Bureau of Energy Efficiency
Government of India, Ministry of Power

STATE ENERGY EFFICIENCY ACTION PLAN

ANDAMAN AND NICOBAR ISLANDS

Prepared by
Confederation of Indian Industry

Supported by
New & Renewable Source of Energy (NRSE)

श्रीकांत नागुलापल्ली, भा.प्र.से.
अपर सचिव, एमओपी एवं महानिदेशक, बीईई
SRIKANT NAGULAPALLI, IAS
Additional Secretary, MoP & Director General, BEE

सत्यमेव जयते

Azadi Ka Amrit Mahotsav

ऊर्जा दक्षता ब्यूरो
(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)

चौथा तल, सेवा भवन, आर.के. पुरम, नई दिल्ली-110066 / 4th Floor, Sewa Bhawan, R.K. Puram, New Delhi-110 066
दूरभाष / Tel. : 91 (11) 26766701, 20867389, फैक्स / Fax : 91 (11) 20867396
ई-मेल / E-mail : dg-bee@nic.in, वेबसाईट / Website : www.beeindia.gov.in

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 Ms. Ranjana Deswal, Secretary (Power), A&N Administration, Ms. Madhuri Shukla, Superintending Engineer (Tech), Electricity Department, A&N Admn. and Ms. Deepa Nair, Executive Engineer (NRSE), Electricity Department, A&N Admn., 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 Andaman and Nicobar Islands. 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 Mr. Abhishek Sharma, Director, Mr. 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 the entire NRSE 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, Andaman & Nicobar Islands 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.

Table of Contents

List of Figures

List of Tables

List of Abbreviations

A&N Islands	Andaman and Nicobar Islands
NRSE	New & Renewable Sources of Energy
U.T	Union Territory
JERC	Joint Electricity Regulatory Commission
STS	State Transport Service
DSS	Directorate of Shipping Services
ALHW	Andaman Lakshadweep Harbour Works
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
DSM	demand side management
ECBC	Energy Conservation Building Code
EE	Energy Efficient
EMS	Energy Management Systems
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
NMEE	National Mission for Enhanced Energy Efficiency
NTPC	National Thermal Power Corporation
OEM	Original equipment manufacturer
PWS/MPWS	Piped Water Supply/Miscellaneous Public Water System
RE	Renewable Energy
SDA	State Designated Agency
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 Andaman & Nicobar Islands, 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. Electricity Department, NRSE Division, with inputs & suggestions from various government departments and sector experts. The primary objective of the State Energy Efficiency Action Plan for Andaman & Nicobar Islands is to formulate sector-specific strategies for enhancing energy efficiency in the union territory.

Energy Landscape and Projections:

Andaman & Nicobar Islands consumed 0.22 Mtoe of energy in FY 2020, primarily through electricity (30%), and oil (70%). With projected economic growth and considering energy intensity, total energy consumption is estimated to reach nearly 0.4 Mtoe by FY 2030.

Strategic Focus:

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

Actionable Strategies:

1) **Transport:**
   - Accelerate the electrification of road transport to reduce dependence on fossil fuels.
   - Invest in and improve public transportation to encourage energy-efficient commuting.
   - Greening vessels and ports
   - Energy efficiency measures for cargo handling equipment
2) **Buildings:**
   - Implement ENS for residential buildings and acceleration of ECBC.
   - 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.
3) **Water Supply:**
   - Mandatory energy audits for water supply
4) **Industry:**
   - Energy audits for MSMEs.
   - Clean transition in MSMEs.
5) **Fisheries:**
   - Energy efficiency across all value chains in fisheries

Expected Outcomes:

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

Energy Savings: Reduction of 0.016 Mtoe (moderate) and 0.025 Mtoe (ambitious) by FY 2030.

Market Potential: Creation of a ₹ 46 crore market for energy-efficient solutions and technologies.

Emission Reduction: Decrease in CO_2 emissions by 0.05 $MtCO_2$ (moderate) and 0.079 $MtCO_2$ (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 Andaman and Nicobar Islands.

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

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

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

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

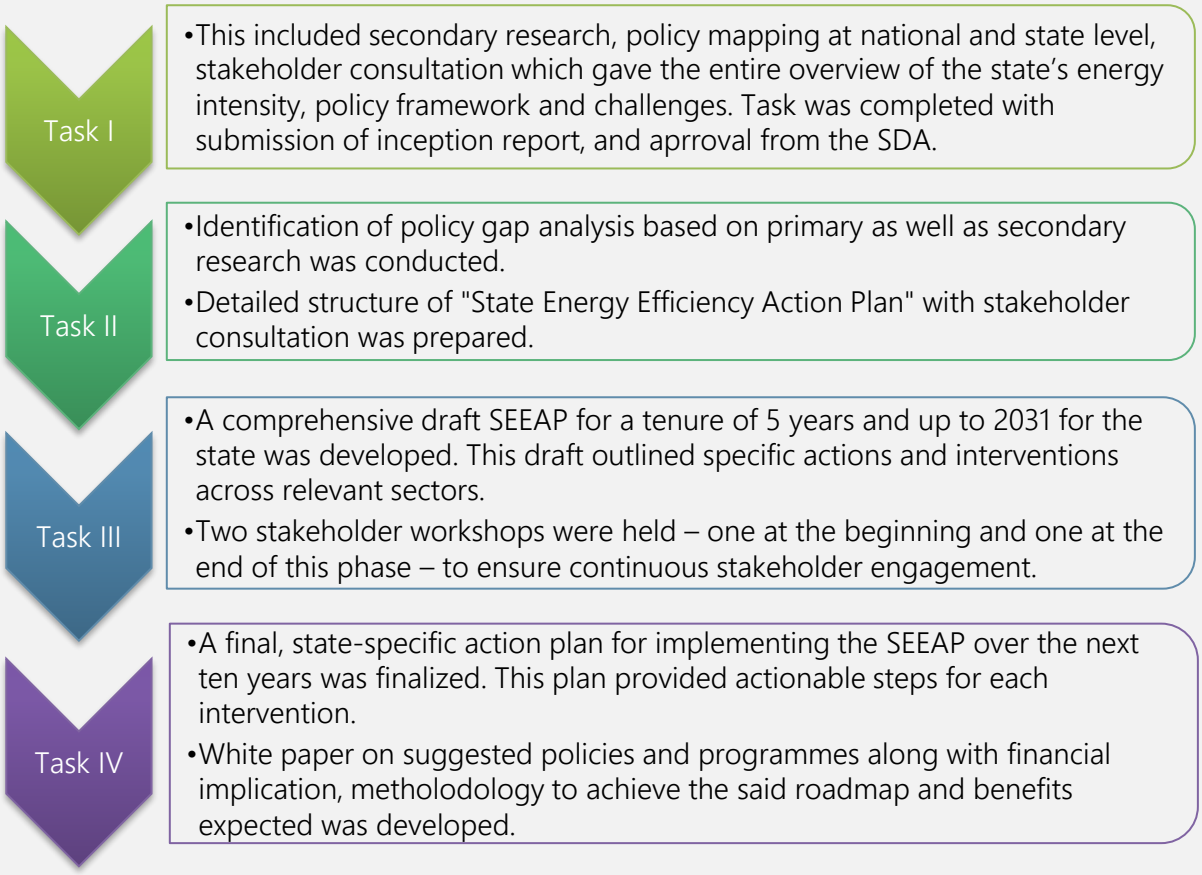
1.2 About State Energy Efficiency Action Plan

This assignment aimed to provide technical assistance for the identification of focus sectors for the Andaman & Nicobar Islands 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.

1.3 Andaman & Nicobar Islands- State Profile

Capital City	Popoulation (2011 Census)	Total Power plant installed capacity
Port Blair	**0.04 crores**	(2022-23) **128 WM**

Major Sectors	GSDP 2021-22
Tourism, Fisheries, Shipping & Logistics, Handicrafts	**₹71,7,247 lakh** (at Constant Prices with Base 2011-12)

The Andaman & Nicobar Islands is a union territory of India. This territory is known as A & N Islands, or ANI. It is located in the Indian Ocean, in the southern reaches of the Bay of Bengal, nearer to Indonesia and Thailand. This comprises of two island groups - the Andaman Islands and the Nicobar Islands - which separates the Andaman Sea to the east from the Indian Ocean. These two groups are separated by the 10° N parallel, the Andamans lying to the north of this latitude, and the Nicobars to the south. The capital of this territory is the Andamanese town of Port Blair. There are 836 Islands/Islets/Rocky Outcrops in the territory, of which only some 31 are permanently inhabited. The smaller Nicobars comprise some 22 main islands (10 inhabited). The Andamans and Nicobars are separated by a channel (the Ten Degree Channel) some 150 km wide. The territory's population as per the most recent (2011) Census of India was 3,79,944 and the literacy rate is 86.27%. Added together, the total land area of the territory is approximately 8,249 km^2.The total area of the Andaman Islands is 6,408 km^2 and that of the Nicobar Islands is 1,841 km^2 approximately.[2]

A&N Island's Gross State Domestic Product (GSDP) at current price stood at ₹10,371 Crores in 2021-22, which is less than 1% of the country's GDP. When compared to 2014-15 levels, the GSDP of the UT is increased at a CAGR of nearly 14%. In A&N Islands, the most contributing sector towards the states GDP is the Tertiary sector and contributes for 67.27% of the GSDP.

[2] https://www.andaman.gov.in/about

The Secondary and Primary sectors of the state contribute for 17.17% and 15.56% of GSDP respectively for 2021-22.[3]

The table below shows the top 5 sectors of the UT in terms of the contribution towards GSDP[4].

Table 1 GSDP by Major Sectors in A&N Islands in 2021-22[5]

Sr. No.	Sub Sector	Sector	GVA (Rs. in crores)	% Share
1	Public administration & defence	Tertiary	1,861	18%
2	Agriculture, forestry & fishing	Primary	1,439	14%
3	Construction	Secondary	1,242	12%
4	Transport, storage, communication & services related to broadcasting	Tertiary	1,082	10%
5	Trade, repair, hotels and restaurants	Tertiary	908	9%

In the SEEI 2020, A&N Islands is in the Aspirant Category by scoring 11.5 points. SEEI 2020 assess the states' performance in energy efficiency through 68 indicators across six sectors: Buildings, Industry, Municipalities, Transport, Agriculture & distribution companies (DISCOMs), and Cross Sector initiatives. The indicators assess states' performance in Policy and Regulation, Financing Mechanisms, Institutional Capacity, Adoption of Energy Efficiency Measures, and Energy Savings. When compared with SEEI 2019, Andaman has improved by 2.5 points[6].

1.4 Overview of Institutional framework - Energy

In exercise of the powers conferred by the Electricity Act 2003 the Central Government constituted a Joint Electricity Regulatory Commission for all Union Territories except Delhi & known as "Joint Electricity Regulatory Commission for the state of Goa and Union Territories". The Commission is a two-member body designated to function as an autonomous authority responsible for regulation of the power sector in the state of Goa and Union Territories of Andaman & Nicobar, Lakshadweep, Chandigarh, Daman & Diu, Dadra & Nagar Haveli, and Puducherry. The Head Office of the Commission is located presently in the district town of Gurgaon, Haryana and falls in the National Capital Region.

