Andhra Pradesh can take initiatives to set up ethanol production infrastructure such as distilleries and ethanol blending units. This can involve attracting private investments or establishing state-owned facilities to produce ethanol from various feedstocks like sugarcane, molasses, agricultural residues, and other suitable sources.
2. The state government can mandate and incentivize ethanol blending in transportation fuels. This involves ensuring that a certain percentage of ethanol is blended with petrol and diesel.
3. The state can create awareness campaigns to educate fuel retailers and consumers about the benefits of ethanol blending, such as reduced greenhouse gas emissions and improved air quality.
4. The state government can provide subsidies, technical assistance, and guidance to farmers to grow high-yielding and energy-rich crops like sugarcane, sweet sorghum, corn, or any other feedstock suitable for ethanol production.
5. State can ease storage, movement, and permit norms for industrial fuel-grade ethanol.
6. Incentive to setup new distilleries to produce ethanol and to install any method approved by CPCB, Capital subsidy (technical civil works, plant and machinery)
7. Interest subsidy at 7% on term loan for 5 years with cap in addition to the assistance received under central government.

5.3 Energy saving potential of the sector & monitoring mechanism

Energy saving potential of the transport sector for moderate and ambitious scenarios in FY 2031 is displayed below.

Table 14 Summary of energy saving from transport sector strategies

Strategies	*Energy Saving Potential in 2031 (Mtoe)*	
	Moderate	Ambitious
1. *Electrification of Road Transport*	0.36	0.65
2. *Facilitating Adequate Public Transport*	0.31	0.44
3. *Ethanol Blending Programme*	0.50	0.63
Total	1.18	1.72
Emission Reduction Potential (mTCO2)	3.70	5.38

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

Policy Type	Monitoring Mechanism
State EV Cell	To efficiently manage and oversee these initiatives, establish a State EV Cell or a Steering Committee. This body can coordinate and monitor the implementation of demand-side incentives and ensure that the state achieves its EV adoption targets.
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.

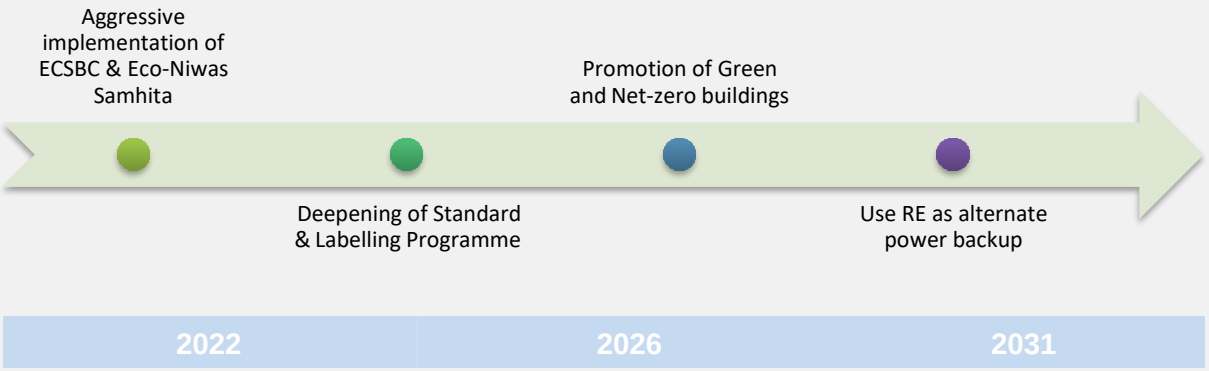
6 FOCUS SECTOR 3: BUILDINGS

6.1 Overview

The adoption of energy-efficient building practices is critical for reducing energy consumption and greenhouse gas emissions in Andhra Pradesh. Despite the adoption of ECBC standards in the state, there is a significant potential for energy savings through various strategies such as building envelope improvements, energy-efficient lighting systems, high-efficiency HVAC systems, and the use of renewable energy sources. The implementation of these strategies requires strong government support, stakeholder engagement, and effective policies to incentivize energy-efficient building practices.

6.2 Energy efficiency strategies in the buildings sector

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



6.2.1 Strategy #1: Energy Efficiency Labelling for Residential Buildings

In FY2020, the residential sector in Andhra Pradesh accounted for 28% of the total electrical consumption, with nearly 16,000 GWh consumed. In contrast, the commercial sector's consumption was only 9%. As per the Indian Energy Scenario 2047 (IESS 2047), the number of households is projected to grow by over 20% and 40% in the next 10 and 20 years respectively, due to economic growth and urbanization trends. This will exert a considerable strain on the power sector, necessitating proactive measures to curb energy consumption in the residential sector.

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.

Recognizing the substantial energy consumption by the residential sector and its significant impact on the total electrical consumption, the star-labelling programme for all single and multiple-dwelling residential units has been initiated by the Bureau of Energy Efficiency

(BEE)[24]. It is a step forward from Eco Niwas Samhita 2018 launched by Ministry of Power in 2018. There is no minimum requirement for the area or connected load (kW) for a building dwelling unit to be covered under this labelling programme. This label is applicable for existing and new buildings. For new building, this label can only be awarded after the occupancy certificate is issued by the authorities having jurisdiction.

The Energy Performance Index (EPI) of a building (annual energy consumption in kilowatt-hours per square metre of the building) is taken as an indicator for the star label of the building. The EPI includes three components, namely E1, E2 and E3. E1 and E2 include building envelope characteristics, lighting systems and comfort systems (air conditioners (ACs)). The calculation is made with the assumption that 25% of the space in the building is air-conditioned with 24°C as the set point (E1) and the remaining 75% of the space is naturally ventilated (E2). The EPI (E3) for microwave ovens, grinders, refrigerators, TVs, water pumps, washing machines, etc. is considered to be in the range of 7–9.

The strategy and its implementation are explained below.

Scope Boundary
There is no minimum requirement with respect to the Area or Connected load (kW) for a building dwelling unit to be covered under this labelling program. Under this scope, all new buildings can be targeted and existing buildings constructed after 2015-16.
Implementing Agency
• Department of Town and Country Planning (DTCP) • Andhra Pradesh State Housing Corporation • Bureau of Energy Efficiency • Andhra Pradesh State Energy Conservation Mission (APSECM) • Third Party Auditors
Current Policy/Policies in Place
Andhra Pradesh is preparing the draft of Eco Niwas Samitha.
Implementation Period
Short Term

[24]https://www.econiwas.com/star-label-foree-homes.php

Saving Potential

Unlike the Energy Norms and Standards (ENS) that apply only to new buildings at the design stage, the labelling program is designed to be applicable to both new and existing residential buildings. It is assumed that all newly approved buildings will be labelled according to their energy efficiency.

In the moderate scenario, by 2026, 50% of existing buildings constructed since 2015 will be labelled. In the ambitious scenario, this number increases to 70%.

In the moderate scenario, by 2031, 70% of the existing buildings constructed since 2015 will be labelled. In the ambitious scenario, all 100% of these buildings will be labelled.

The distribution of energy efficiency is assumed to be such that 60% of buildings are labelled as inefficient (1 star) and 40% have average efficiency. The energy saving potential for 2026 and 2031 is calculated by comparing the energy consumption of buildings labelled with 5 stars (excellent energy efficiency) with the energy consumption of buildings that are inefficient (1 star).

Table 15: Energy Saving Potential

Particulars	*2026*		*2031*	
	Moderate	Ambitious	Moderate	Ambitious
Total BUA under Labelling Scheme (Crore ft^2)	29	34	46	56
Electricty Consumption (GWh) 1 star	1,883	2,216	2,971	3,636
Electricty Consumption (GWh) 2 star	1,480	1,741	2,334	2,857
Electricty Consumption (GWh) 5 star	794	934	1,252	1,532
Energy Saving Potential (Mtoe)	0.08	0.09	0.13	0.15
GHG Emission Reduction Potential ($MtCO_2$)	0.25	0.29	0.39	0.48

Action Plans

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

1. Mandatory Labelling for New Construction:

a) Draft legislation to mandate BEE's Energy Efficiency Labelling for all new residential construction projects. Ensure that builders and developers comply with energy efficiency standards and obtain the appropriate label before occupancy permits are granted. Andhra Pradesh can consider a threshold of 500 m^2 and all residential buildings with a built-up area exceeding this threshold would be subject to mandatory labelling.

b) Mandate the integration of the Bureau of Energy Efficiency's (BEE) Energy Conservation Sustainable Building Code (ECSBC) and Energy Efficiency Labelling (EEL) for Residential Buildings into the building byelaws of Andhra Pradesh.

2. **Financial Incentive**

   It is imperative to motivate construction builders to prioritize energy efficiency and this can be achieved with effective structure financial incentive. For example, the state can offer a 10% discount in property tax for three years for residential buildings with a five-star rating.

3. **Labelling Infrastructure:**

   Collaborate with BEE to establish a network of accredited energy auditors and professionals. Provide training and certification opportunities to ensure a qualified workforce.

4. **Energy Efficiency Certification Rebate:**

   a) Introduce a rebate program for homeowners who obtain BEE's Energy Efficiency Labelling certification.

   b) The rebate could be a percentage of the energy-efficient equipment or building materials' cost, up to a predetermined limit.

5. **Low-Interest Energy Efficiency Loans:**

   a) Collaborate with local banks to provide low-interest loans for homeowners undertaking energy-efficient renovations.

   b) These loans can cover expenses related to insulation, energy-efficient windows, and high-efficiency appliances.

6. **Local Builder Incentives:**

   Offer incentives to builders who construct energy-efficient residential buildings. Incentives could include reduced permit fees, faster approval processes, or recognition for their sustainable construction practices.

7. **Home Energy Efficiency Financing Program:**

   Establish a dedicated financing program that provides affordable loans for homeowners looking to improve the energy efficiency of their homes. Offer financial mechanisms, such as low-interest rates and flexible repayment options.

8. **Local Government Demonstration Projects:**

   Encourage local government departments to undertake energy efficiency upgrades in their residential buildings as demonstration projects. Share the success stories and cost savings to inspire homeowners to follow suit.

9. **Consumer Education Initiatives:**

   a) Develop and distribute educational materials and online resources about BEE's Energy Efficiency Labelling and its benefits in the local language.

   b) Create a user-friendly online platform where homeowners can calculate potential savings and access information about energy-efficient products and services.

10. Awareness Campaigns:

a) Conduct regular workshops and training sessions in collaboration with local authorities and educational institutions.

b) Offer these workshops to builders, architects, and homeowners to educate them on energy-efficient building practices and the significance of BEE's Energy Efficiency Labelling.

11. Behavioural Energy Efficiency Program (BEEP) for Andhra Pradesh

Behavioural interventions have the potential to achieve energy savings of 5-15% in households. Applying this to Andhra Pradesh's residential sector could translate to substantial energy cost reductions and emission reductions. Implementing a BEEP program based on the BRPL model holds immense potential for reducing energy consumption and promoting sustainable behaviour in Andhra Pradesh. By prioritizing affordability, localization, and community engagement, the program can empower residents, achieve energy savings, and contribute to the state's clean energy goals.

Case Study: Behavioural Energy Efficiency Program by BSES Rajdhani Power Limited (BRPL) in Delhi
BSES Rajdhani Power Limited (BRPL), one of the power distribution companies in Delhi, implemented a successful Behavioral Energy Efficiency Program. The program focused on providing personalized Home Energy Reports (HERs) and an integrated web portal to selected residential consumers, aiming to improve energy efficiency and reduce energy consumption.
Based on results in comparable markets, Home Energy Reports (HERs) have the potential to save 1-2% of BRPL‟s peak power demand. The program was rolled-out across South and West Delhi in the month of October, 2018. Considerable saving has been observed under this program[25]

Components:

- Home Energy Reports (HERs): Selected consumers receive personalized reports detailing their energy consumption patterns, comparisons with similar households, and energy-saving recommendations.
- Integrated Web Portal: An interactive online platform allows consumers to access their energy usage data, track their progress, and access energy-saving tips and resources.
- Behavioural Change Campaigns: Conduct awareness campaigns and programs to educate consumers about energy efficiency, energy-saving practices, and behavioural changes that lead to energy conservation.
- Incentives and Rewards: Provide incentives and rewards to encourage active participation and achievement of energy-saving targets.