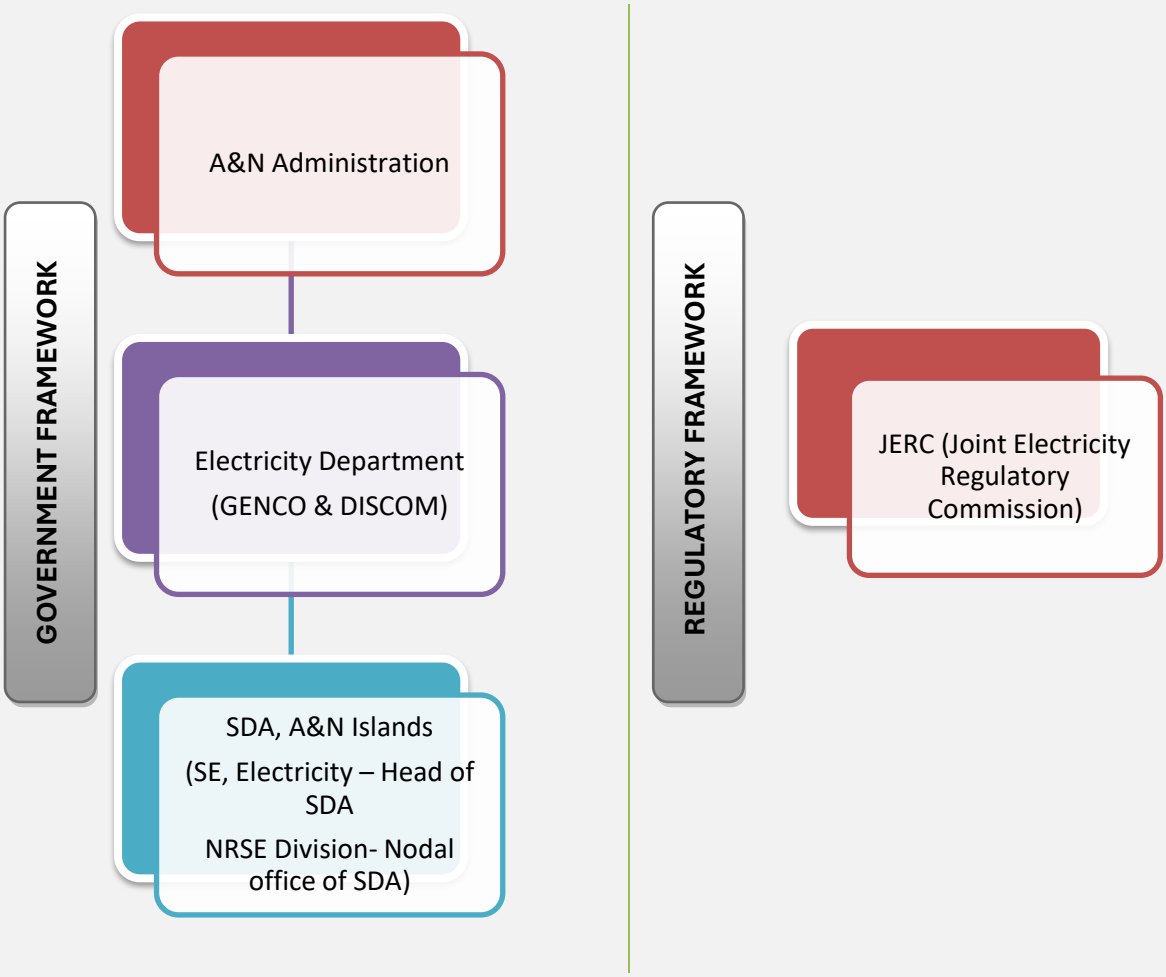
Electricity Department of Andaman & Nicobar Islands (EDA&N) under the JERC is responsible for the generation of power in the UT. As the islands are scattered, the generation & distribution of electricity is done by standalone powerhouses (mainly DGs).

The Superintending Engineer, Electricity Department, A&N Administration is the State Designated Agency and New & Renewable Sources of Energy (NRSE) Division under Electricity Department has been assigned for promoting energy conservation and energy efficiency through enforcing Energy Conservation Act, 2001 in the UT.

[3] http://andssw1.and.nic.in/ecostat/basicstatPDF2022_23/25.StateDomesticProduct.pdf
[4] http://andssw1.and.nic.in/ecostat/basic_statistics2021.php
[5] http://andssw1.and.nic.in/ecostat/basicstatPDF2022_23/25.StateDomesticProduct.pdf
[6] State Energy Efficiency Index 2020

The institutional framework for energy efficiency in A&N Islands is shown below.

Figure 1 Institutional framework of Andaman and Nicobar Islands – Energy



1.5 Current Energy Scenario

The present installed capacity in the islands is 127.80 MW (as of 31.03.21). Diesel generation remains the primary source of power, accounting for roughly 99.2 MW out of a total installed capacity of around 93.32 MW. This dependence on fossil fuels makes the islands vulnerable to price fluctuations and environmental concerns. Solar power has a small footprint of around 29.23 MW Hydropower contributes a mere 5.25 MW.[7] Despite the current scenario, A&NI boasts promising potential for renewable energy sources like solar, wind, hydro, biomass, and even ocean power.

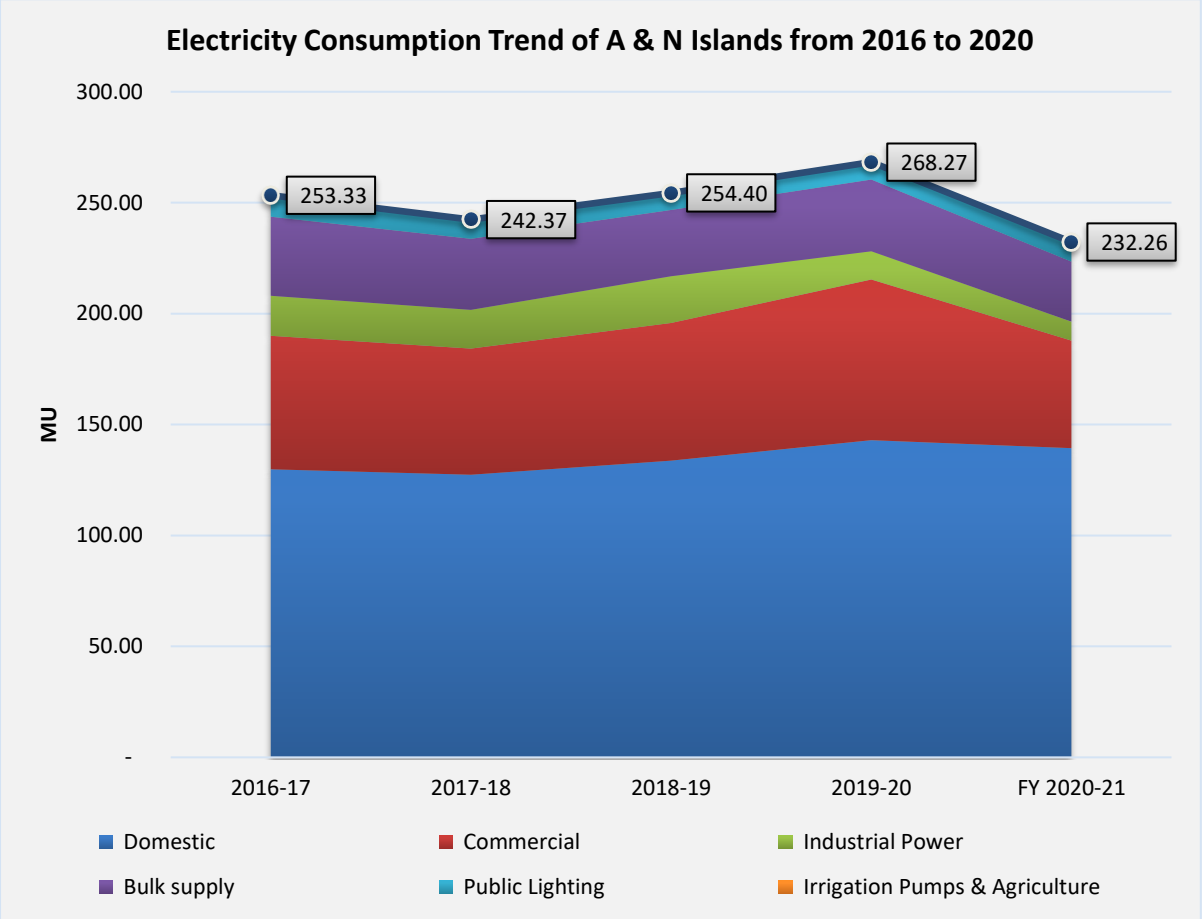
1.6 Electricity Demand

The Electricity Department of Andaman & Nicobar Administration (ED A&N) is solely responsible for power supply in the Union Territory (UT). Power requirements of ED, A&N are met by own generating stations as well as power purchase. Due to the geographical and topographical peculiarities of the islands including separation by sea over great distances, there is no single power grid for the entire electrified islands, instead, DG based powerhouse at various islands caters independently to the power requirements of area/islands. Apart from DGs, a minor portion of power is also generated from Hydel & Solar power plants.

[7] https://vidyut.andaman.gov.in/doc/24-01-2024_43A&N(E)_BP_Sub_JERC_compressed.pdf

In A&N Islands, the total power inflow is 232.26 for FY 2020-21, out of which 91% is from DG based powerplants. The T&D losses in the system are to the tune of 23%, which is on higher side. The electricity consumption[8] in MU by the major sectors of A&N Islands for FY 2020 is displayed below.

Figure 2 Electricity Consumption Trend of A & N Islands from 2016 to 2022



For FY 2020-21, The domestic building sector is the most significant consumer of electricity and consumes about 60% of total electricity, followed by commercial sector at 27%. Bulk supply category contributes to 12% of the total electricity consumption. Industry accounts for nearly 5% of total electricity consumption. In Industries, there are no HT consumers in A & N Islands. The YoY growth rate has been erratic with escalating CAGR for the recent years. It may be attributed to shifting of hotel industry consumers between commercial and industrial categories.

The electricity consumption of A & N Islands increased at a CAGR of 4.1% between FY 2016 and 2020. The largest contributor to electricity consumption, the building sector has the highest CAGR of 3.59%. All other sectors have a negative CAGR. The industrial sector has the lowest CAGR of -4.51%, followed by Agriculture (-1.28%) and Municipalities (-0.44%). The DISCOMs are included in Others as the bifurcation not available for some of the financial years considered.

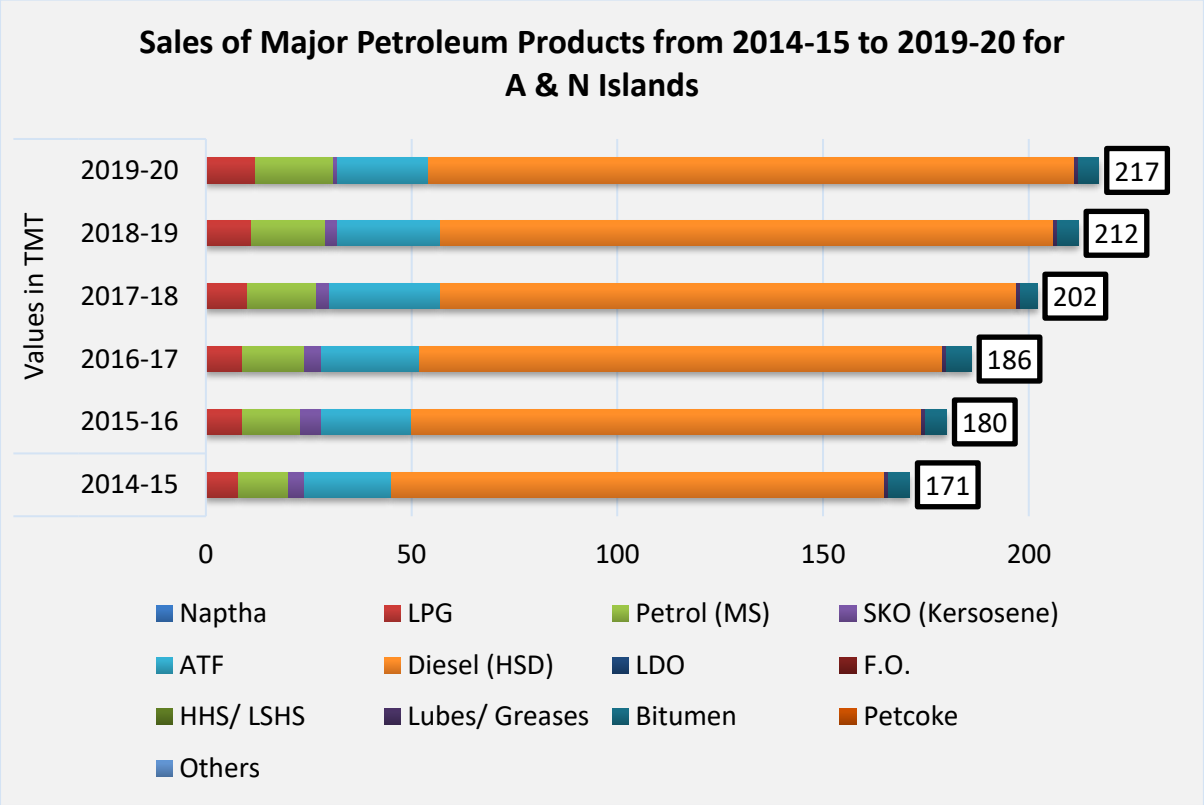
The present Installed Capacity of EDA&N is approximately 113.86 MW from various generating stations. The current demand mainly comprises of the domestic and commercial categories, which contributed more than 75% to the total sales of the ED A&N.

[8] ARR – ERC Petition of A&N Islands 2022-27

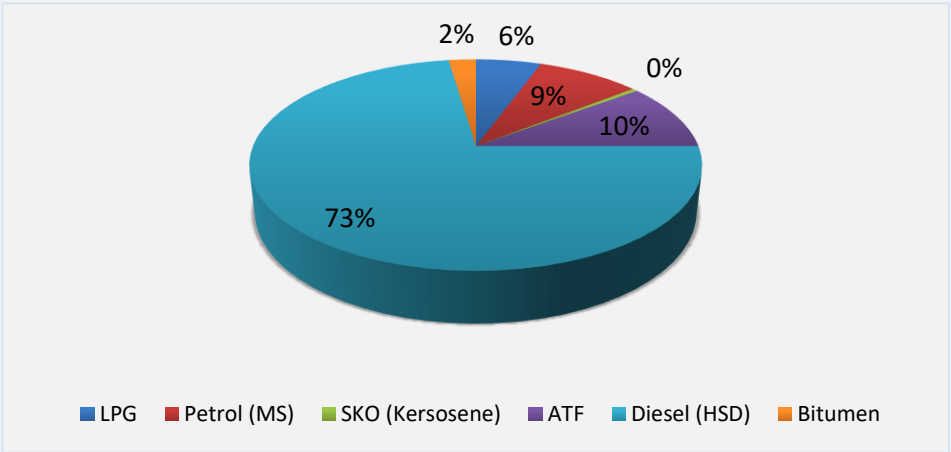
1.7 Fuel Demand

Over the past few years, the total consumption of petroleum products in the Andaman & Nicobar Islands has exhibited a notable upward trend. From 171 TMT (Thousand Metric Tonnes) in 2014-15, it escalated to 217 TMT by 2019-20, reflecting a CAGR of 4.9%. This rise underscores the growing energy needs of the islands, driven by factors such as urbanization, economic development, and increasing population.

Figure 3 Sales of Major Petroleum Products from 2014-15 to 2019-20 for A & N Islands[9]



Composition of Fuel Consumption



[9] https://mopng.gov.in/en/petroleum-statistics/indian-png-statistics

Trends in Fuel

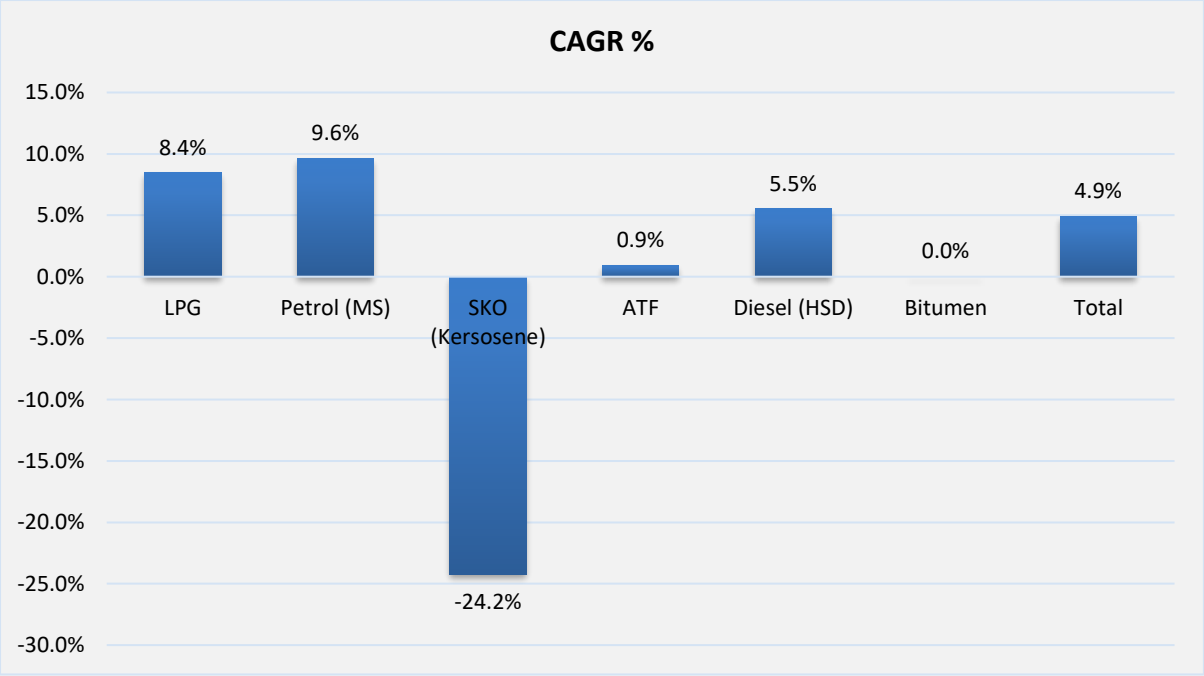
In 2019-20, the fuel mix of the Andaman and Nicobar Islands was predominantly comprised of High-Speed Diesel (HSD), accounting for a staggering 73% of total fuel consumption. This dominance can be attributed to the reliance on diesel generators for electricity generation, a necessity dictated by the geographical constraints of the islands. Aviation Turbine Fuel (ATF) and Petrol followed at 10% and 9%, respectively, reflecting the demand from transportation sectors and private vehicles. Liquefied Petroleum Gas (LPG), with a share of 6%, serves as a vital energy source for cooking and household needs.

Consumption

The graph below displays fuel-specific consumption trends in the Andaman and Nicobar Islands.

- Diesel consumption witnessed a steady growth, with a notable CAGR of 5.5%. This growth is primarily driven by urbanization, particularly in the capital city of Port Blair, where diesel-powered generators cater to the rising demand for electricity.
- LPG consumption has maintained a robust growth trajectory, with a CAGR of 8.4%. The steady rise in LPG usage can be attributed to the government's Ujjwala Yojana, which aims to provide clean cooking fuel to Below Poverty Line (BPL) households, thereby reducing reliance on traditional fuels like kerosene.
- Petrol consumption witnessed a significant surge, reflecting a CAGR of 9.6%. This spike is indicative of increased urbanization and the proliferation of private vehicles in the union territory, highlighting the need for sustainable transportation solutions.
- Contrastingly, Kerosene consumption displayed a negative CAGR of -24%, primarily attributable to the implementation of initiatives like the Ujjwala Yojana has accelerated the reduction in kerosene usage, incentivizing households to switch to cleaner and more efficient LPG alternatives.
- ATF: Aviation Turbine Fuel consumption has remained relatively stable, with a modest CAGR of 0.9%.

Figure 4 CAGR trend of major fuels consumed in the A & N Islands



As the union territory navigates towards a sustainable energy future, it is imperative to address the evolving energy needs while embracing cleaner and more efficient alternatives. By leveraging insights from fuel consumption trends, the union territory can devise targeted strategies to optimize energy usage, promote renewable energy adoption, and enhance energy efficiency across sectors, thereby ensuring a resilient and environmentally conscious energy ecosystem.

1.8 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.

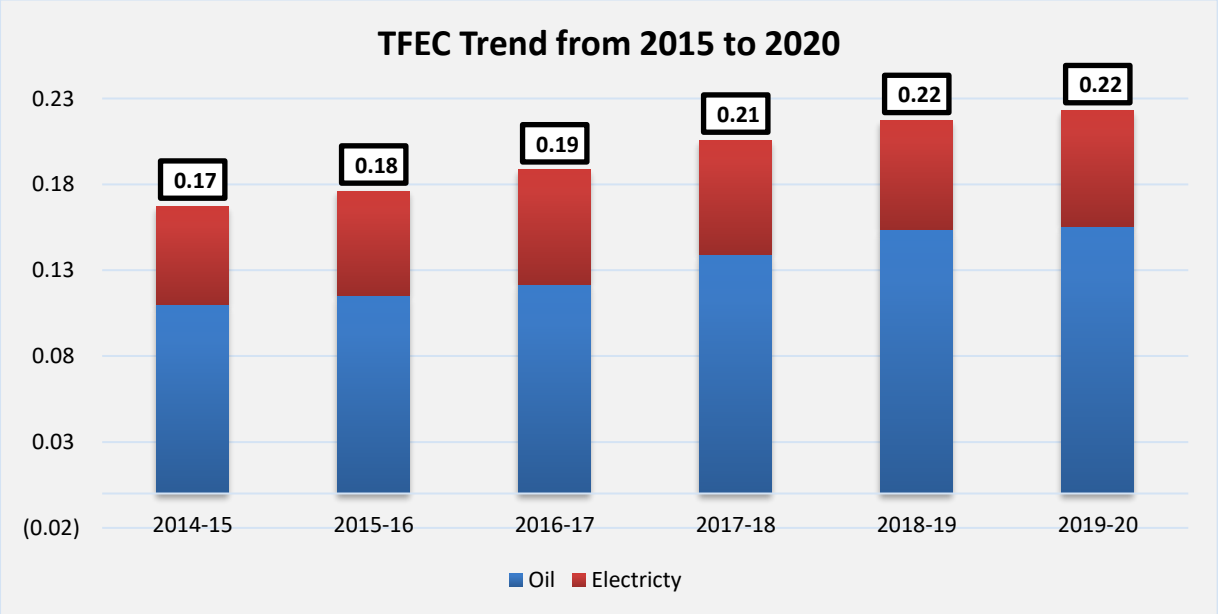
TFEC is a variable that was developed particularly to measure the progress of the Sustainable Development Goals. It aids in the analysis of the energy-saving target, which will lower the intensity of GHG emissions, and it can be reached by improving energy efficiency and reducing the usage of fossil fuels.

The TFEC in the Andaman and Nicobar Islands witnessed a notable increase over the past few years, reflecting the region's evolving energy dynamics. From 0.17 Mtoe in 2014-15, it escalated to 0.22 Mtoe by 2019-20, marking a CAGR of 6%. This rise underscores the growing energy needs of the islands, driven by factors such as population growth, urbanization, and economic development.

Electricity emerged as a significant contributor, accounting for 30% of the TFEC. The remaining 70% was predominantly contributed by various petroleum products utilized across sectors such as transportation, households, industries, and commercial establishments. Private generators, both in commercial and residential settings, also contributed to the TFEC, highlighting the reliance on decentralized energy sources for meeting power needs.

The graph below displays the TFEC Trend over the years in A & N Islands.

Figure 5 TFEC Trend from 2014-15 to 2019-20 in A & N Islands



2 ENERGY DEMAND PROJECTIONS

2.1 Overview

This phase involves demand forecasting for the union territory's energy consumption till FY 2031. This established baseline will facilitate the evaluation of proposed action plans regarding their impact on Total Final Energy Consumption (TFEC) reduction and overall energy efficiency improvement. Both short-term plans with a five-year horizon and long-term strategies targeting high-impact energy efficiency by 2031 will be formulated. This will enable the estimation of potential TFEC savings and the assessment of the feasibility of achieving a reduced TFEC by the end of FY 2031.z

2.2 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 Andaman & Nicobar Islands involved analysing historical trends in final energy consumption and Gross State Domestic Product (GSDP) and growth of GSDP as per the state's vision.