Benefits:

- Improved Energy Efficiency: Personalized HERs and access to energy data empower consumers to make informed decisions, adopt energy-saving practices, and reduce energy consumption.

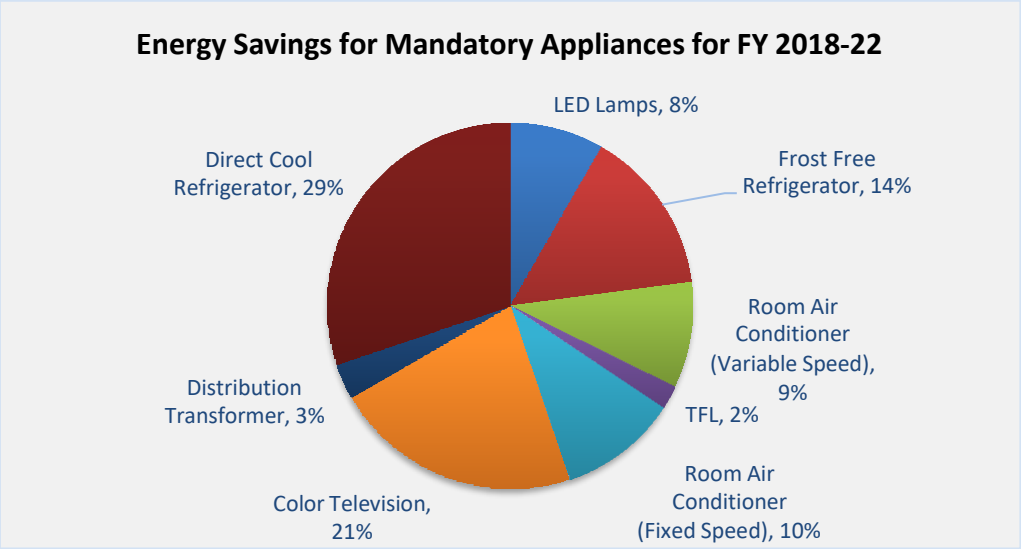
[25] BSES Rajdhani Power Limited (BRPL) website

- Energy Cost Savings: By implementing energy-saving recommendations and efficient usage of appliances, consumers can reduce their energy bills and achieve cost savings.
- Environmental Impact: Reduced energy consumption contributes to a decrease in carbon emissions and environmental footprint, promoting sustainability.

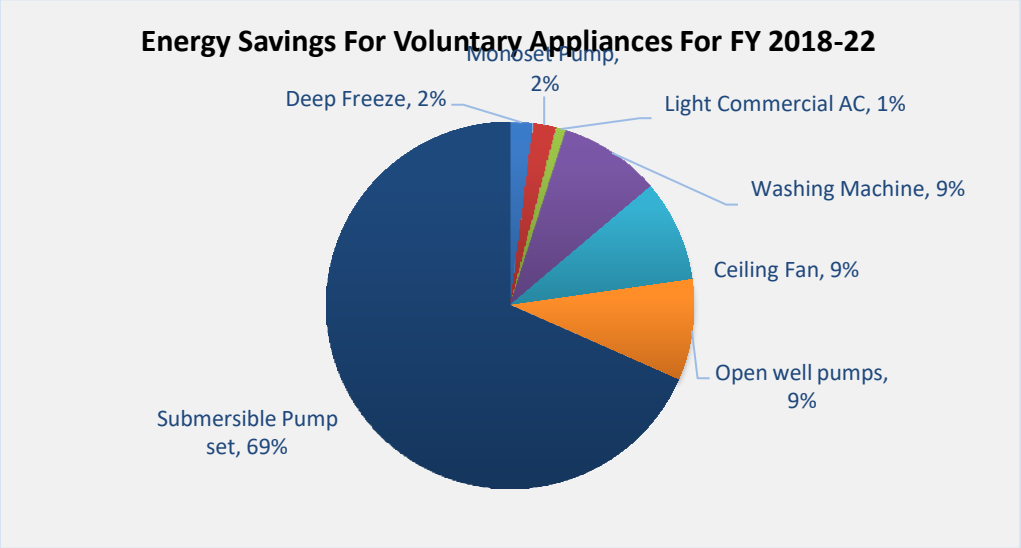
6.2.2 Strategy #2: Deepening of Standard & Labelling Programme

The Standards and Labelling (S&L) program is an important initiative of the Bureau of Energy Efficiency (BEE) under the Ministry of Power, aimed at promoting energy efficiency in various appliances and equipment. Under this program, minimum energy performance standards (MEPS) are set for different categories of products and appliances, which are mandatory for manufacturers to comply with before they can sell their products in the market. Additionally, the S&L program provides for labelling of these products with star ratings to help consumers make informed choices.

Direct-cool refrigerator (29%) followed by colour television (21%) and frost-free refrigerator (14%), contributed to 54% of the total energy savings due to mandatory star rated appliances under S&L programme[26] during FY2018-22 in India.



[26]https://beeindia.gov.in/sites/default/files/publications/files/Impact%20Assessment%202021 - 22_%20FINAL%20Report_June%202023.pdf



With the exponential growth in the number of refrigeration and air conditioning (RAC) units in Andhra Pradesh state due to urbanization, there is a need to accelerate the ambition of MEPS and expand the scope of the S&L program. This will help to drive the adoption of energy-efficient RAC units and reduce the energy consumption and carbon footprint of the state. Additionally, the S&L program can help to create awareness among consumers about the benefits of energy-efficient appliances and incentivize manufacturers to innovate and develop more efficient products.

In FY20-21, the production of 5-star labelled was32% of ACs and 79% of washing machines, indicating a positive trend towards energy-efficient appliances. However, there is a significant gap in the adoption of 5-star labelled appliances like refrigerators, ceiling fans, LED bulbs, and TFL bulbs. To address this disparity and accelerate the transition to energy-efficient technologies, "Deepening of Standard & Labelling Programme" is proposed. Additionally, Andhra Pradesh has only distributed 1,037 LED bulbs while its neighbouring states like Telangana has the second highest distribution of the LED bulbs in India, similarly Karnataka has distributed 6,16,239 LED bulbs[27] which highlights the need for a focused and comprehensive scheme to enhance the standard and labelling program in the state.

The strategy and its implementation are explained below.

Scope Boundary
The policy will cover a wide range of energy-consuming products, including but not limited to household appliances (e.g., refrigerators, air conditioners, fans), lighting products, industrial equipment, and commercial appliances.
Implementing Agency
• Bureau of Energy Efficiency (BEE) • Andhra Pradesh State Energy Conservation Mission (APSECM) • Andhra Pradesh State Electricity Regulatory Commission (APSERC)
Current Policy/Policies in Place
BEE's Standard & Labelling Programme
Implementation Period
Short-term (1-2 years): Conduct a comprehensive review of existing S&L initiatives and

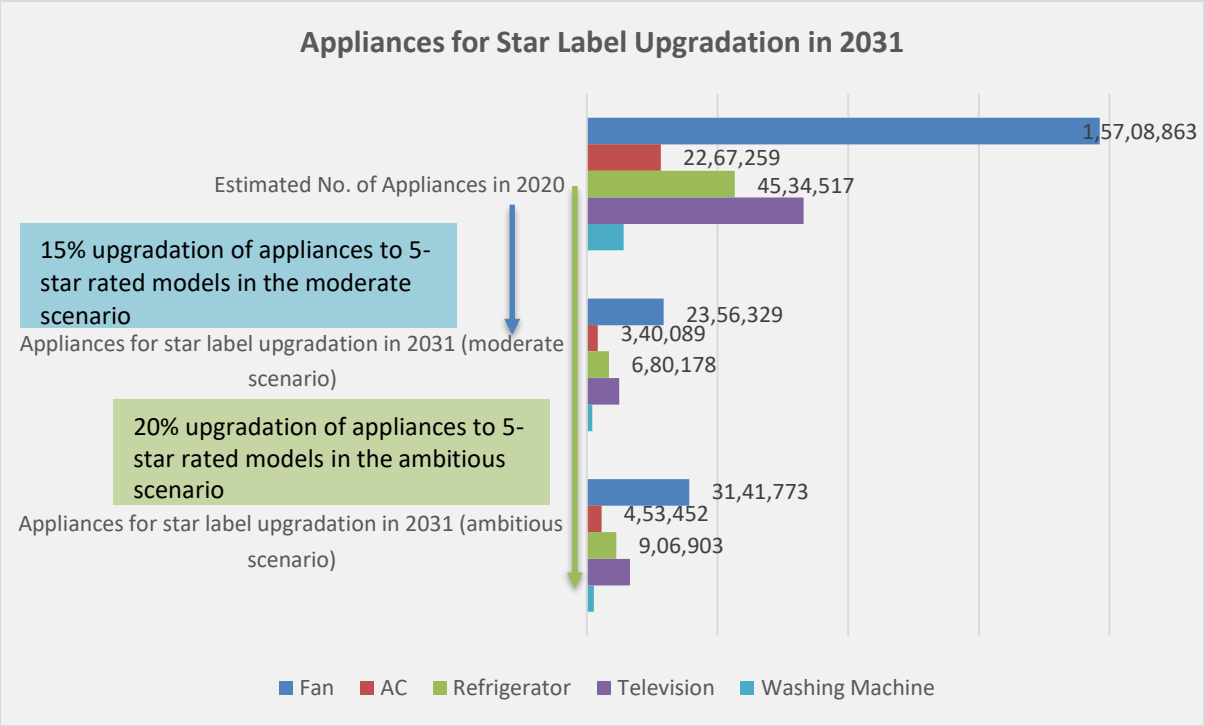
[27] BEE's Impact of Energy Efficiency Measures for the year 2020-21

identify gaps in the coverage of products. Develop an action plan for implementing the policy and creating public awareness.

Medium-term (3-5 years): Assess energy savings, and periodically update the efficiency standards to align with advancements in technology and evolving consumer needs.

Saving Potential

The proposal aims to achieve a 15% upgradation of appliances to 5-star rated models in the moderate scenario and 20% of the total appliances[28] in the ambitious scenario by the year 2031. These targets are based on the analysis of star label appliance production in India according to the BEE's report and trends observed over the past three years.



To realize these savings, it is crucial to transition older 5-star rated appliances to the new 1-star rating and phase out older 4-star and below rated appliances, as the market now offers appliances with more energy-efficient technologies.

The state can play a role in enhancing monitoring, verification, and enforcement (MV&E) activities in collaboration with the BEE to effectively enforce energy efficiency standards and encourage the adoption of energy-efficient appliances.

Table 16: Energy Saving Potential

Particulars	*2026*		*2031*	
	Moderate	Ambitious	Moderate	Ambitious

[28]The number of appliances has been estimated using the urban population of the state.

Energy Saving Potential (Mtoe)	0.03	0.04	0.10	0.15
GHG Emission Reduction Potential ($MtCO_2$)	0.09	0.14	0.31	0.46

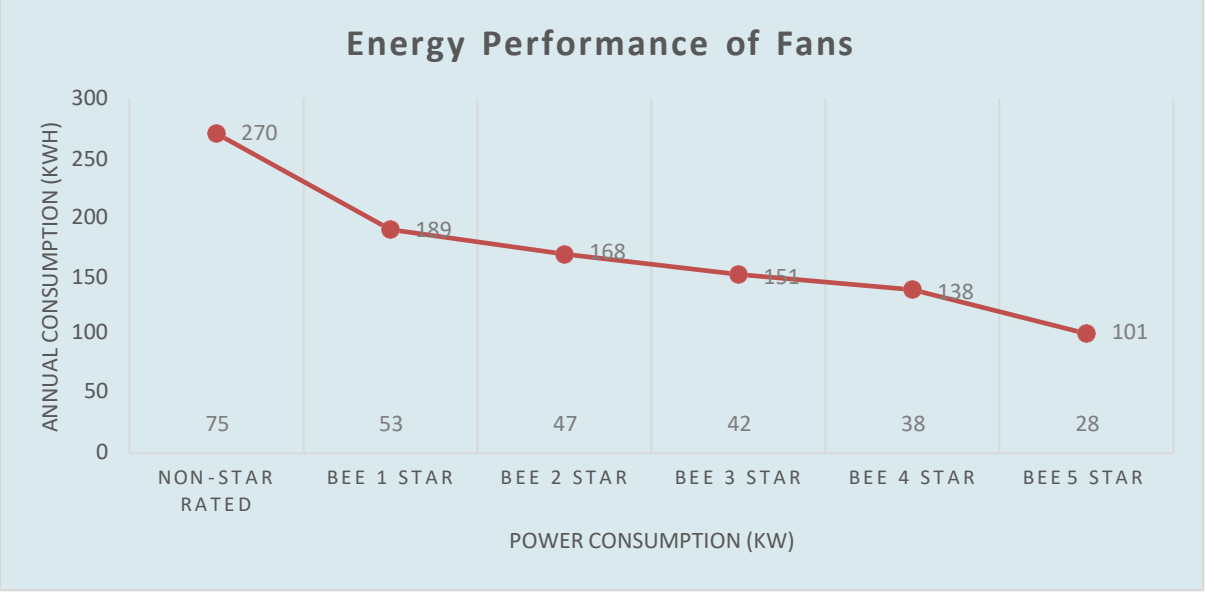
Action Plans

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

1. Bulk-purchase initiatives for energy efficient fan technologies

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

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



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

d) The scheme can be implemented by partnering with manufacturers of BLDC fans and offering bulk purchase orders at discounted rates. The scheme can also be extended to government offices, public institutions, and commercial buildings. Additionally, the existing five-star rating for fans can be promoted to become the new one-star minimum. This will encourage manufacturers to produce more energy-efficient fans and drive down the prices of energy-efficient fans further.