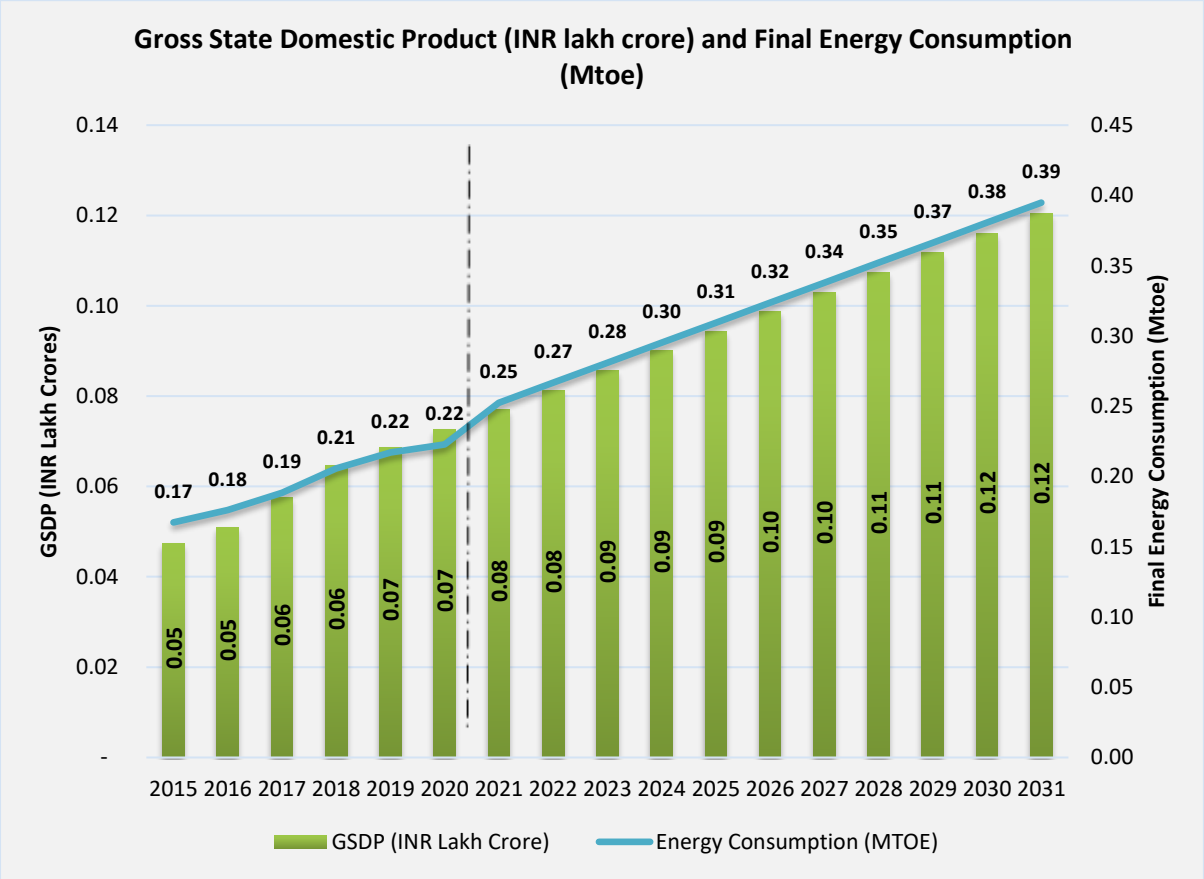
The union territory's GSDP at constant price was ₹72,6574 lakh in 2019-20[10]. Based on this, the GSDP is expected to reach ₹ 12,04,249 lakh by FY 2031. The available historical energy data, when correlated with the GSDP of the corresponding year the energy intensity of the state can be evaluated.

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 2.9 Mtoe/₹ lakh crore in FY 2031 as compared to 3.3 Mtoe/₹ lakh crore in FY 2021.

Using the calculated GSDP and energy intensity, the TFEC for FY 2031 is calculated to be 0.39 Mtoe. The graph below depicts the trends of GSDP, energy intensity and TFEC between FY 2016 to FY 2031 for Andaman & Nicobar Islands.

[10] RBI- Handbook of Statistics on Indian States- Gross State Domestic Product (Constant Prices) https://www.rbi.org.in/scripts/PublicationsView.aspx?id=22092

Figure 6 Gross State Domestic Product (INR lakh crore) and Final Energy Consumption (Mtoe)[11]



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

2.3 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, water supply, and fisheries.

Business as Usual (BAU) Scenario	•The BAU scenario represents a baseline projection of energy consumption for the state, assuming no specific interventions or changes in the existing trends. •It serves as a reference point against which the impact of energy-saving strategies can be measured.
Moderate (MOD) Scenario	•The Moderate scenario takes into account moderate levels of technological interventions and policy and program initiatives. •It reflects a realistic but not overly aggressive approach to energy efficiency measures, considering advancements in technology and moderate policy changes.
Ambitious (AMB) Scenario	•The Ambitious scenario considers high levels of technological advancements and ambitious policy and program interventions. •It represents an optimistic outlook, showcasing the potential energy savings if the state adopts cutting-edge technologies and implements ambitious policies to enhance energy efficiency.

Figure 7 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 8 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.
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.

3 IDENTIFICATION OF FOCUS SECTORS

3.1 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 A & N Islands, 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 the economy of A & N Islands. 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 union territory's overall economic growth.

- **Policy Gap Analysis:**

A gap analysis of the union territory's schemes and policies was performed for sectors like transport, industry, buildings, and agriculture 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 government of Andaman & Nicobar Islands were given preference. This ensured that the selected sectors were in line with the overall strategic direction of the U.T.

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 Andaman & Nicobar Islands.

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

TRANSPORT SECTOR

4 FOCUS SECTOR 1: TRANSPORT

4.1 Overview

A) Road Transport

The Andaman & Nicobar Islands, an archipelago in the Bay of Bengal, present a unique transportation challenge. Isolated from mainland India's national highway and railway networks, they rely on a multifaceted system of roadways, waterways, and airways for economic activity and resident needs. The following table displays number of vehicles categorized based on various type of vehicles in the union territory.

Table 2 Number of vehicles in A & N Islands[12]

Type of Vehicle	2018-19	2019-20	2020-21	2021-22	2022-23
Motorcycle/Scooter/ Moped	99,494	1,06,133	1,09,457	1,13,369	1,18,127
Lorry / Truck	3,048	3,138	3,263	3,507	3,959
Bus	1,119	1,135	1,177	1,179	1,198
Car, Taxi, Omni & Jeep (LMV)	31,766	33,916	35,309	36,596	38,424
Auto	4,738	4,835	4,982	5,135	5,565
Others	886	903	915	955	971
Total	**1,41,051**	**1,50,060**	**1,55,103**	**1,60,741**	**1,68,244**

As of FY 2022-23, nearly 1,68,244 vehicles navigate the islands, with significant annual growth. Two-wheelers dominate, constituting 70% of the fleet, followed by four wheelers, as displayed in the graph below.

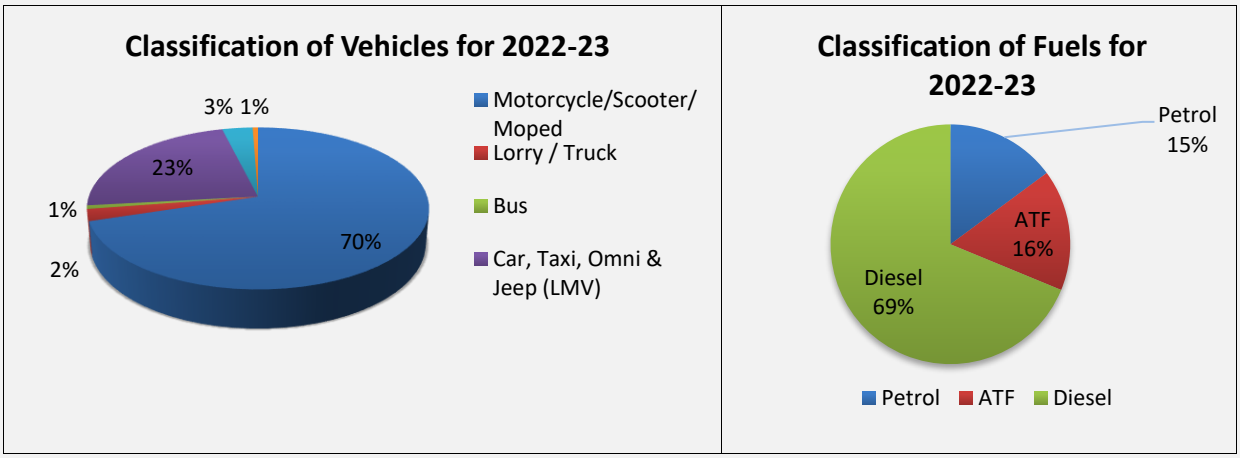


Figure 9 Classification of Vehicles and fuels for 2022-23[13]

[12] http://andssw1.and.nic.in/ecostat/basicstatPDF2022_23/18.Transport.pdf

However, this growth strains the existing road network, limited by hilly terrain and constrained landmass. Traffic congestion and its associated environmental concerns threaten the pristine beauty of the islands. Recognizing these issues, the government prioritizes the development of a robust public transport infrastructure as a long-term solution. Meanwhile, initiatives to transition towards cleaner fuels like CNG and LPG aim to mitigate the environmental impact of transportation.

A) Maritime Transport

The maritime sector plays a crucial role in the economy and development of Andaman & Nicobar Islands (A&NI), serving as a vital link to mainland India and supporting various industries like tourism, fishing, and international trade. With one major port and eight wharfage ports handling over 4 lakh tonnes of cargo annually and 4.15 lakh passengers, the sector plays a vital role. Tourism, attracting over 2-3 lakh visitors every year, fuels the economy. Cruise tourism emerges as a promising sector, with Port Blair becoming a key Indian destination.

The Directorate of Shipping Services (DSS) is responsible for manning, maintaining and operation of the vessels owned by the Administration. The Department is presently providing Shipping services to 29 of the 36 inhabited Island. The Shipping is the main mode of transportation for passenger and cargo between Mainland-Island and the only mode between the Islands. The department has been able to achieve regular service in almost all the sectors. The DSS presently operates 66 vessels in four sectors as of FY 2022-23. These are:

Table 3 Types of vessels

Type of Vessel	Function
Mainland -Island Sector	To provide service between Port Blair and Kolkata/Chennai/Vizag
Inter-Island Sector	To provide services between Port Blair and the distant group of Islands.
Fore Shore Sector	To provide services between Port Blair and nearby Islands.
Harbour Ferry Sector	To provide services within the sheltered water and narrow creeks by ferry vessels.

The types of vessels in the islands are displayed below.

Table 4 Types of Vessels in A & N Islands[13]

Name of Ship	2018-19	2019-20	2020-21	2021-22	2022-23
A) Passenger Vessel					
i) Mainland	03	03	03	01	01
ii) Inter-Island	06	06	06	07	08
B) Foreshore- Pax-Cum-Cargo Vessels	16	17	17	17	17
C) Cargo Vessel	2	03	02	02	02

[13] http://andssw1.and.nic.in/ecostat/basicstatPDF2022_23/19.Shipping.pdf

D)	**Landing Ferry**	-	00	02	00	00
E)	**Harbour Ferry Services**					
i)	Pax-Cum-Vehicle Ferry	14	14	14	14	11
ii)	Ferry Vessel	12	15	13	12	11
iii)	Motor Launch	5	06	05	05	05
F)	**Other Type Of Vessel/Charter Vessel For Inter Island**	13	17	13	12	11
Total		**71**	**81**	**75**	**70**	**66**

The table below displays the details of passengers embarked and disembarked for Port Blair & Mainland voyages.

Table 5 Passenger Traffic (Port Blair & Mainland) [14]

Passenger (Port Blair & Mainland)					
Name of Ship	2018-19	2019-20	2020-21	2021-22	2022-23
Embarked					
Chennai - P/Blair		5,132	222	-	4,542
Kolkata - P/Blair		1,941	196	-	648
Vizag - P/Blair		4,459	581	201	4,420
Disembarked					
Chennai - P/Blair		5,038	367	67	3,770
Kolkata - P/Blair		2,032	555	-	365
Vizag - P/Blair		6,068	80	253	5,190
Total		**24,670**	**2,001**	**521**	**18,935**

The table below displays the details of cargo embarked and disembarked for Port Blair & Mainland voyages.

Table 6 Cargo (Port Blair & Mainland) [15]

Cargo (Port Blair & Mainland) in MT					
Name of Ship	2018-19	2019-20	2020-21	2021-22	2022-23
Embarked					
Chennai - P/Blair		1,875.65	1,017.20	-	434.27
Kolkata - P/Blair		321.17	315.00	-	-
Vizag - P/Blair		-	3.30	-	-
Disembarked					

[14] http://andssw1.and.nic.in/ecostat/basicstatPDF2022_23/18.Transport.pdf
[15] http://andssw1.and.nic.in/ecostat/basicstatPDF2022_23/18.Transport.pdf

Chennai - P/Blair					
Kolkata - P/Blair		6,589.53	307.50	-	1,982.26
Vizag - P/Blair		870.63	-	-	8
Total		**9,656.98**	**1,647.00**	**2.00**	**2,427.09**

The table below displays the details of passengers travelled in Foreshore, Inter-Island and Harbour Ferry Services.