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

f) This action plan can be modelled after Delhi's "BEE 5 star rated Super Energy Efficient Fan Replacement Scheme".

Case Study of Delhi: BEE 5 star rated Super Energy Efficient Fan Replacement Scheme[29]

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

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

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

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

2. Accelerating Access to Energy-Efficient Air Conditioners (ACs)

a) Andhra Pradesh, being a tropical state is experiencing rising demand for air conditioning due to increasing heatwaves and urbanization. However, this reliance on traditional, less efficient ACs leads to increased energy consumption, emissions, and strain on the electricity grid.

b) By adopting a multi-pronged approach combining policy, financial incentives, awareness campaigns, market development, and continuous monitoring, Andhra Pradesh can effectively accelerate access to energy efficient ACs. With successful initiatives like BEE and CLASP, Andhra Pradesh can pave the way for a future where efficient and sustainable cooling solutions are accessible to all.

Case Study: Energy Efficient Air Conditioners in India by BEE and CLASP[30]

Objective

The objective of the project is to accelerate access to energy-efficient air conditioners (ACs) in India, considering the country's growing middle-class population and rising disposable

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

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

income. The focus is on creating awareness about energy-efficient schemes and interventions to influence purchase decisions and promote the adoption of high-quality and affordable AC products.
Project Activities: • The government of India expects that 300 million ACs will be purchased in India. Awareness of energy-efficient schemes and intervention campaigns will be key to purchase decisions. • CLASP collaborated closely with BEE by providing technical and institutional support to accelerate access to ACs in India. • AC efficiency policies were launched in 2006 in India, seeing an increase in energy efficiency by 47 %. The introduction of Minimum Energy Performance Standards (MEPS) and revised star rating plan are some policies by BEE with the support of CLASP. • Over the past 15 years, India has manufactured more than 63 million efficient AC units that reduced the country's electricity consumption by 85 TWh. Efficient ACs have also lowered electricity bills by an estimated USD 5.6 billion.

3. **Promote Energy-Efficient and Low-GWP Refrigerant-Based Cooling:**
   a) Launch awareness campaigns highlighting the benefits of energy-efficient and low-GWP refrigerant-based cooling systems for public and private stakeholders.
   b) Introduce financial incentives, such as rebates or tax credits, for the purchase and installation of energy-efficient cooling systems.
   c) Enforce regulatory measures that mandate the use of low-GWP refrigerants in cooling systems to reduce environmental impact.
4. **Energy-Efficient Public Procurement:**
   a) Establishing a certification process for service technicians to ensure proper installation and maintenance of cooling systems.
   b) Regularly update the Public Works Department (PWD) Schedule of Rates (SoR) to incorporate the latest energy-efficient materials and technologies in procurement projects.
5. **Promotion of Heat Pumps**:
   a) Provide subsidies and financial incentives to consumers and businesses for the installation of heat pumps for space cooling and hot water supply.
   b) Collaborate with manufacturers to promote research and development in heat pump technology and offer market-based incentives for adopting this technology.

5. **Mandatory Use of 4-Star Rated Appliances:**
   a) Enforce regulations requiring the use of 4-star rated appliances in all commercial and government buildings to reduce energy consumption and greenhouse gas emissions.
   b) Establish a monitoring and enforcement mechanism to ensure compliance with the mandatory rating requirements.

6.2.3 Strategy #3: Promotion of Green Building Rating Systems

This strategy recommends the adoption and promotion of green building rating systems as a key strategy for achieving energy efficiency and environmental goals within the state. 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.

Several nationally recognized green building rating systems exist, each offering a framework for assessing and optimizing a building's environmental performance. IGBC has a majority stake in the green rated buildings, followed by BEE Star Rating, GRIHA, LEED, cater to diverse building types and priorities, emphasizing energy efficiency, water conservation, resource management, and climate-responsive design. Implementing these systems, either through mandatory or incentivized schemes for government buildings and public infrastructure projects, can significantly reduce energy consumption, lower carbon footprint, and improve indoor air quality.

The state government has introduced various policies and initiatives to encourage the adoption of green building practices, such as the Andhra Pradesh Building Rules, 2017, which mandate certain energy efficiency standards for new buildings. Furthermore, the Andhra Pradesh Capital Region Development Authority (APCRDA) has incorporated green building principles in the construction of Amaravati, the new capital city of the state. The APCRDA has set ambitious targets for the construction of green buildings and has established a Green Buildings Advisory Committee to oversee the implementation of green building practices. Overall, these efforts demonstrate the commitment of Andhra Pradesh towards promoting sustainable building practices and reducing energy consumption in the state.

The strategy and its implementation are explained below.

Scope Boundary
The policy will cover commercial buildings, including office complexes, malls, IT parks.
Implementing Agency
• Certification Body • Department of Country and Town Planning • Andhra Pradesh State Energy Conservation Mission (APSECM)
Current Policy/Policies In Place
The Andhra Pradesh state is actively implementing mandatory energy conservation building code (ECBC) in commercial buildings in the State. The Municipal administration department has already integrated the ECBC compliance into the online Development Permission Management System (DPMS). However, the Star Rating and Shunya Rating of buildings is currently at a voluntary stage only.
Implementation Period
Phase 1 (2022-2024) • Launch public awareness campaigns to inform builders, developers, and the public about the advantages of energy-efficient and green building practices. • Create financial incentive programs to encourage voluntary adoption. Phase 2 (2025-2028): • Gradually introduce mandatory compliance for new building construction based on

specific criteria.
- Develop technical resources and capacity for builders and architects to achieve high BEE star ratings and green building certifications.

Phase 3 (2029-2031):

- Enforce mandatory compliance for a broader range of building categories.
- Monitor and evaluate the policy's impact on energy consumption and environmental sustainability.

Saving Potential

Moderate Scenario: It is assumed that in 2026, 5% of the buildings are green rating certified, and in 2031, 8% of the buildings are certified. Similarly, for Ambitious Scenario: It is assumed that in in 2026, 7% of the buildings are green rating certified, and in 2031, 10% of the buildings are green rating certified.

Green Rated Buildings in India incorporating both active (technology-based) and passive (design-oriented) strategies to improve energy efficiency measures can lead to a 15% potential savings in energy efficiency compared to conventional buildings. This is considered as ambitious scenario.

The energy saving potential of implementation of this strategy is mentioned below.

Table 17: Energy Saving Potential

Particulars	*2026*		*2031*	
	Moderate	Ambitious	Moderate	Ambitious
Commercial Buildings	24,759	38,270	39,615	54,672
Energy Reduction through Energy Audit	8%	10%	12%	15%
Energy Saving Potential (Mtoe)	0.01	0.02	0.03	0.05
GHG Emission Reduction Potential ($MtCO_2$)	0.04	0.07	0.09	0.15

Action Plans

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

1. **Development of Compliance Portal:**

   Develop and maintain an Energy Conservation Building Code (ECBC) compliance portal. This portal can serve as a resource for builders, architects, and contractors to access information on energy-efficient and green materials and technologies.

2. **Market Outreach and Awareness:**

   Conduct market outreach campaigns to promote ECBC-compliant products. Utilize various communication channels such as radio jingles, social media, and awareness programs to educate the public about the benefits of energy efficiency.

3. **Pilot Projects for Super ECBC and Net Zero Buildings:**

   Initiate pilot projects to showcase the of benefits of Net Zero (Energy) Rating. Select an initial set of 20 buildings as case studies to demonstrate the feasibility and advantages of higher energy efficiency standards.

4. **Home Energy Auditor Training:**

   Establish training programs for home energy auditors. Create a compliance structure that rewards residential projects for energy savings achieved through energy-efficient measures, such as insulation and lighting upgrades.

5. **Government Building Energy Audits and BEE Star Rating Target:**

   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.

6. **Capacity Building for Professionals:**

   Develop training and capacity-building programs for architects, building professionals, and developers focused on energy-efficient building design and construction practices. Encourage them to incorporate energy-efficient technologies and designs into their projects.

7. **Transformation of Iconic Government Buildings:**

   Identify and select iconic government buildings for transformation into Net-Zero energy buildings. Implement energy-efficient retrofits, renewable energy integration, and smart technologies to showcase the possibilities of sustainable construction and operation.

8. **Mandatory Temperature Set Point for ACs**:

   Enforce a mandatory minimum set point of 24°C for air conditioners in all government buildings.

9. **Cool Roof Programme**:

   a) Mandatory cool roofing for all the government, government-owned, non-residential and commercial buildings irrespective of site area/built up area.

   b) Mandatory cool roof application for all the residential buildings that have a plot area of 500m^2 and above.

10. **Promoting District Cooling in Andhra Pradesh**

    a) District Cooling Systems (DCS) are centralized cooling systems that provide efficient and sustainable cooling to multiple buildings and facilities. DCS can help reduce the carbon footprint, lower energy consumption, and improve air quality.

    b) Involvement of Municipalities and Utilities: The state government will work closely with municipalities and utilities to promote the adoption of district cooling systems (DCS). Municipalities will be encouraged to provide the necessary infrastructure for DCS, including space for thermal storage tanks and access to the distribution network.

Approach:

- Involvement of Municipalities and Utilities: The state government will work closely with municipalities and utilities to promote the adoption of district cooling systems

(DCS). Municipalities will be encouraged to provide the necessary infrastructure for DCS, including space for thermal storage tanks and access to the distribution network.

- DCS Pilot Projects: The government will initiate DCS pilot projects in select urban areas to demonstrate the benefits of this technology. The pilot projects will serve as a basis for identifying challenges, best practices, and potential improvements.
- Mandate DCS in Urban Planning for Greenfield Projects: The state government will mandate the use of DCS in urban planning for all greenfield projects with a cooling capacity of 10,000 TR/sqkm or higher. This will ensure that new developments are built with sustainability in mind from the outset.
- Special Power Tariff to Promote Thermal Storage: The government will introduce a special power tariff to promote the use of thermal storage in DCS. This will incentivize system operators to use excess energy during off-peak hours to charge thermal storage tanks, which can then be used during peak demand periods.
- Establish and Standardize Project Development Process: The government will establish and standardize the project development process for DCS. This will include guidelines for project feasibility studies, design, procurement, construction, and operation.
- Business Models and Contracting: The government will promote the development of various business models for DCS, including public-private partnerships, build-operate-transfer, and concession agreements. Standard contracts will be developed to facilitate the implementation of these models.

Case of Gujarat International Finance Tech-City (GIFT City)[31]

Gujarat International Finance Tech-City or GIFT City, India's first IGBC Platinum rated city, is India's first merchant DCS developed by the Government of Gujarat. GIFT City has been developed on 886 acres of land with a planned total built up area of 5.76 Mn Sqm, and includes commercial buildings, residential buildings, social buildings such as hotel, club and malls, and a hospital.

With DCS, the total requirement of 270,000TR of air conditioning shall be met with just 180,000TRof chillers. Each plant has been designed with chilled water based stratified thermal energy storage tank, which can be charged during off-peak period and discharged during peak period, thus reducing the electrical demand from 240MW to 135 MW only.

GIFT City is a notable example of DCS that was properly planned with involvement of authorities and municipal corporation for planning and implementation of DCS in Gift city. GIFT city has experienced challenges in terms of demand assessment.

Currently, only one plant of 10,000TR is operational feeding eight buildings. In DCS, capital costs are "front-loaded" because of the high costs of installing basic plant infrastructure and pipe mains in the early years.

[31]https://eeslindia.org/wp-content/uploads/2021/03/Final-Report_National-District-Cooling-Potential-Study-for-India.pdf

6.3 Energy saving potential of the sector& monitoring mechanism

Energy saving potential of the building sector is displayed in the table below.

Table 18 Summary of energy saving from building strategies

Strategies	*Energy Saving Potential in 2031 (Mtoe)*	
	Moderate	Ambitious
1. *Star Labelling of Residential buildings*	0.13	0.15
2. *Deepening of S&L Programme*	0.10	0.15
3. *Promotion of Green Rating of Buildings*	0.03	0.05
Total	0.25	0.35
Emission Reduction Potential (mTCO2)	0.71	0.94

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

Policy Type	Monitoring Mechanism
Reporting & Disclosure	Establishing a system for enforcing compliance with energy efficiency codes and standards under operating conditions every few years can help ensure that buildings are meeting the required standards for reducing carbon emissions.
Performance contracting	The government can encourage performance contracting, where third-party contractors are responsible for implementing energy efficiency measures in buildings. The contractors can be required to report on energy savings achieved and the government can monitor these savings.

7 FOCUS SECTOR 4: AGRICULTURE & FISHERIES

7.1 Overview

Andhra Pradesh is one of the major agricultural states in India, with a diverse range of crops being grown in different regions. The state's economy is largely dependent on agriculture and fisheries, with approximately 62% of the population engaged in these sectors. Improving energy efficiency in these sectors is crucial for achieving sustainable development and reducing greenhouse gas emissions.

In the agriculture sector, energy is primarily used for irrigation, crop processing, and transportation. The use of diesel pumps for irrigation is common in rural areas, which are highly inefficient and consume a significant amount of energy. To address this, the state government has initiated various programs to promote the use of solar-powered pumps, which are more energy-efficient and cost-effective in the long run.

In addition, the state government has also implemented measures to promote energy-efficient crop processing and storage facilities. These include the promotion of solar dryers, biomass-based power plants, and cold storage facilities that use energy-efficient refrigeration systems.

In the fisheries sector, energy is mainly used for fishing operations, ice production, and transportation. The state government has launched programs to promote the use of energy-efficient fishing boats, which are equipped with solar-powered lights and GPS systems. In addition, the government is also promoting the use of energy-efficient ice-making machines and cold storage facilities for fish preservation.

7.2 Energy efficiency strategies in the agriculture & fisheries sector

7.2.1 Strategy #1: Transition of electrical pumps to solar powered pumps

The use of energy-efficient pumps can result in significant energy savings. In Andhra Pradesh, the agricultural sector consumes about 27% of the total electricity generated in the state in FY 2020, and pumps account for 80% of this energy consumption. Therefore, there is a significant opportunity for energy savings by improving pump efficiency. A policy on solar pumps for the agriculture sector in Andhra Pradesh can help promote sustainable irrigation practices and reduce the dependence on conventional energy sources.

The strategy and its implementation are explained below.

Scope Boundary
The policy will encompass the establishment of solar feeder distribution networks to supply electricity specifically for agricultural and irrigation purposes. The focus will be on transitioning existing electrical pumps used in agriculture and other relevant sectors to solar-powered pumps.
Implementing Agency
• Bureau of Energy Efficiency (BEE) • Department of Agriculture • New & Renewable Energy Development Corporation of Andhra Pradesh Ltd. (NREDCAP) • Andhra Pradesh State Electricity Regulatory Commission (APERC) • DISCOMs
Current Policy/Policies in Place
• Component-C of PM KUSUM Scheme is a new initiative from the Government of India aimed at ensuring reliable day time power supply for irrigation, reducing subsidy burden on DISCOMs. • Under this Component, individual farmer having grid connected agriculture pump will be supported to solarise pump. • Solar PV capacity up to two times of pump capacity in kW is allowed under the scheme, so that the farmer will be able to use the generated solar power to meet the irrigation needs and get additional income by selling surplus solar power to DISCOMs.
Implementation Period
• Component-C of PM KUSUM Scheme is a new initiative from the Government of India aimed at ensuring reliable day time power supply for irrigation, reducing subsidy burden on DISCOMs. • Under this Component, individual farmer having grid connected agriculture pump will be supported to solarise pump. • Solar PV capacity up to two times of pump capacity in kW is allowed under the scheme, so that the farmer will be able to use the generated solar power to meet the irrigation needs and get additional income by selling surplus solar power to DISCOMs.

Saving Potential

The number of electrical pumps is projected till 2031. If 8% of these pumps are converted to solar pumps in moderate scenario and 10% in ambitious scenario by 2031, it would result into energy savings of 0.13 Mtoe and 0.16 Mtoe respectively.

Figure 16 No. of electrical pumps vs solar pumps projected for FY 2031

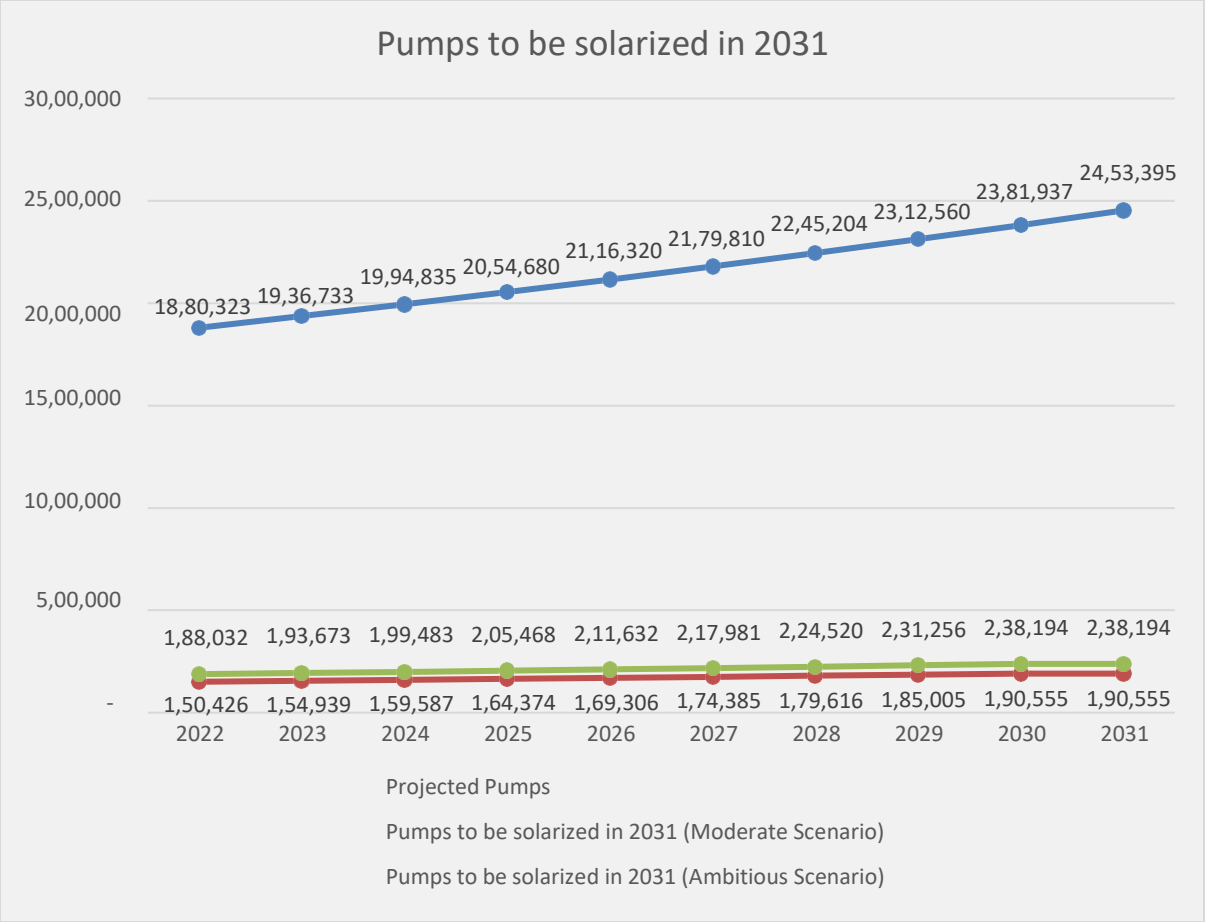


Table 19: Energy Saving Potential

Particulars	*2026*		*2031*	
	Moderate	Ambitious	Moderate	Ambitious
Energy Saving Potential (Mtoe)	0.04	0.07	0.13	0.16
GHG Emission Reduction Potential ($MtCO_2$)	0.13	0.22	0.40	0.51

7.2.2 Strategy #2: Replacement of inefficient pumps with BEE 5 Star Rated Pumps along with smart control panel

According to a report published by the Bureau of Energy Efficiency (BEE), inefficient pumps account for a significant portion of the energy consumption in India's agricultural sector. The report states that up to 30% of the energy consumed by agricultural pumps in India is wasted due to inefficient pump sets, resulting in a loss of about Rs. 50,000 crores annually.

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

the agricultural sector with more energy-efficient options to reduce energy consumption and reduce electricity bills. Traditional agricultural pumps i.e inefficient grid-powered motors, show significant vulnerabilities with regards to water and energy management. However, advancements in digital control systems have introduced intelligent agricultural pumps equipped with advanced control panels. These embedded modules operate as dedicated microcontrollers, utilizing sensor data and algorithms to optimize irrigation and pump operation.

EESL is implementing the Energy Efficient Pump Programme to distribute BEE 5-star energy efficient agricultural pumps and ensures a minimum of 30% reduction in energy consumption with smart control panels which can be remotely operated to enhance the ease of operation of pumps by the farmers. While the installation of 75,000 pumps in Andhra Pradesh[32] marks a commendable start, further acceleration is crucial to maximize the program's potential.

The strategy and its implementation are explained below.

Scope Boundary
The policy will focus on the agriculture sector of Andhra Pradesh, specifically targeting inefficient pumps used for irrigation purposes. It will cover the replacement of existing inefficient pumps with BEE 5-star rated pumps and smart control panels in agricultural fields and related irrigation systems.
Implementing Agency
• Bureau of Energy Efficiency (BEE) • Department of Agriculture • New & Renewable Energy Development Corporation of Andhra Pradesh Ltd. (NREDCAP) • Andhra Pradesh State Electricity Regulatory Commission (APERC) • DISCOMs
Current Policy/Policies in Place
• BEE's S&L Programme • Under AgDSM programme EESL has been retrofitting BEE star rated pump sets in Andhra • Pradesh.
Implementation Period
Long Term

Saving Potential

The number of electrical pumps is projected till 2031. If 10% of these pumps are replaced with BEE 5-star rated pumps in moderate scenario and 15% in ambitious scenario, it would result into energy savings of 0.06 Mtoe and 0.11 Mtoe respectively.

[32]https://eeslindia.org/en/ouragdsm/#:~:text=EESL%20is%20implementing%20the%20Energy,of%20pumps%20by%20the%20farmers.