Table 7 Passenger in Foreshore, Inter-Island and Harbour Ferry Services[16]

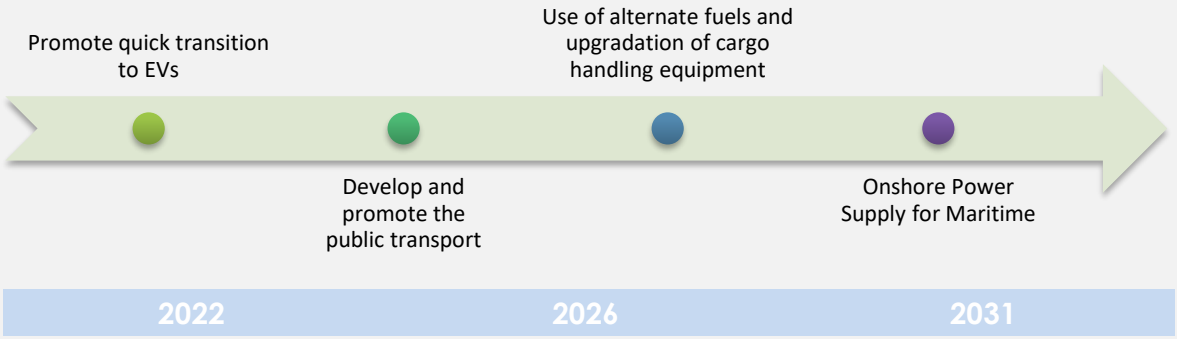
Passenger in Foreshore, Inter-Island and Harbour Ferry Services					
Name of Ship	2018-19	2019-20	2020-21	2021-22	2022-23
Foreshore Services	4,33,900	4,68,425	1,33,256	1,86,432	3,07,343
Inter-Island Services	2,00,536	1,95,282	54,392	58,542	1,46,478
Harbour Ferry Sector	71,12,697	88,79,961	4,44,664	16,40,890	58,37,875
Total	**77,47,133**	**95,43,668**	**6,32,312**	**18,85,864**	**62,91,696**

Plans are underway to expand port capacity, upgrade navigation systems, and improve inter-island connectivity. Sustainable fishing practices, deep-sea exploration, and value-added processing are being promoted. Tourism diversification, infrastructure improvements, and responsible practices aim to enhance the sector's potential.

Currently, aging infrastructure and reliance on traditional fuels like diesel contribute to significant energy consumption and emissions within the sector. This not only impacts operational costs but also raises environmental concerns in this ecologically sensitive region.

4.2 Energy efficiency strategies for 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.

[16] http://andssw1.and.nic.in/ecostat/basicstatPDF2022_23/18.Transport.pdf

4.2.1 Strategy #1: Facilitating Electrification of Road Transport

Electric vehicles (EVs) offer a potentially transformative solution, promising cleaner air, reduced noise pollution, and enhanced energy security. The A&N Islands EV Policy 2022 offers incentives and has an ambitious aim for 30% of new registrations to be EVs by 2026, it seeks to accelerate EV adoption and improve air quality. This policy, combined with continued infrastructure development and public awareness campaigns, holds the key to unlocking the potential of EVs for a sustainable future. However, widespread adoption faces hurdles. High upfront costs, lack of public charging infrastructure, limited EV models suitable for the terrain, and inadequate after-sales support deter potential buyers. As shown in the figure below, the union territory has 215 electric vehicles as on 31.03.2023, which makes its share less than 0.5% of the total number of vehicles.

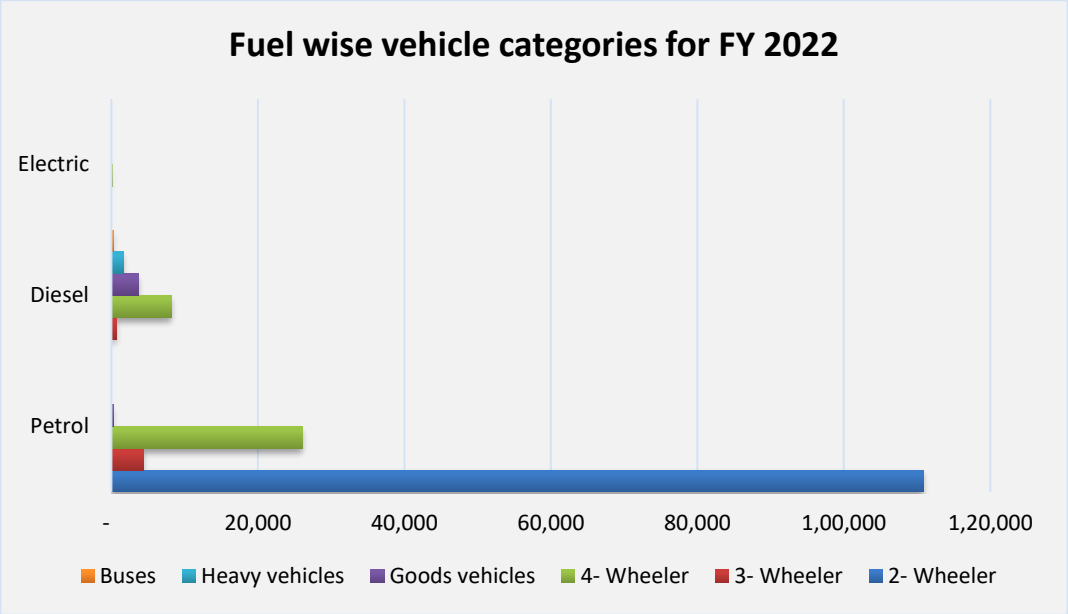
Table 8 Number of electric vehicles[17]

Type of Electric Vehicle	2021-22	Total as on 31.03.2022	2022-23	Total as on 31.03.2023
Motorcycle/Scooter/ Moped	-	1	17	18
Lorry / Truck	-	-	-	-
Bus	-	40	-	40
Car, Taxi, Omni & Jeep (LMV)	22	119	8	127
Auto	-	30	-	30
Others	-	-	-	-
Total	**22**	**190**	**25**	**215**

Additionally, compared to their internal combustion engine (ICE) counterparts, EVs achieve demonstrably higher energy efficiency. While ICE vehicles typically convert only 17-21% of fuel energy into wheel power, EVs excel with a rate of up to 60%. This translates to a remarkable 80% reduction in energy waste, directly impacting fuel consumption and associated emissions. As renewable energy sources like solar and wind gain traction, the environmental benefits of EVs further magnify. By leveraging a cleaner grid, EVs offer a sustainable transportation solution, aligning with the archipelago's ecological imperatives.

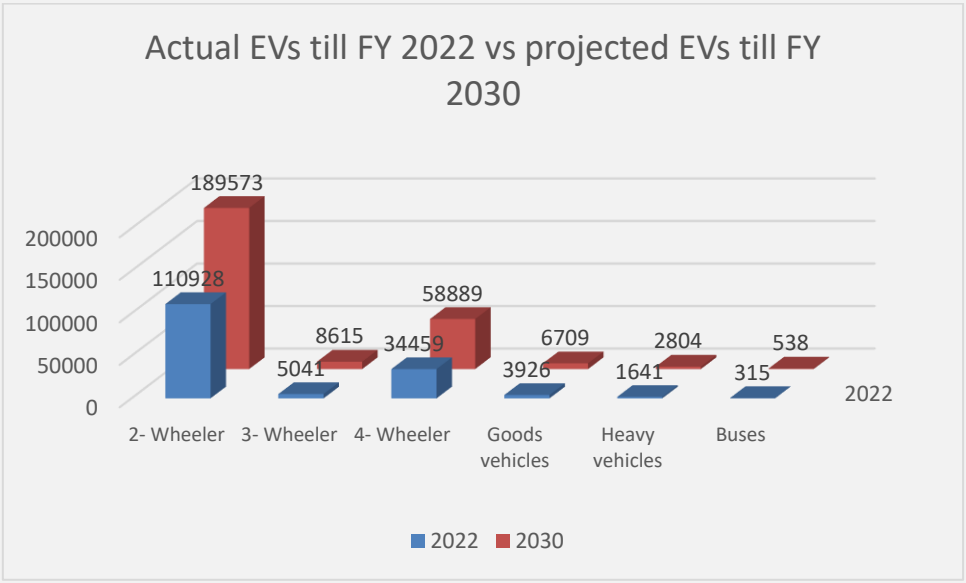
[17] http://andssw1.and.nic.in/ecostat/basicstatPDF2022_23/18.Transport.pdf

Figure 10 Fuel Wise Vehicle Categories as on FY2022



Projected number of vehicles for FY2030 is estimated by projecting electric vehicles currently.

Figure 11 Actual EVs till FY 2022 vs projected EVs till FY 2030



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
• Directorate of Transport, A&N Admn • Andaman Nicobar State Transport Services • Electricity Department, New & Renewable Source of Energy (NRSE) Division • Municipal Corporations and Urban Development Authorities • Andaman and Nicobar Islands Integrated Development Corporation Ltd (ANIIDCO) for charging infrastructure
Current Policy/Policies in Place
The state government has released the draft of "A&N Islands Electric Vehicle Policy, 2022" *Key Objectives:* • The primary objective of the A&N Islands EV Policy 2022 is to accelerate adoption of EVs for improvement in the air quality such that they contribute to 30% of the new registrations by 31st December 2026.
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 Andaman and Nicobar Islands with 19,099 EVs in moderate scenario and 30,513 EVs in ambitious scenario by 2030, additionally 565 charging stations and battery swapping infrastructure by 2031 in moderate scenario and 895 charging stations and battery swapping infrastructure by 2031 in ambitious scenario, with Level-1, Level-2 and Level-3 (DC) chargers across all cities will result into energy saving of 0.025 MTOE by FY 2030.

Table 9: Energy Saving Potential

Particulars	*2026*		*2031*	
	Moderate	Ambitious	Moderate	Ambitious
Energy Saving Potential (toe)	2,155	3,852	7,583	11,458
GHG Emission Reduction Potential (tCO_2)	6,745	12,057	23,735	35,864

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.

2. **Setting target thresholds for ICE vehicles**
   a) Setting target thresholds for ICE vehicles: The government 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 A & N Islands. This approach will create a clear market signal for manufacturers to prioritize the production and sale of zero-emission vehicles.

4. **Adoption of Battery Swapping for 2 & 3 Wheelers**
   a) Pilot Projects: Identify 2-3 model cities such as Port Blair, Havelock Island, 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.

5. 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.

6. 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.

7. 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.

4.2.2 Strategy #2: Adequate Public Transport

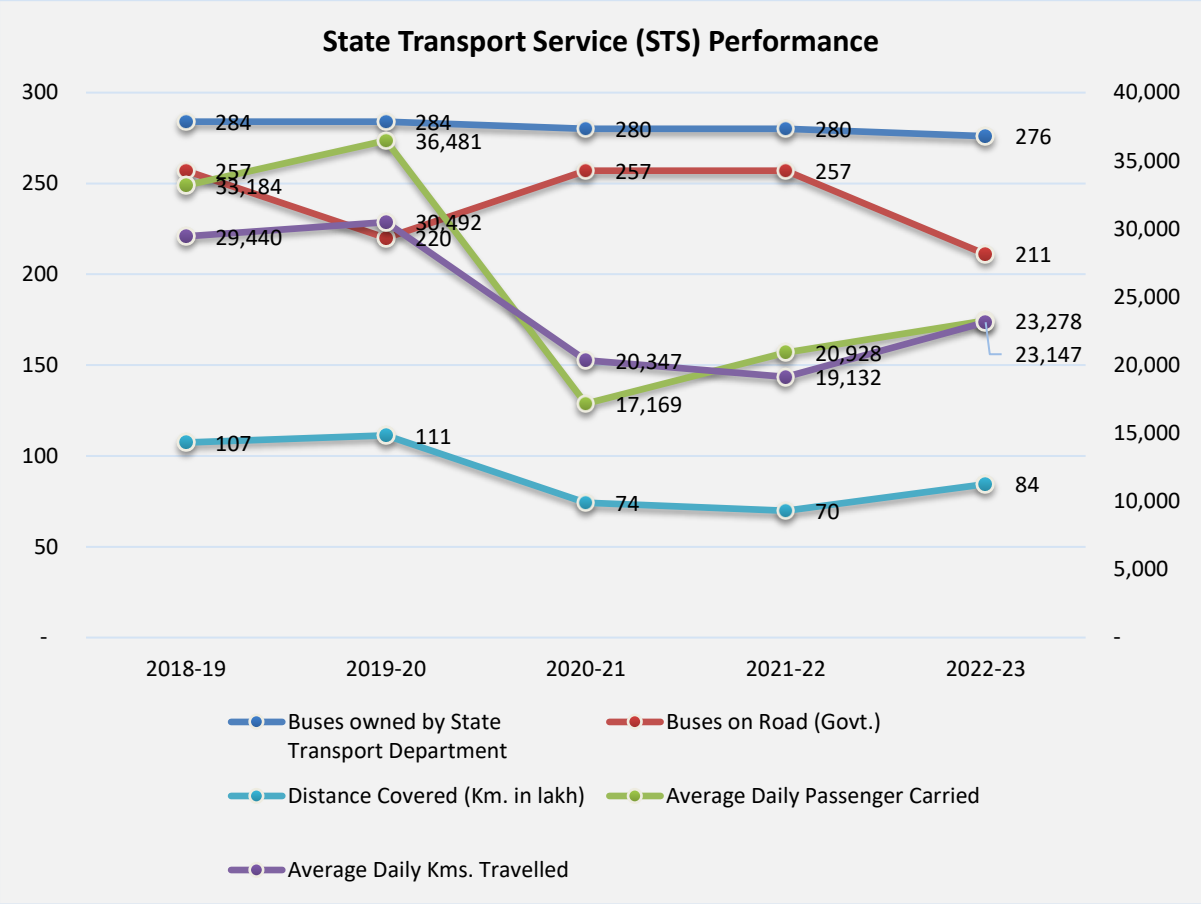
The current state of the electricity grid dominated by diesel generator in the islands limits the immediate environmental benefits of widespread electric vehicle (EV) adoption. Therefore, in the short term, prioritizing improvement and expansion of public transport emerges as a more effective strategy for rapid emissions reduction. Enhancing the accessibility, efficiency, and reliability of public buses 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 the union territory. 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.