Figure 17 Replacement with E.E pumps for 2031

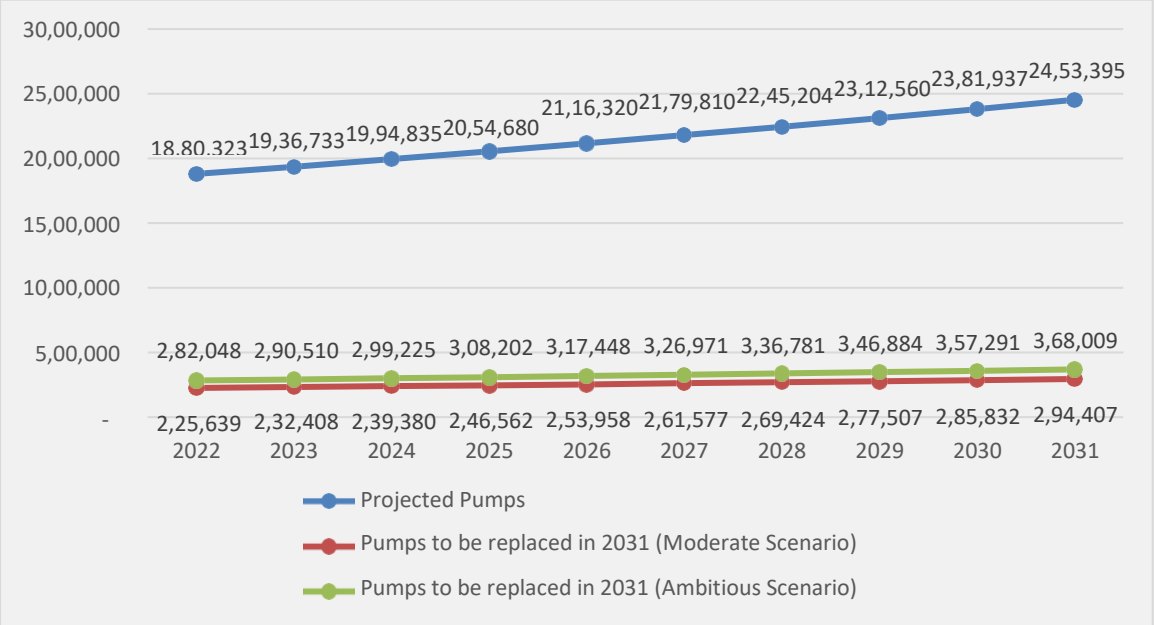


Table 20: Energy Saving Potential

Particulars	*2026*		*2031*	
	Moderate	Ambitious	Moderate	Ambitious
Energy Saving Potential (Mtoe)	0.02	0.04	0.06	0.11
GHG Emission Reduction Potential ($MtCO_2$)	0.05	0.14	0.19	0.36

Action Plans

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

1. **Boost Farmer Awareness:**
   a) Develop targeted media campaigns in local languages using farmer testimonials and showcasing program benefits (energy savings, reduced costs, better control).
   b) Organize awareness camps in villages with agricultural extension officers and pump manufacturers.
   c) Partner with farmer cooperatives and rural retailers to conduct demos and distribute informative brochures.
   d) Offer free energy audits to quantify potential savings for interested farmers.

2. **Streamline Implementation:**
   a) Implement online application portals with simple interfaces and local language support.

b) Train local technicians and retailers for installation and basic maintenance support.

c) Partner with financial institutions to offer easy loan schemes with minimal paperwork.

3. Integrate with Existing Initiatives:

a) Align AgDSM with Andhra Pradesh's existing Jal Sanjeevani and YSR Rythu Bharosa schemes for water management and farmer support.

b) Leverage existing agriculture extension infrastructure and training programs to promote the program.

c) Collaborate with local agricultural universities and research institutions for pilot projects and technology demonstrations.

4. Impact Assessments

Conduct impact assessments to quantify program benefits beyond energy savings (water use, crop yields, farmer income).

Develop innovative financing models like Energy Service Agreements (ESAs) to share investment costs and risks.

5. Scheme for IoT-enabled Precision Irrigation Integrated Nutrient Management

a) This scheme involves the use of IoT sensors to measure soil moisture levels, weather conditions, and crop growth patterns in real-time. The data is then processed using machine learning algorithms to create a predictive model that helps farmers optimize their irrigation practices. This leads to a reduction in water wastage, which in turn reduces the carbon footprint associated with pumping water from groundwater sources.

6. Organic and Biofertilizer Promotion

Encourage the adoption of organic and biofertilizers to enhance soil fertility and reduce reliance on chemical fertilizers.

7.2.3 Strategy #3: Energy efficiency across value chain of fisheries

The fisheries sector is an important contributor to the economy of the state of Andhra Pradesh, located on the southeastern coast of India. The state has a long coastline of around 974 km and several major rivers, making it well-suited for fishery activities.

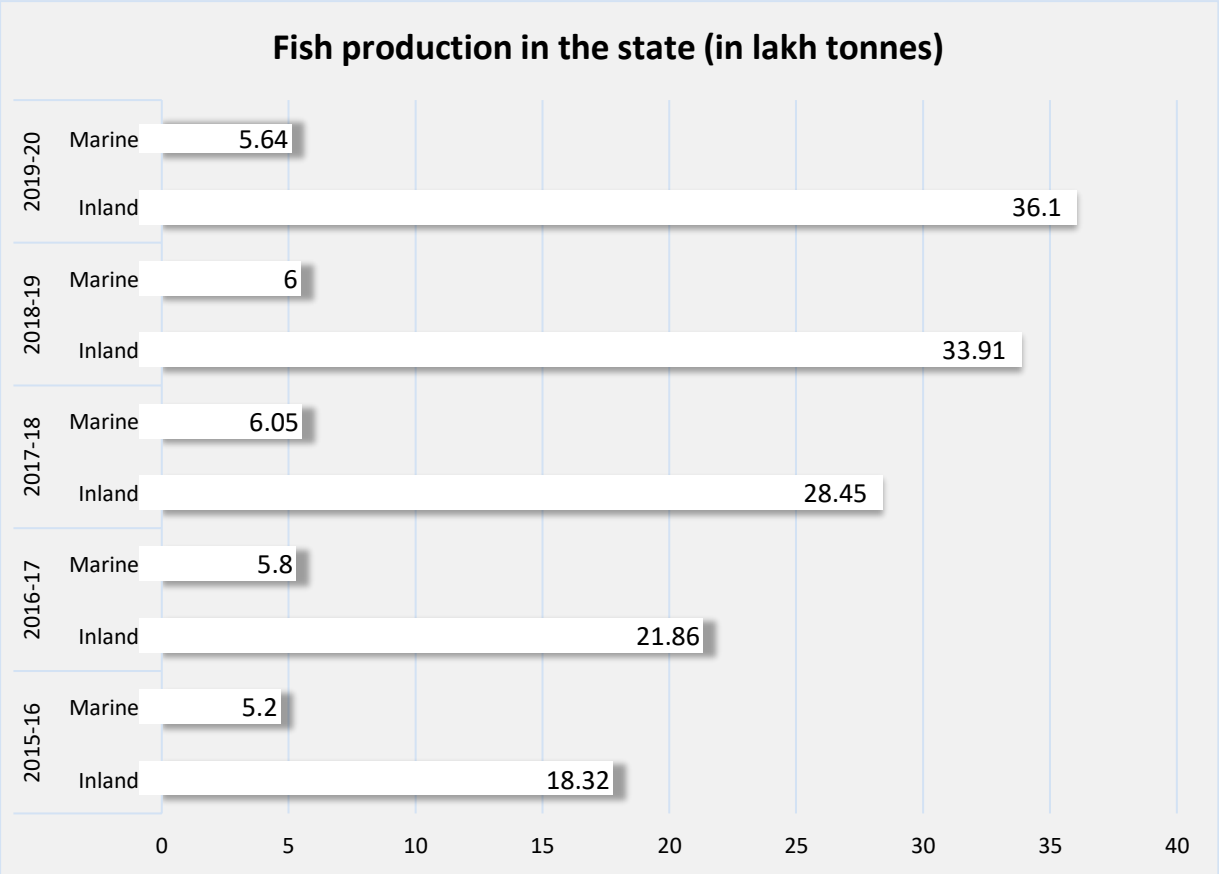
The fisheries sector in Andhra Pradesh comprises both inland and marine fisheries, including capture and culture fisheries. The marine fisheries are dominated by traditional, small-scale fishing operations using non-motorized boats, while the inland fisheries are largely based on freshwater aquaculture.

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

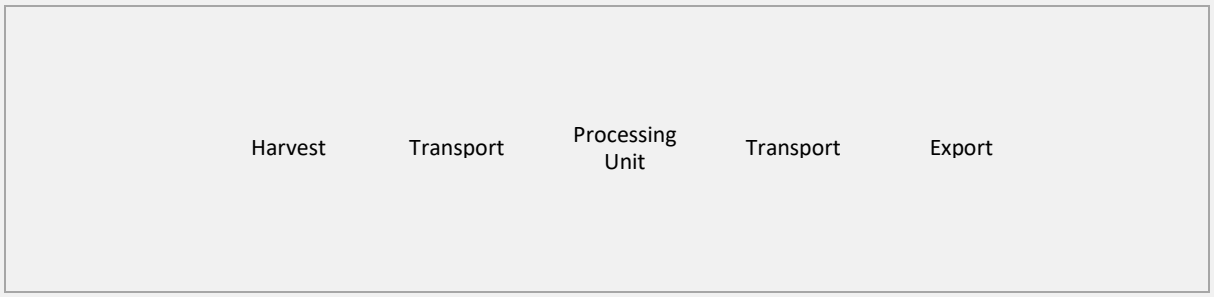
To address these challenges, there have been efforts to promote energy efficiency in the fisheries sector in Andhra Pradesh. These include the adoption of energy-efficient fishing techniques, such as the use of more fuel-efficient boats and gears, as well as the promotion of renewable energy sources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

The fisheries sector in Andhra Pradesh is divided into marine and inland fisheries. The state has established a number of fish farms, hatcheries, and processing units to support the sector. The state government has also introduced various schemes and initiatives to promote fish farming and provide support to fish farmers.

According to Handbook on Fisheries Statistics 2020 by Department of Fisheries, Andhra Pradesh produced 36 lakh inland fishes and 5 lakh marine fishes as seen below.



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



In the processing and packaging stages, energy is mainly consumed for cooling, freezing, and drying of fish products. The use of energy-efficient refrigeration and drying equipment can significantly reduce energy consumption and associated costs. Additionally, adoption of

renewable energy sources such as solar and wind can further reduce energy consumption and greenhouse gas emissions.

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

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

The strategy and its implementation are explained below.

Scope Boundary
The policy will cover all aspects of the fisheries value chain, including fishing vessels, transportation vehicles, processing units, cold storage facilities, and related infrastructure. It will focus on adopting energy-efficient technologies and practices throughout the sector to minimize energy consumption and optimize resource utilization.
Implementing Agency
• Department of Fisheries, GoI • Department of Fisheries, Andhra Pradesh • New & Renewable Energy Development Corporation of Andhra Pradesh Ltd. (NREDCAP)
Current Policy/Policies in Place
No current policy in the state centering around energy conservation in fisheries sector.
Implementation Period
Phase 1 (First 2 years): Conduct a comprehensive assessment of energy consumption patterns and identify areas with high energy intensity in the fisheries value chain. Phase 2 (Next 3 years): Initiate pilot projects to test and demonstrate the feasibility and effectiveness of energy-efficient technologies in select fisheries operations. Phase 3 (Next 5 years): Scale up the adoption of energy-efficient practices and technologies across the entire fisheries sector, targeting major fishing hubs and processing centers. Phase 4 (Next 10 years): Aim for widespread implementation of energy-saving measures across all aspects of the fisheries value chain in Andhra Pradesh

Saving Potential

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

Table 21: Energy Saving Potential

Particulars	*2026*		*2031*	
	Moderate	Ambitious	Moderate	Ambitious
Energy Saving Potential (Mtoe)	0.09	0.18	0.29	0.46

GHG Emission Reduction Potential ($MtCO_2$)	0.29	0.58	0.90	1.44

Action Plans

This section describes several action plans that can be implemented across fisheries sector.

1. **Skill Development:**
   a) Launch training programs for boat operators on fuel-efficient navigation through route optimization software, gear selection based on catch data and weather forecasts, and proper engine maintenance techniques.
   b) Partner with ICAR-CMFRI to develop and deliver state-specific training modules on efficient fishing practices and gear selection for Andhra Pradesh's diverse fishing grounds.
2. **Awareness Campaigns:**
   a) Conduct workshops in major fish processing centers like Visakhapatnam and Kakinada, focusing on energy-efficient equipment like variable-speed drives for compressors, LED lighting upgrades, and automated cleaning systems.
   b) Develop and distribute technical manuals in Telugu detailing best practices for optimizing cooling systems, waste heat recovery, and water management in fish processing plants.
3. **Financial Incentives:**
   a) Offer subsidies for replacing traditional engines with Bureau of Indian Standards (BIS)-approved energy-efficient models.
   b) Implement a "scrap and replace" scheme for outdated vessels, incentivizing lightweight fiberglass designs with higher fuel efficiency.
4. **Pilot Projects:**
   a) Collaborate with local fishing communities in Visakhapatnam and Kakinada harbours to pilot energy-efficient fishing vessels with advanced navigation systems and automated gear deployment.
5. **Energy Efficient Fishing Vessels:**
   a) In Andhra Pradesh, there are around 17,000 motorized fishing boats, which consume a considerable amount of diesel fuel. By adopting energy-efficient engines and reducing vessel weight, fuel consumption can be reduced. According to a study conducted by the Indian Council of Agricultural Research (ICAR), the use of energy-efficient engines in fishing vessels can reduce fuel consumption by up to 40%.
   b) Promote the adoption of solar-powered accessories like navigation lights, bilge pumps, and onboard refrigeration units to reduce reliance on diesel generators.
   c) Develop and disseminate guidelines for safe and efficient installation and operation of solar panels on fishing vessels, considering marine environment and safety regulations.
6. **Guidelines for BEE Star-Rated Products:**

a) Develop and distribute state-specific guidelines highlighting the benefits and availability of BEE Star-rated equipment for fishing vessels, processing units, and cold storage facilities.

b) Organize awareness campaigns in fishing communities and processing centers to educate stakeholders on identifying and choosing energy-efficient equipment.

c) Collaborate with equipment manufacturers and distributors to promote and stock BEE Star-rated products in Andhra Pradesh.

7. Partial Support for Energy Audits

Offer partial financial support or subsidies for conducting energy audits in fishing vessels, processing units, and cold storage facilities, similar to the program available for MSMEs.

8. Mandatory Data Collection and Reporting

Consider mandating ISO 50001 energy management system certification for larger processing units to ensure effective data collection and continuous improvement in energy efficiency.

9. Standardization of Cold Chain Technologies

a) Develop and maintain a state-specific database of standardized cold chain technologies for fisheries, covering investment costs, Return on Investment (ROI), energy specifications, vendor information, and operational benefits.

b) Regularly update the database with new technologies and best practices, disseminating information through industry workshops and technical manuals.

c) Collaborate with research institutions and industry experts to evaluate and endorse energy-efficient cold chain technologies.

10. First and Last Mile Transportation:

a) Phase Changing Materials (PCM) Technology: Encourage the adoption of PCM coolers/freezers for transporting fish, reducing reliance on ice and maintaining consistent cool temperatures during transport.

b) Energy-Efficient Aerators: Promote the use of energy-efficient aerators in aquaculture farms to optimize oxygen levels and reduce energy consumption.

c) EV adoption: Collaborate with fisheries departments and EV manufacturers to explore expanding the use of electric three-wheelers or small cargo EVs for fish transportation within cities and urban areas.

11. Cold Storage and Processing:

a) Solar PV Systems: Incentivize the installation of rooftop solar PV systems for fisheries and cold storage facilities through subsidies, net metering policies, and technical assistance programs.

b) Ammonia/CO2 Brine Systems: Promote the adoption of efficient Ammonia/CO2 brine systems in cold storage facilities, offering higher cooling efficiency compared to traditional systems.

c) Evaporative Condensers: Encourage the use of evaporative condensers for cooling in processing units and cold storage facilities, utilizing ambient air and water evaporation for heat rejection.

d) Low Charge Ammonia Systems: Consider exploring the feasibility and safety of adopting low charge Ammonia refrigeration systems in suitable scenarios, minimizing refrigerant use and potential leaks.

12. Reefer Transport:

a) Mobile Chilling for Reefer Trucks: Support the development and pilot testing of mobile chilling units for long-distance reefers, allowing pre-cooling of fish at landing sites and reducing energy consumption during transport.

b) PCM Swapping for Reefer Trucks: Explore the feasibility of implementing PCM-based temperature stabilization systems within reefers, reducing reliance on refrigeration units and maintaining consistent temperatures during shorter transport journeys.

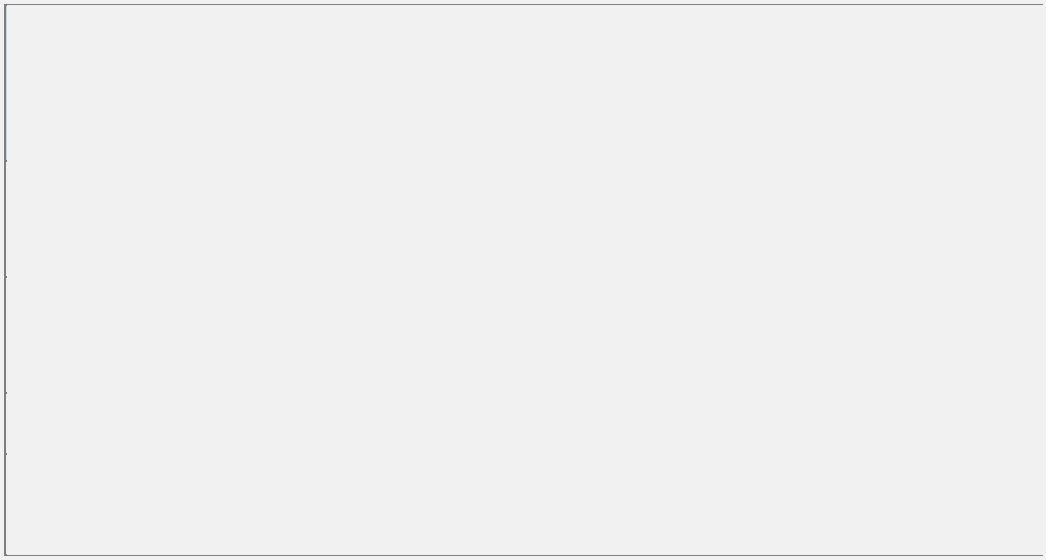
Case Study: Energy Efficiency in Fisheries Value Chain

Objective

The project aims to conduct an energy and greenhouse gas (GHG) audit of selected fisheries sector value chains to identify opportunities for enhancing energy efficiency and reducing the use of refrigerants with high global warming potential and ozone-depleting substances. The focus is on promoting best practices in the cold chain of the fisheries sector and encouraging private sector participation.

Project Activities:

- Reviewing Local, National, and International Best Practices: The project will assess existing cold chain processes and identify energy-efficient methods and sustainable refrigerants used globally.
- Detailed Energy Audit: An in-depth energy audit of fisheries sector value chains in India will be conducted to establish mass balance and estimate benchmarks for specific energy consumption (SEC), GHG emissions, and overall energy consumption.



- Value Chain Improvement Recommendations: Based on the audit findings, the project will propose measures and recommendations to enhance the efficiency of the fisheries sector value chains.
- National Design Challenge: A competition will be organized to invite innovative ideas for mobile kiosks for fish vending and live fish transport, promoting safety, hygiene, reduced waste, and energy efficiency.

- Stakeholder Consultations: Engagement with various stakeholders in the fisheries sector will facilitate the adoption of best practices and foster private sector involvement.

Impact:

- The energy and GHG audit of selected value chains provided crucial data on SEC, GHG emissions, and energy consumption benchmarks, enabling a better understanding of best practices in the fisheries sector.
- Some noteworthy technologies found during the cold chain assessment include the use of phase change material technology in coolers, solar PV systems for cold storage, electric vehicles for emission reduction, reefer trucks, aerators for water quality improvement, and VFDs for refrigeration systems.
- The "National Design Challenge" received active participation from over 150 individuals and entities, including college students, innovators, start-ups, associations, and industry experts. The challenge aimed to find the most effective and efficient mobile kiosk for fish vending, promoting a circular economy and waste reduction.

Recommendations:

Based on the analysis and stakeholder consultations, the following recommendations are proposed to increase private sector participation in the fisheries sector:

- Develop an Investment Potential Compendium:
  Compile information on investment opportunities and highlight current best practices across different supply chains and value chains in the fisheries sector.
- Organize B-to-B Workshops:
  Facilitate workshops and networking events involving stakeholders and financing institutions to encourage collaborations and investments in the fisheries sector.
- Implement Pilot Projects:
  Initiate pilot projects showcasing successful practices that can be replicated, documented as case studies, and attract private investors to invest in sustainable fisheries initiatives.

7.3 Energy saving potential of the sector& monitoring mechanism

Energy saving potential of the agriculture & fisheries sector is displayed below.

Table 22 Summary of energy saving from the strategies

Strategies	*Energy Saving Potential in 2031 (Mtoe)*	
	Moderate	Ambitious
1. *Transition to solar powered pumps*	0.13	0.16
2. *Replacement of inefficient pumps with BEE 5 Star Rated Pumps along with smart control panel*	0.06	0.11
3. *Energy efficiency across all value chain in fisheries sector*	0.17	0.29
Total	0.36	0.56
Emission Reduction Potential (mTCO2)	1.13	1.76

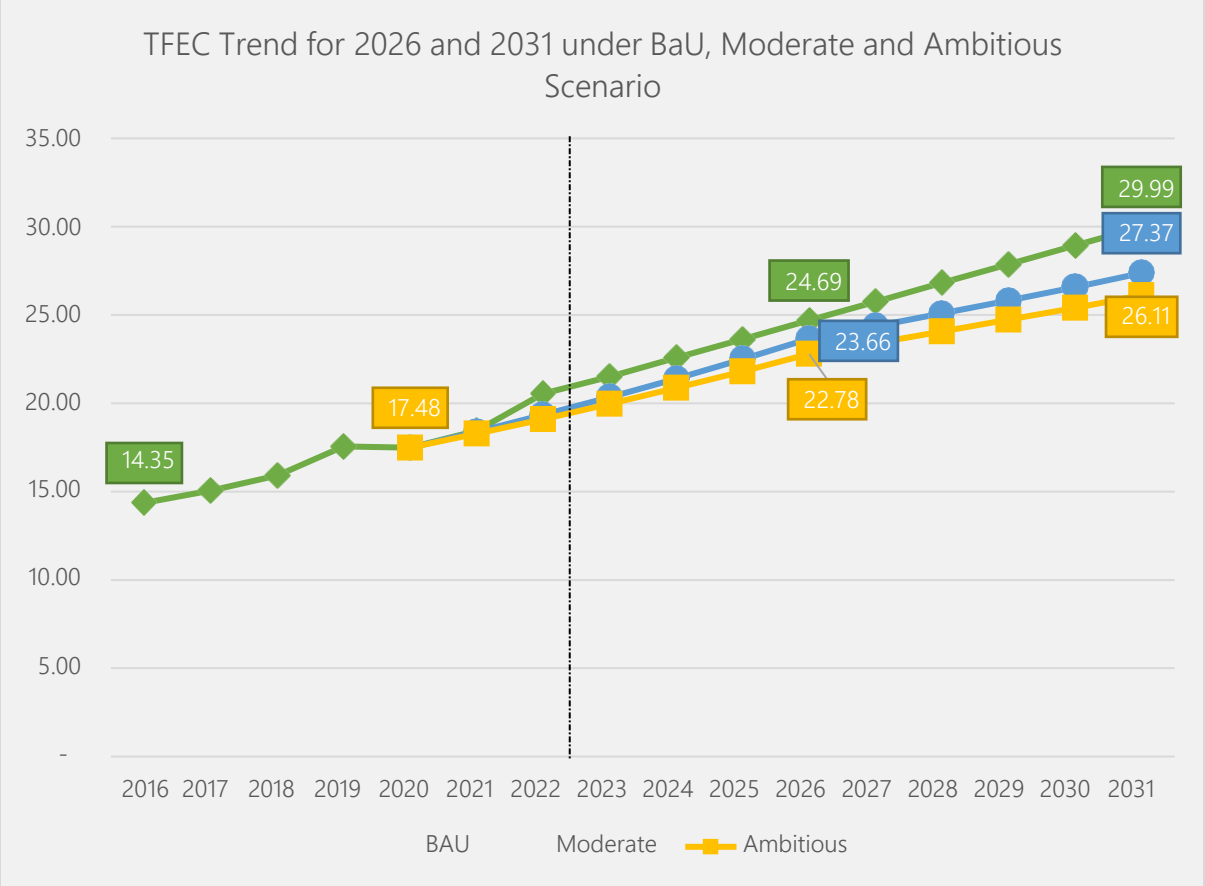
Following are the monitoring mechanisms that could be implemented to track the progress and effectiveness of the policies in the agriculture and fisheries sector in Andhra Pradesh state:

Policy Type	Monitoring Mechanism
Benchmarking	Benchmarking can be used to compare the energy consumption patterns of different farms in the same region. This can help identify the most efficient farms and highlight areas where other farms can improve their energy efficiency.
Awareness Programs	Educating farmers about the benefits of energy efficiency and providing training on energy-saving practices can help increase adoption rates and improve the effectiveness of energy efficiency policies.
Reporting and Monitoring	Regular reporting and monitoring can help ensure that energy efficiency policies are being implemented effectively and that progress is being made towards energy-saving goals. This can include regular reporting on energy consumption patterns, energy savings achieved, and greenhouse gas emissions
Data Reporting	Remote sensing and GIS mapping: Remote sensing and GIS mapping can be used to monitor changes in ocean temperatures and salinity, which can affect fish distribution and abundance. These tools can also help identify areas where vulnerable fish species are concentrated.