The State Transport Service (STS) offers efficient and cost-effective public transportation to the residents of the union territory. As of FY 2022-23, the STS operates a fleet of 276 buses, with ages ranging around 10 years, inclusive of some buses undergoing condemnation. The union territory comprises 572 islands across three districts, with STS providing services to 12 islands from 14 dispersed STS units spanning from Diglipur in the north to Campbell Bay in the south, covering a distance of approximately 750 kilometres.

Given the dispersed nature of the islands and the logistical complexities involved in reaching all areas, ensuring a robust public transport system becomes essential. By facilitating accessible and reliable public transportation services through the State Transport Service (STS), the union territory can effectively reduce reliance on individual vehicles, consequently lowering fuel consumption and emissions.

Figure 12 State Transport Service (STS) Performance[18]



The number of buses owned by the STS has remained relatively stable. However, the number of buses on the road has fluctuated more significantly, dropping from 257 in 2018-19 to 211 in 2022-23, suggesting potential maintenance issues or underutilization. Passenger ridership has also decreased (33,184 in 2018-19 vs. 23,278 in 2022-23), which might be linked to public transport unreliability. Additionally, average daily travel distances have decreased (29,440 km in 2018-19 vs. 23,147 km in 2022-23), potentially due to fewer operational buses, shorter routes, or traffic congestion. These trends indicate challenges in fleet utilization, operational efficiency, and creating demand for public transportation. This highlights the need to facilitate adequate public transport in Andaman and Nicobar Islands.

The strategy and its implementation are explained below.

Scope Boundary
The strategy 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
• Directorate of Transport, A&N Admn. • State Pollution Control Board

[18] http://andssw1.and.nic.in/ecostat/basicstatPDF2022_23/18.Transport.pdf

• Municipal Corporations and Urban Development Authorities
Current Policy/Policies in Place
No current policy specifically for public transport.
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.

Table 10 Fuel consumption with & w/o Public Transport (PT)[19]

		Fuel consumption (kL/day)		Savings Potential	
Urban Agglomerations	**Population (Census 2011)**	**Without Adequate PT**	**With Adequate PT**	**kL/day**	**toe/year**
Nicobar	<5 lakhs	18	17	3	981.12
North and Middle Andaman					
South Andaman					

[19] Ministry of Urban Development

Table 11: Energy Saving Potential

Particulars	*2026*		*2031*	
	Moderate	Ambitious	Moderate	Ambitious
Energy Saving Potential (toe)	392	491	687	981
GHG Emission Reduction Potential (tCO_2)	1,228	1,535	2,150	3,071

Action Plans

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

1. Improve Intermodal Connectivity: Develop seamless integration between public buses and ferries 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.

2. Conduct a comprehensive assessment of the current public transport bus fleet's energy consumption, identifying energy-intensive routes.
3. Gradually replace older, less energy-efficient buses with newer models that comply with energy conservation standards and adopting hybrid or electric buses where feasible.
4. Implement measures to ensure optimal fuel usage, such as fuel-efficient driving practices, fuel quality monitoring, and exploring the use of cleaner alternative fuels.
5. Establish necessary infrastructure, such as charging or refueling stations for electric, hybrid, or alternative fuel buses.

4.2.3 Energy Efficiency opportunities in Maritime Transport

1. Onshore Power Supply (OPS) as a Clean Alternative:

During port calls, ships rely on onboard auxiliary engines for power generation during port operations. These engines, typically running on heavy fuel oil (HFO) or marine diesel oil (MDO), emit air pollutants such as sulfur oxides (SOx), nitrogen oxides (NOx), and particulate matter (PM). These emissions negatively impact local air quality, affecting the health of port workers and nearby residents. Additionally, the amount of fuel consumed and emissions generated are directly proportional to the duration of a ship's stay at berth.

OPS offers a cleaner and more sustainable solution. It involves connecting docked vessels to the local electricity grid, eliminating the need for onboard power generation and its associated emissions. This approach provides several benefits:

- Reduced Air Pollution: By eliminating exhaust from auxiliary engines, OPS significantly improves air quality in ports, benefiting both port workers and nearby residents.
- Improved Environmental Profile: Onshore power plants can utilize cleaner fuels or employ exhaust gas cleaning systems, resulting in a lower environmental impact compared to shipboard generation.
- Increased Efficiency: Land-based power plants are generally larger and more efficient than shipboard engines, especially when operating at partial loads. This translates to reduced fuel consumption and lower overall emissions.

Implementation Considerations for Andaman and Nicobar Islands:

Implementing OPS in the Andaman and Nicobar Islands requires careful planning and consideration of several factors:

- Assessing the existing grid capacity to ensure it can handle the additional demand from docked vessels.
- Upgrading or expanding port infrastructure to accommodate onshore power connections for various ship types.
- Evaluating the economic feasibility of OPS considering initial investment costs, potential energy savings, and long-term environmental benefits.
- Ensuring compatibility between onshore power supply systems and the electrical specifications of visiting vessels.

Scope Boundary
All major ports and terminals within the Andaman and Nicobar Islands.
Implementing Agency
• Ministry of Ports, Shipping and Waterways (MoPSW) • Andaman and Nicobar Islands Port Management Board (ANI PMB) • Electricity Department, A & N Admn. • Shipping Corporation of India (SCI)
Current Policy/Policies in Place
• National Maritime Strategy 2010: Highlights the importance of promoting environmentally sustainable shipping practices. • Standard Operating Procedures for Supply of Shore Power to Ships (2023): Provides technical guidelines for OPS implementation.
Implementation Period
Phase 1 (2024-2025): Feasibility studies, assessments of grid capacity, and development of a comprehensive implementation plan. Phase 2 (2026-2027): Pilot projects at select ports, securing funding, and finalizing technical specifications for OPS infrastructure. Phase 3 (2028-2030): Large-scale rollout of OPS at major ports, expanding capacity, and monitoring the program's effectiveness.

2. Fleet Modernization:

a) Prioritize LNG-fuelled vessels: Explore the feasibility of transitioning to LNG-fueled ferries for inter-island and mainland-island routes. Consider bunkering facilities at Port Blair and key ports. Assess potential infrastructure investments and economic viability.

b) Hybrid/electric ferries for short routes: Implement hybrid/electric ferries for short routes like harbour ferry and fore-shore sectors, especially within sheltered harbors. Analyse feasibility based on charging infrastructure needs and route distances.

Retrofit existing vessels with energy-saving technologies like:

c) Variable-speed drives (VSDs) for propulsion systems: Reduce energy consumption by adjusting propeller speed to varying engine loads.

d) Waste heat recovery systems: Utilize engine exhaust heat for auxiliary systems like heating or desalination, improving overall thermal efficiency.

e) Energy-efficient lighting and appliances: Replace traditional lighting with LEDs and upgrade appliances to energy-efficient models.

f) Invest in advanced hull designs: When acquiring new vessels, prioritize designs with optimized hull shapes, low-friction coatings, and air lubrication systems to minimize drag and fuel consumption.

3. Operational Optimization:

a) Voyage optimization software: Implement advanced voyage optimization software considering wind, currents, and wave conditions to identify the most fuel-efficient routes.

b) Real-time weather routing: Integrate real-time weather data into voyage planning to adjust routes dynamically for optimal speed and fuel efficiency.

c) Just-in-time (JIT) arrival: Collaborate with port authorities and cargo handlers to implement JIT arrival procedures, minimizing waiting time in ports and reducing idling fuel consumption.

d) Trim and ballast optimization: Implement trim and ballast optimization software and train crew on best practices to ensure optimal vessel loading and minimize resistance.

e) Speed management: Encourage fuel-efficient cruising speeds based on route characteristics and cargo weight. Explore the feasibility of slow steaming initiatives where applicable.

4. Port Infrastructure

a) Mandatory Rooftop Solar:

   a. Implement a policy mandating all port buildings to install rooftop solar panels.

   b. Offer subsidies or low-interest loans to incentivize adoption.

   c. Conduct training programs for port staff on solar system maintenance.

b) Workshop Skylights:

   a. Retrofit existing workshop buildings with skylight systems to maximize natural light and reduce reliance on artificial lighting.

   b. Consider incorporating light sensors to automatically adjust artificial lights based on natural light availability.

c) Transformer Placement:

   a. Conduct an energy audit to identify areas where transformers are located far from the primary load centers.

   b. Develop a plan to relocate transformers closer to major power consumption points to minimize transmission losses.

d) Power Factor Improvement:

   a. Install capacitor banks at strategic locations within the port to improve power factor and reduce reactive power losses.

5. **Maintenance and Fuel Quality:**
    a) Implement a program for regular maintenance of ship engines and auxiliary equipment to optimize fuel efficiency.
    b) Encourage the use of high-quality, low-sulfur fuels to reduce emissions and improve engine performance.
6. **Hull Resistance Reduction:**
    a. Develop a program for regular hull cleaning to remove biofouling (sea growth) that increases drag and fuel consumption.
    b. Explore technologies like hull coatings that inhibit biofouling growth.
7. **Aerodynamic Improvements:**
    a. Investigate the feasibility of incorporating air cavity systems in new or existing hulls to reduce drag and improve fuel efficiency.
8. **Propeller Optimization:**
    a. Analyze current propeller designs and explore opportunities for upgrading to more efficient models that offer better thrust with lower energy consumption.
9. Waste Heat Recovery:
    a. Explore the potential of using waste heat from engines to generate electricity through tail shaft generators with clutch systems.

4.3 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 12 Summary of energy saving from transport sector strategies

Strategies	*Energy Saving Potential in 2031 (toe)*	
	Moderate	Ambitious
1. *Electrification of Road Transport*	7583	11,458
2. *Facilitating Adequate Public Transport*	687	981
Total	8,270	12,439
Emission Reduction Potential (TCO2)	25,885	38,934

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

Policy Type	Monitoring Mechanism
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.

BUILDING SECTOR

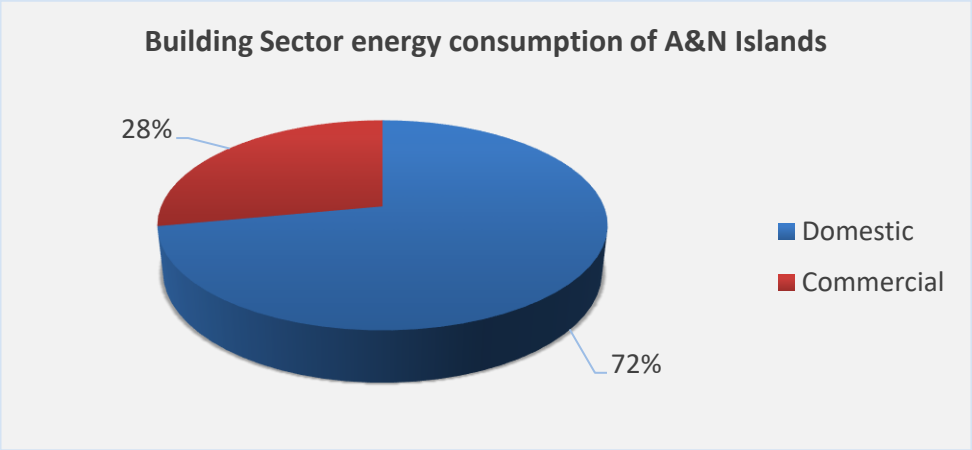
5 FOCUS SECTOR 2: BUILDINGS

5.1 Overview

The building sector has a significant contribution to electricity demand in the Andaman & Nicobar Islands. This is particularly important for the tourism industry, which is a major economic driver in the region. Hotels, restaurants, and resorts represent a substantial share of electricity consumption, and the recent shift to a higher tariff category for these establishments (Rs. 14.50 per unit and for 1001+ units and proposed Rs. 20.30 per unit for FY 2023-24) underscores the economic imperative of energy efficiency.