8 SUMMARY

The state energy efficiency action plan identifies significant energy-saving potential in Andhra Pradesh through the implementation of energy efficiency and conservation strategies. The state has the opportunity to save 2.85 Million Tonnes of Oil Equivalent (Mtoe) by 2031 under the moderate scenario and nearly 3.88 Mtoe under the ambitious scenario.

Figure 18 TFEC Trend for 2026 and 2031

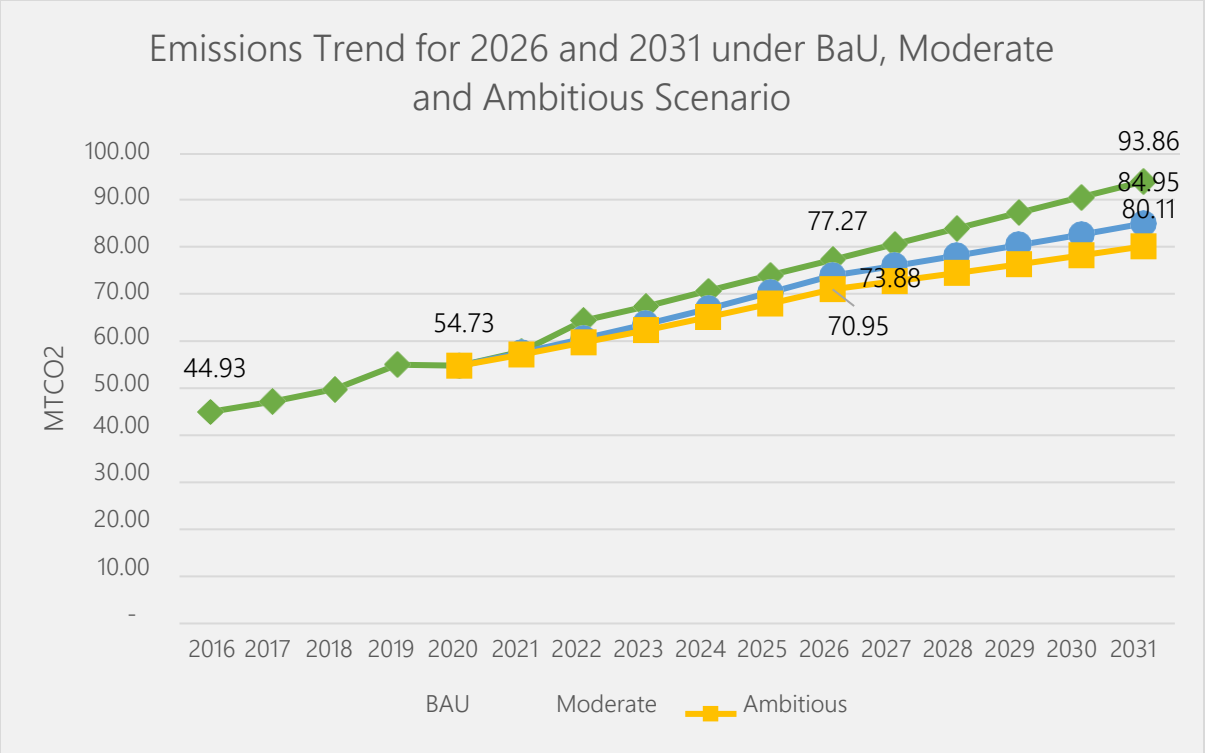


The figure provided in the plan illustrates the Total Final Energy Consumption (TFEC) for the state in 2026 and 2031 under different scenarios. In the Business as Usual (BaU) scenario, TFEC is projected to reach nearly 30 Mtoe by 2031. This scenario assumes that present energy consumption patterns will continue without significant changes in policies, technology, or behavior. The BaU scenario helps understand the likely trajectory of energy consumption without specific energy efficiency measures or conservation efforts.

In the moderate scenario, which assumes some moderate-level energy efficiency measures and conservation efforts will be implemented, TFEC is reduced to 27.37 Mtoe by 2031.

In the ambitious scenario, aggressive and transformative efforts are assumed to be implemented, aiming to significantly reduce energy consumption and achieve substantial energy savings. Under this scenario, the state can reduce its TFEC to 26.11 Mtoe by 2031.

Figure 19 Emissions Trend for 2026 and 2031



The table below shows the summary of energy consumption reduction and emission reduction - sector wise. The total energy consumption reduction is 3.88 Mtoe and the total emission reduction is 12 MtCO2 under ambitious scenario. The biggest reduction in energy consumption is in the transport sector, at 1.72 Mtoe, followed by the industry sector at 01.25 Mtoe. The biggest reduction in emissions is in the transport sector, at 5.38 MtCO2, followed by the industry sector at 3.70 MtCO2.

Table 23 Summary of energy consumption reduction and emission reduction- sector wise.

Sector	Emissions Reduction (MtCO2) - FY2031		Energy Consumption Reduction (Mtoe) - FY2031	
	Moderate	Ambitious	Moderate	Ambitious
	MtCO2 reduction	MtCO2 reduction	Mtoe Reduction	Mtoe Reduction
Industry	2.57	3.92	0.82	1.25
Transport	3.70	5.38	1.18	1.72
Building	0.71	0.94	0.25	0.35
Agriculture	1.13	1.76	0.36	0.56
Total	8.11 MtCO2	12 MtCO2	2.62 Mtoe	3.88 Mtoe

To achieve these energy savings, collaborative efforts are required from all stakeholders, including the national government, state government, state departments, large and small industries, and citizens. By working together, Andhra Pradesh can effectively reduce energy consumption, enhance sustainability, and contribute to a greener and more energy-efficient future.

9 INVESTMENT POTENTIAL

The strategies outlined in the State Energy Efficiency Action Plan are designed to yield substantial energy savings across various sectors. These energy savings, in turn, translate into a reduced demand for energy generation. To effectively implement these strategies, there is a need for investments in energy efficiency projects and the development or modification of policies that create a conducive environment for such projects.

Investments in energy efficiency projects are critical for the successful execution of the plan and offer benefits, including:

- Economic Growth: These investments accelerate economic growth by creating job opportunities and fostering innovation in energy-efficient technologies and practices.
- Environmental Benefits: Energy efficiency investments lead to a significant reduction in greenhouse gas emissions, contributing to a cleaner and more sustainable environment.
- Energy Security: By reducing the state's energy consumption, investments in energy efficiency enhance energy security and reduce dependence on external energy sources.

The table below displays the economic opportunities that energy efficiency measures in each of the focus sectors present under ambitious scenario by FY 2031.

Table 24 Investment Potential[33]

Sector	Energy Consumption Reduction (Mtoe) - FY2031		Investment Potential
	Moderate	Ambitious	
	Mtoe Reduction	Mtoe Reduction	INR Crores
Industry	0.82	1.25	₹ 2,668
Transport	1.18	1.72	₹ 3,165
Building	0.25	0.35	₹ 644
Agriculture	0.36	0.56	₹ 1,601
Total	2.62 Mtoe	3.88 Mtoe	₹ 8,078

The energy saving investment potential of the state is estimated to be nearly ₹8,000 crores by the year 2031, under the ambitious savings scenario, with the transport sector constituting highest energy saving investment potential followed by industry sector.

[33]The Ministry of Power, Government of India, in consultation with the Bureau of Energy Efficiency (BEE), has established a reference price for per metric tonne of oil equivalent. For the year 2018 -19, this benchmark price stands at INR 18,402. This price serves as a benchmark for assessing the economic value of the energy saved through the energy efficiency measures.

10 FINANCING MODELS FOR ENERGY EFFICIENCY

Energy efficiency stands as one of the most effective approaches for meeting the growing energy demand, curbing greenhouse gas emissions, and delivering socio-economic advantages. To fully harness the potential of energy efficiency, substantial investments are necessary to stimulate technological availability in the market and encourage energy efficiency adoption among end consumers. Various developed countries have successfully unlocked energy efficiency financing potential through innovative models, some of which are also under exploration in India, notably the Energy Service Companies (ESCOs) model. The present study delves into several financing models that could prove helpful across commercial, residential, and industrial sectors. In India, several financing strategies are already prevalent, including:

There are several other financing strategies employed globally and adopted by other countries:

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.

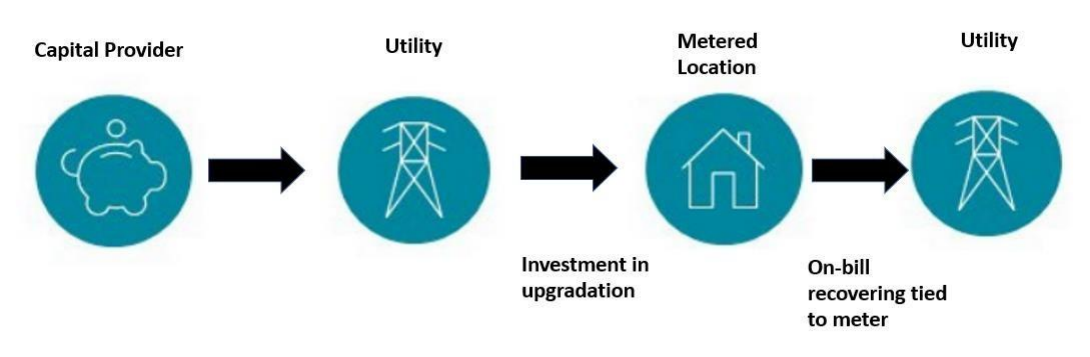
It has been demonstrated that basic energy efficiency measures like insulation, air sealing, heat pumps, and lighting upgrades produce an average energy savings of 25%. Through on-bill initiatives, an electric company or a third-party financier can cover the initial cost of energy-saving upgrades and 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 20 Major common energy consuming appliances and equipment in buildings sector

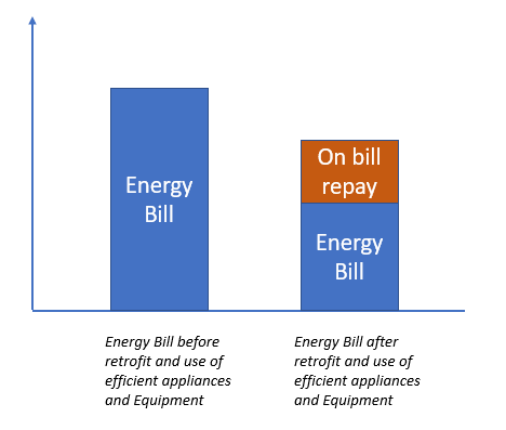
Energy efficiency is frequently the fastest-acting alternative to reduce the consumption of fossil fuels. The plan of delivering EE appliances to consumers may be more significant in order to offer them significant benefits. With the OBF model, consumers won't be put at a financial disadvantage because 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 21 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 22 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

ESCOs have been operating in India over a decade, however the scale of operation is still quite low compared to other countries. By addressing existing barriers and capitalizing on opportunities, they can propel India's energy efficiency landscape.

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). Because 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.

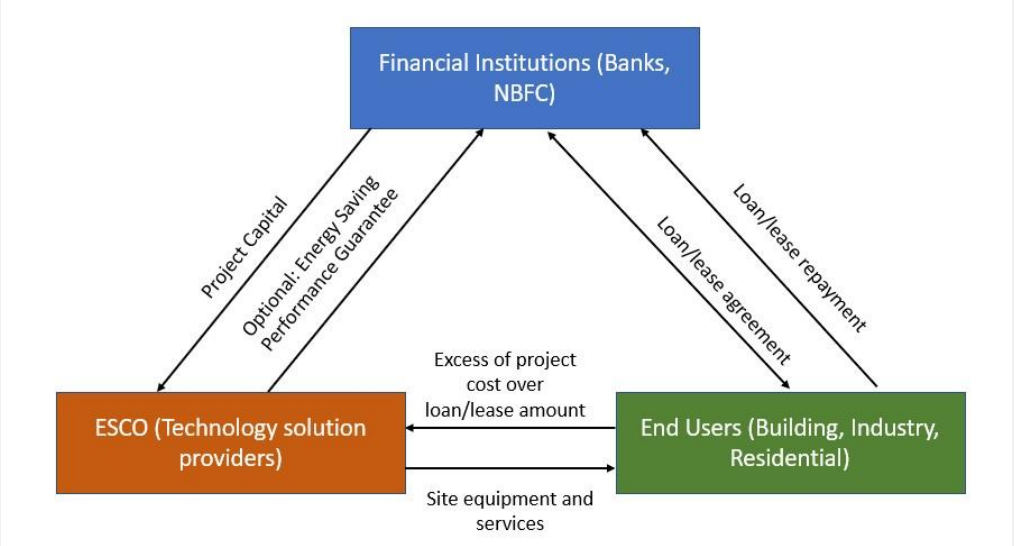
In an EPC, the ESCO guarantees energy savings as long as predetermined operational and maintenance guidelines are followed. Processes for measurement and verification are also put in place to make it easier to calculate the actual energy savings. The ESCO reimburses the energy end user with an amount 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.

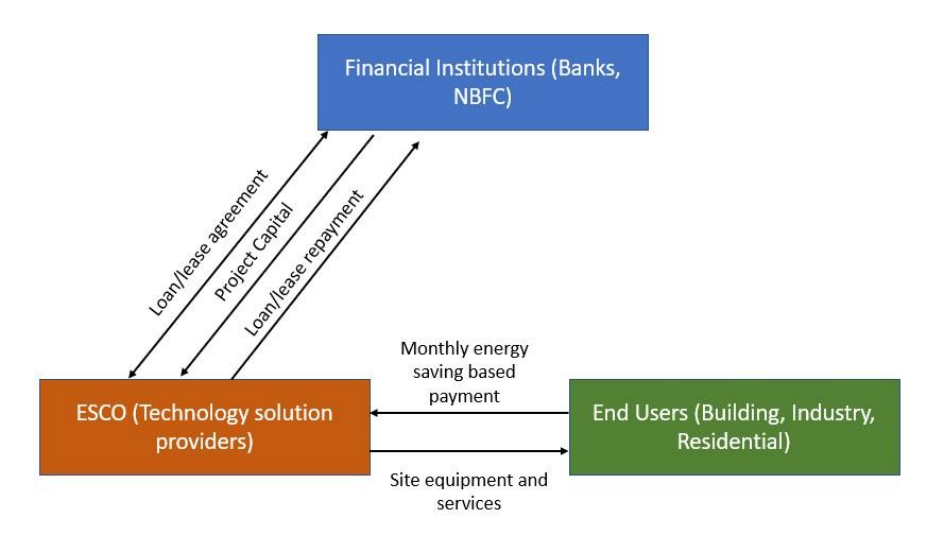
Figure 23 Guaranteed Saving Model



- 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 24 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 25 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

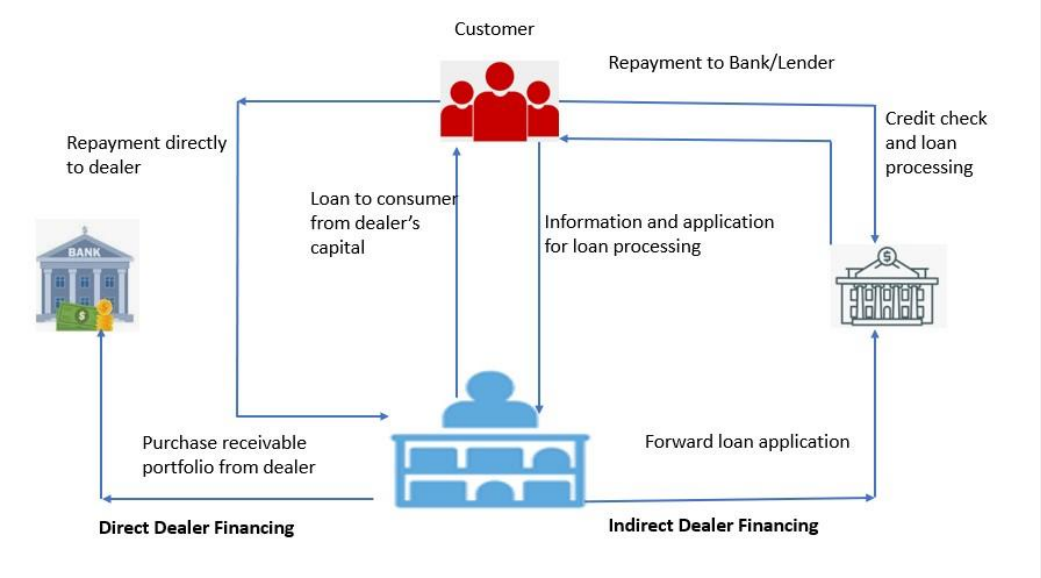
Source: Climate Policy Initiative, 2021

10.3 Dealer or retailer financing model

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.

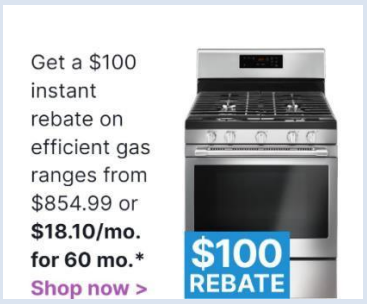
Dealer financing lowers the cost of loan for consumers and easier access to credit facility. Dealer also helps the consumer to do all paperwork, credit risk assessments etc. Dealer can negotiate with multiple finance provider for lending at discounted interest rates.

Figure 25 Dealer and retailer financing model



Case study: ECO-Financing Model by Enervee

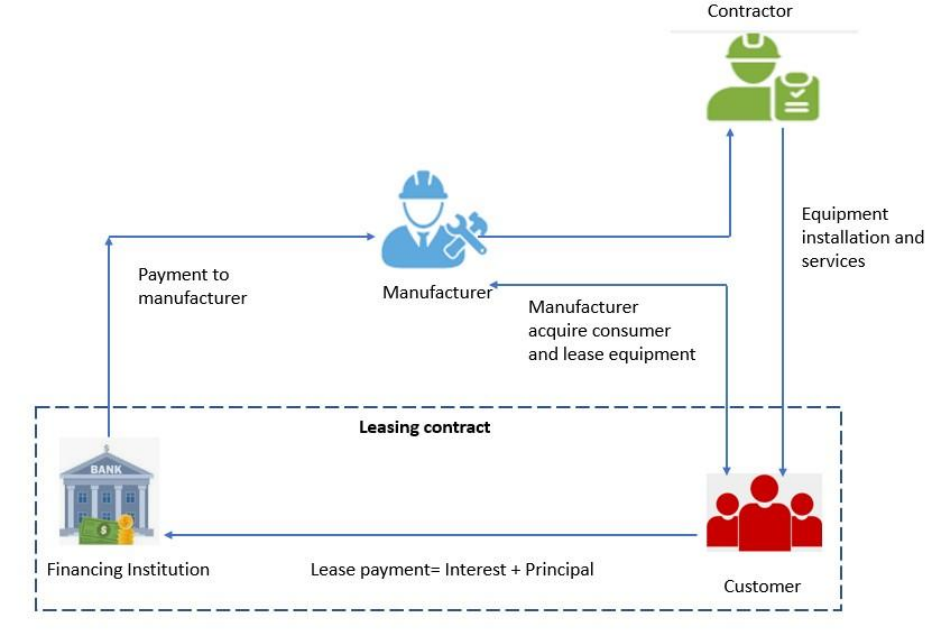
Los Angeles based Enervee company, a provider of energy efficient appliances through online marketplace announced the ECO-Financing model for making energy efficient appliances affordable. The program was launched in collaboration with lenders Southern California Gas Company & the Sate of California.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



10.4 Leasing financing model

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.

Figure 26 Leasing financing model



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:

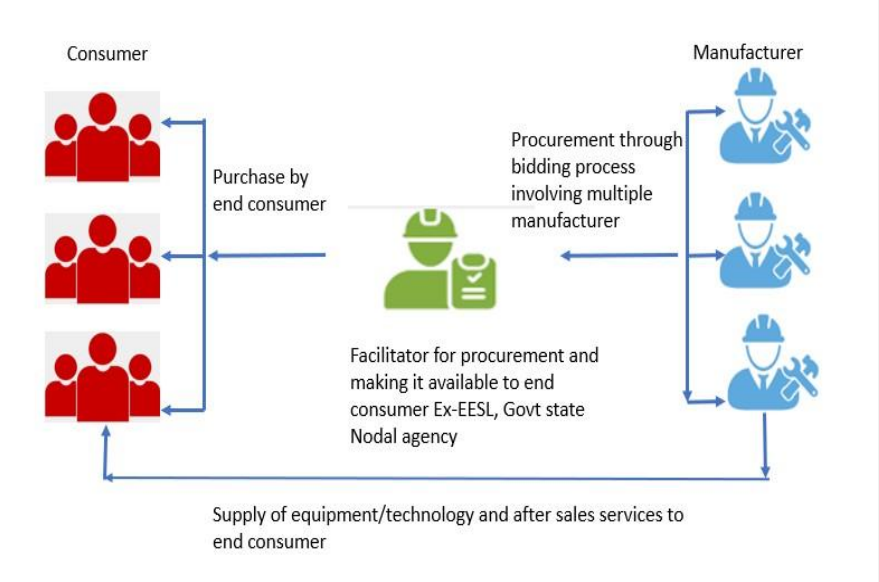
- Component 1: Increasing capacity of suppliers in the category of Renewable and Energy efficient products.
- Component 2: Facilitate the implementation of energy efficient and Renewable energy technologies, best practices in MSMEs cluster of India.
- Component 3: Scaling up the project at national level.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

And key outcomes of the project is as given below:

10.6 Bulk Procurement model

Procurement of appliances and equipment in large volume helps in achieving economies of scale and bulk procurement bring down the cost significantly and make it more affordable to end consumer.

Figure 27 Bulk procurement model



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.

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.

3)	(Nos Lakh)		
1.10	0.15	0.08	0.05
1.50	0.15	0.08	0.06
2.20	0.15	0.11	0.07
3.70	0.15	0.14	0.09
5.50	0.15	0.20	0.13
7.50	0.15	0.23	0.16
11	0.10	0.47	0.25
15	0.10	0.49	0.31
22	0.10	0.65	0.40

11 WAY FORWARD

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

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

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

In conclusion, the State Energy Efficiency Action Plan report for Andhra Pradesh 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.

12 ANNEXURES

Sector	Actual Production 2020	Actual SEC[34]	Moderate SEC (Estimated)	Ambitious SEC (Estimated)	Growth rate	Projected Production by 2031
	Tonne	toe/tonne	toe/tonne	toe/tonne	%	Tonne
Steel	70,96,000[35]	0.44	0.40	0.38	5%	1,10,08,225
Cement	84,49,000[36]	0.08	0.07	0.07	5%	1,31,07,172
Paper	17,37,646[37]	0.41	0.38	0.36	5%	26,95,660

*Growth rate assumed at 5% for projecting the production in FY 2031.

*In the moderate scenario, a reduction of 8% is accounted for, while in the ambitious scenario, a reduction of 12% is accounted for. These reductions align with the approximate 2.5% reduction targeted in each PAT cycle.

% Conversion of existing fleet onto EVs	
Moderate-%	Ambitious-%
3%	5%
2%	5%
2%	3%
1%	2%
1%	2%
5%	10%

[34]Estimated from the PAT data
[35]Estimated from https://pib.gov.in/PressReleasePage.aspx?PRID=1736730
[36]Estimated from Indian Minerals Yearbook 2021
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