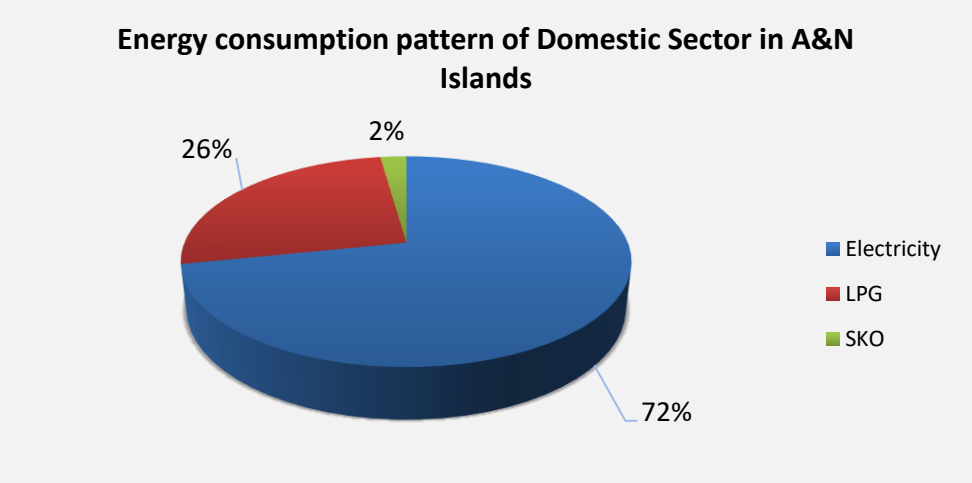
The Figure 20 shows the sector wise energy consumption in buildings.

Figure 13 Building sector energy consumption pattern[20]



The major consumption in domestic sector is from electricity & accounts for 72% of the total energy consumption. The consumption of LPG is more than SKO. The figure below shows the energy consumption pattern in the domestic sector.

Figure 14 Energy consumption pattern of the domestic sector[21]



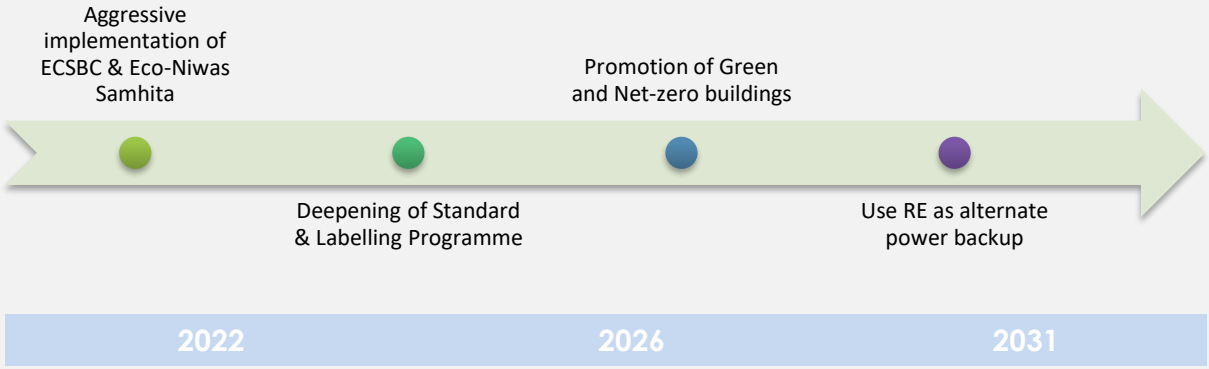
[20] JERC Tariff Order 2022
[21] JERC Tariff Order 2022

While the adoption of Energy Conservation Building Code (ECBC) standards is a positive step, significant potential for energy savings remains untapped. Implementing various strategies like improved building envelopes, efficient lighting systems, high-performance HVAC systems, and utilizing renewable energy sources can significantly reduce energy consumption and associated costs. This not only benefits the environment by lowering emissions from diesel generators but also helps businesses save on electricity bills.

Therefore, promoting and implementing energy-efficient building practices in A&NI is not just an environmental imperative but also an economic necessity for the long-term sustainability of the tourism industry and the islands.

5.2 Energy efficiency strategies in the buildings sector

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



5.2.1 Strategy #1: Implementation of ECBC & ENS (ECSBC)

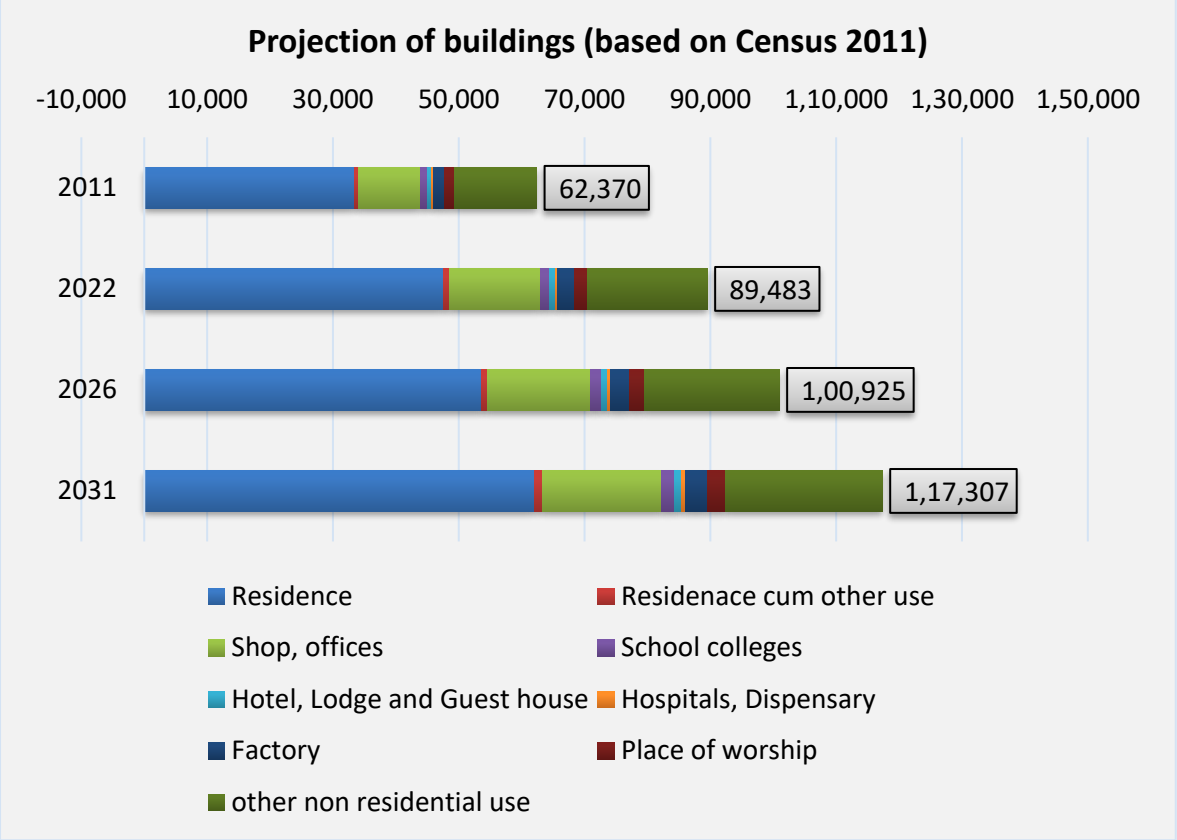
In the recent amendment to the Energy Conservation (EC) Act in 2022, a unified code called the "Energy Conservation and Sustainable Building Code" (ECSBC) has been introduced. This new code will include both commercial and residential buildings. Until the implementation of ECSBC in State/UT, the existing Energy Conservation Building Code (ECBC) and Eco-Niwas Samhita (ENS) will be referred to as ECSBC.

The Energy Conservation Building Code (ECBC) is applicable to all new commercial buildings with a connected load of 100 kW or more, or a connected load of 120 kVA or more. This includes buildings used for office, institutional, healthcare, retail, and other commercial purposes. ECBC is also applicable to major retrofits of existing commercial buildings, where the total connected load is increased by 50% or more, or where the conditioned area is increased by 50% or more. ECBC is mandatory for all the states and union territories of India, and compliance with the code is a legal requirement under the Energy Conservation Act, 2001

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

According to the housing Census 2011 of Andaman and Nicobar Islands, there are nearly 62,370 establishments which are further categorized into residence, offices, shops, schools,

hotels, hospitals, factories, etc. Total number of households and commercial establishments were projected to 2031 as shown below.



The strategy and its implementation are explained below.

Scope Boundary
The plot area for ENS is built up area ≥ 500 m2 and the minimum criteria for applicability of ECBC has been notified as connected load of ≥ 50 kW or 60 kVA.
Implementing Agency
• Bureau of Energy Efficiency • Department of Housing & Urban Development • Directorate of RD/PRIs/ULBs • Electricity Department, NRSE Division
Current Policy/Policies in Place
A&N Islands ECBC, 2019
Implementation Period
Short Term

Saving Potential

The saving potential for FY2030 is 0.0023 MTOE. This is estimated by calculating energy saving per household (kWh/household) and energy savings per commercial building which is then multiplied with the projected households and projected commercial buildings respectively for FY2030 for both moderate and ambitious scenarios. 35% and 40 % of Households are considered for moderate and ambitious scenario respectively in residential sector and similarly 4% (shops, offices), 3% (schools, colleges), 2% (Hotel, lodge, guest

house), 2% (Hospitals, Dispensary), 2% (Factory) are considered in commercial sector. Similarly, the GHG saving potential for this strategy is 0.007 $MtCO_2$.

Table 13: Energy Saving Potential

Particulars	*2026*		*2031*	
	Moderate	Ambitious	Moderate	Ambitious
Energy Saving Potential (toe)	1,050	1,577	1,551	2,334
GHG Emission Reduction Potential (tCO_2)	3,286	4,935	4,856	7,304

Action Plans

This section describes several action plans that can be implemented across the residential 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. **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. Andaman and Nicobar Islands can consider a threshold of 300 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 Andaman and Nicobar Islands.

5. **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.

6. **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.

7. **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.

8. **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.

9. **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.

10. **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.

11. **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.

12. **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.

13. **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.

14. **Behavioural Energy Efficiency Program (BEEP) for Andaman and Nicobar Islands**

    Behavioural interventions have the potential to achieve energy savings of 5-15% in households. Applying this to A & N Islands 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 the union territory. 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[22]

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:

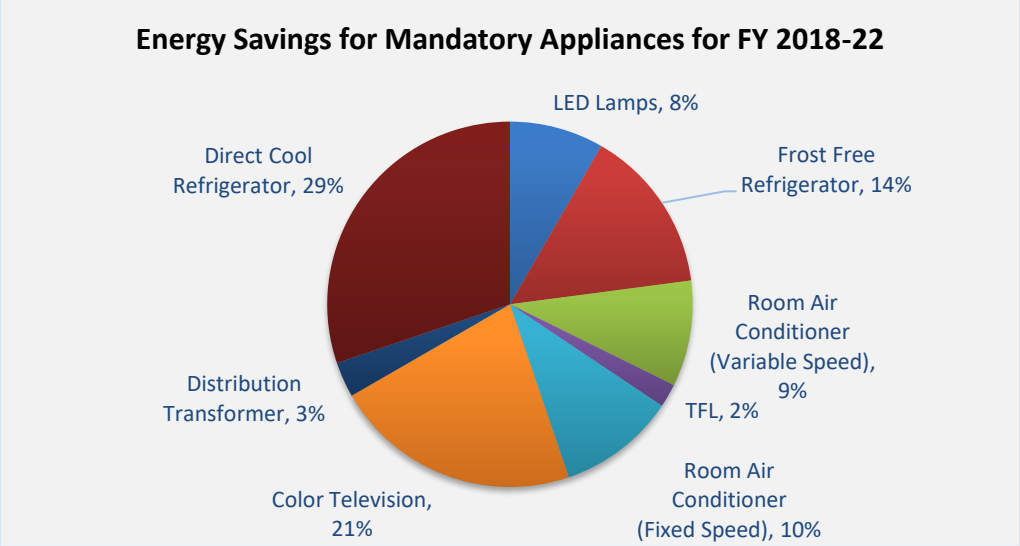
- Improved Energy Efficiency: Personalized HERs and access to energy data empower consumers to make informed decisions, adopt energy-saving practices, and reduce energy consumption.
- Energy Cost Savings: By implementing energy-saving recommendations and efficient usage of appliances, consumers can reduce their energy bills and achieve cost savings.
- Environmental Impact: Reduced energy consumption contributes to a decrease in carbon emissions and environmental footprint, promoting sustainability.

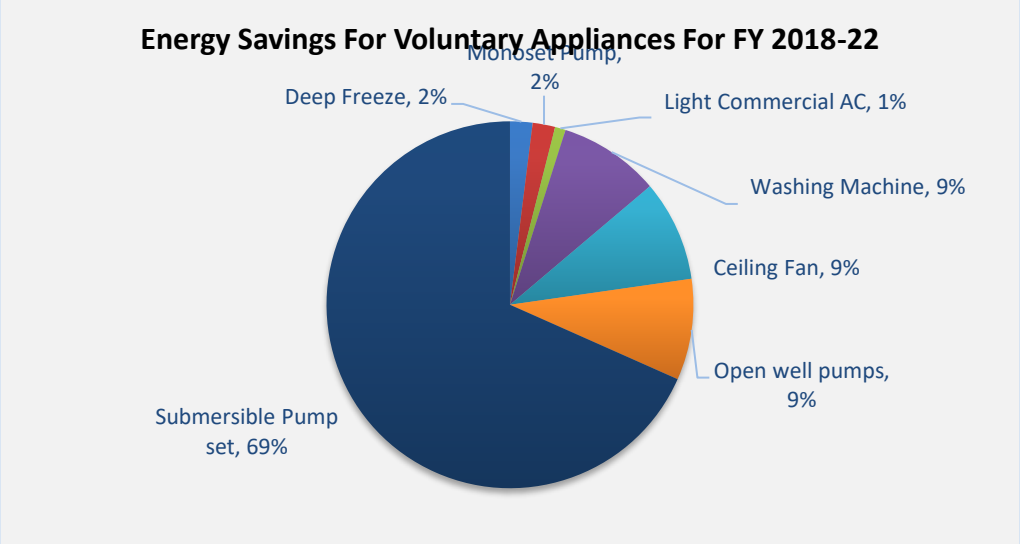
[22] BSES Rajdhani Power Limited (BRPL) website

5.2.2 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[23] during FY2018-22 in India.





With the growth in the number of refrigeration and air conditioning (RAC) units in A & N Islands 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

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

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 appliances in India was 32% for ACs and 79% for 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

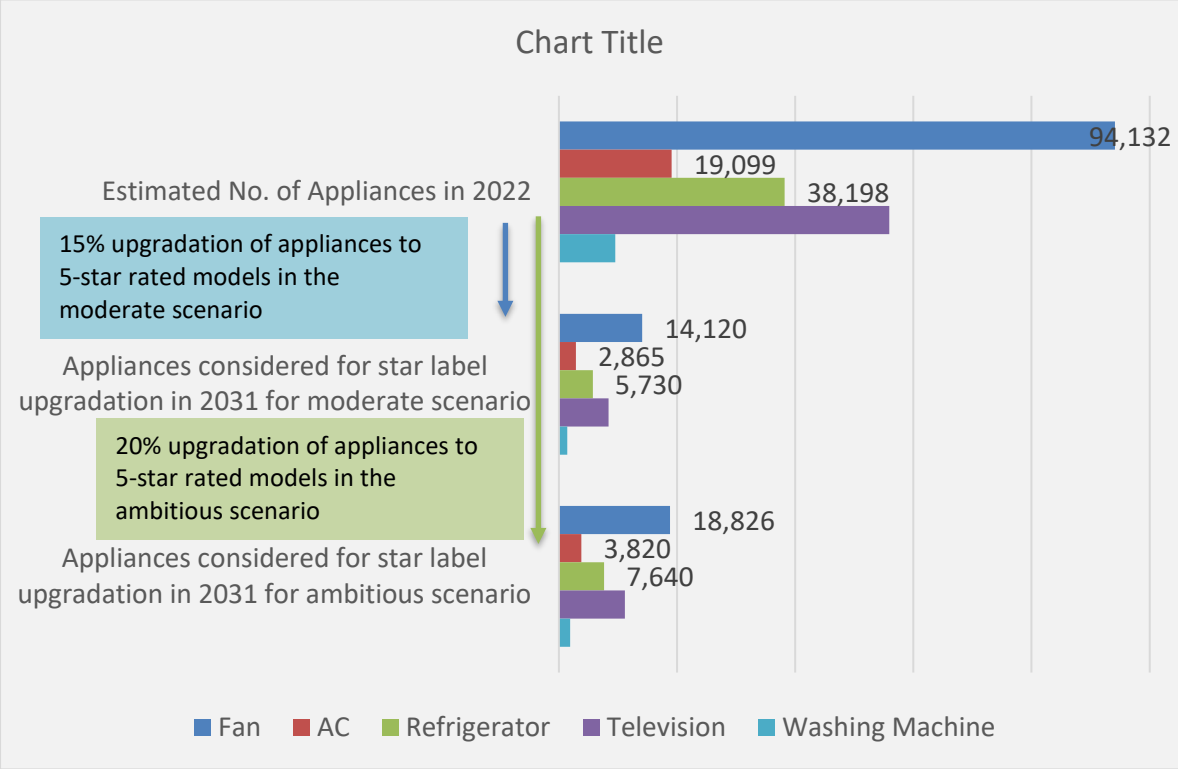
The strategy and its implementation are explained below.

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) • Electricity Department, NRSE Division • APWD
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 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[24] 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.

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



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 14: Energy Saving Potential

Particulars	*2026*		*2031*	
	Moderate	Ambitious	Moderate	Ambitious
Energy Saving Potential (toe)	567	603	709	1,005
GHG Emission Reduction Potential (tCO_2)	1,776	1,887	2,220	3,144

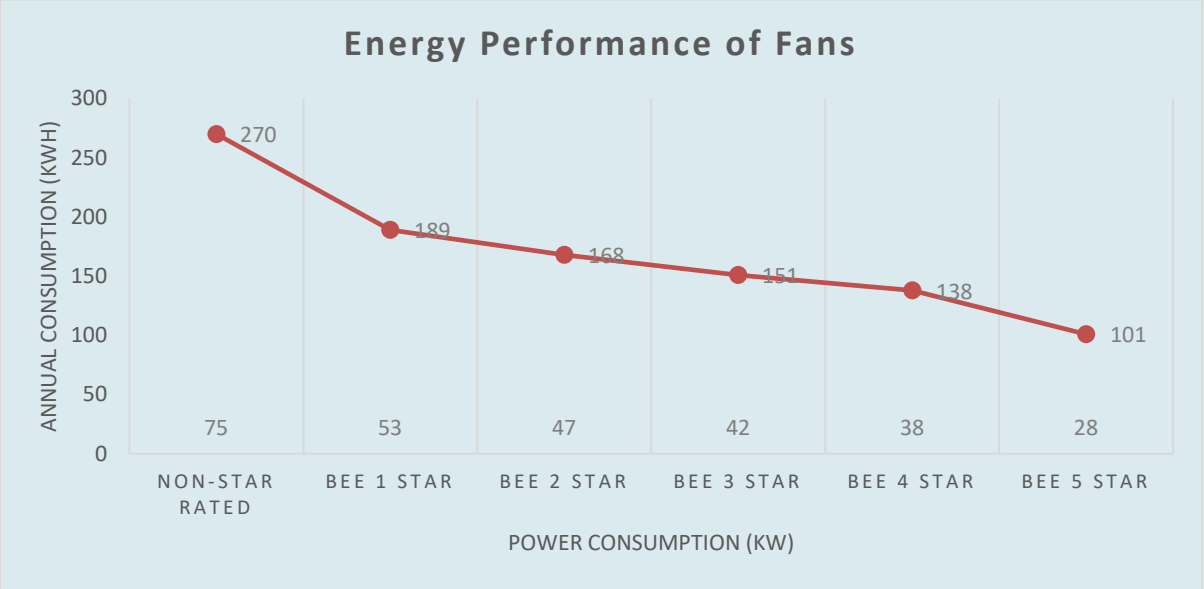
Action Plans

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 region like Andaman and Nicobar Islands 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 the U.T, 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 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 U.T 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[25]

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

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

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) Andaman and Nicobar Islands, being a tropical region 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, A & N Islands can effectively accelerate access to energy efficient ACs. With successful initiatives like BEE and CLASP, the union territory 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[26]

Objective

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

Project Activities:

- The government of India expects that 300 million ACs will be purchased in India. Awareness of energy-efficient schemes and intervention campaigns will be key to purchase decisions.
- CLASP collaborated closely with BEE by providing technical and institutional support to accelerate access to ACs in India.
- 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.

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

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.
6. **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.

5.2.3 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 energy.

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 strategy and its implementation is explained below.

Scope Boundary
The policy will cover commercial buildings, including hotels, office complexes, government buildings.
Implementing Agency

• Certification Body
  • Bureau of Energy Efficiency (BEE)
  • Town and Country Planning
  • PBMC
  • Directorate of RD/PRIs/ULBs
  • Electricity Department, NRSE Division

Current Policy/Policies In Place
The U.T is actively implementing mandatory energy conservation building code (ECBC) in commercial buildings in the State. 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

Residential Sector: A total of 1500 and 2000 households have been considered with a saving potential of 25% and 30% respectively for moderate and ambitious scenarios.

Commercial Sector: A total of 0.2% and 0.3% of the projected households have been considered with a saving potential of 20% and 25% respectively for moderate and ambitious scenarios. The energy saving potential of implementation of this strategy is mentioned below.

Table 15: Energy Saving Potential

Particulars	*2026*		*2031*	
	Moderate	Ambitious	Moderate	Ambitious
Energy Saving Potential (toe)	413	827	1,660	3,615
GHG Emission Reduction Potential (tCO_2)	1,294	2,588	5,195	11,316

Action Plans

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

1. **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.

2. **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.

3. **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.

4. **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.

5. **Building management system (BMS)**

   Mandate building management system (BMS) to centrally manage and monitor lighting, HVAC, and other building systems for optimized energy consumption.

6. **LEDs & Occupancy Sensors**

   Accelerate adoption of all lighting to LED fixtures. Utilize occupancy sensors in public areas and daylight harvesting strategies (e.g., light shelves) to further reduce lighting energy use.

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

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

8. **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.

9. **Mandatory Rooftop Solar Installation:**
   a) Implement a phased approach for mandatory rooftop solar installation on all new commercial and residential buildings above a specific size threshold (e.g., carpet area).
   b) Existing buildings can be incentivized to install solar through subsidies, tax breaks, or low-interest loans.
   c) Collaborate with architects, developers, and builders to integrate solar design considerations into new construction projects.

10. **After-Sales Service for Inverters:**
   a) Enact a policy mandating manufacturers and retailers of inverters in the A&N Islands to provide after-sales service to customers for a minimum period (e.g., 5 years).
   b) The NRSE division of the Electricity Department can support in:
      - Establishing a certification program for qualified inverter technicians and maintaining a registry of certified technicians readily accessible to customers.
      - Enforcing the after-sales service policy through regular inspections and consumer complaint redressal mechanisms.

5.3 Energy saving potential of the sector & monitoring mechanism

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

Table 16 Summary of energy saving from building strategies

Strategies	*Energy Saving Potential in 2031 (toe)*	
	Moderate	Ambitious
1. *Implementation of ENS* 2. *Acceleration of ECBC*	1,551	2,334
3. Deepening of S&L Programme	709	1,005
4. Promotion of Green Rating of Buildings	1,660	3,615
Total	3,920	6,954
Emission Reduction Potential (TCO2)	12,270	21,766

Following are the monitoring mechanisms that could be implemented to track the progress and effectiveness of the policies in the building sector of the U.T:

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.

WATER SUPPLY SECTOR

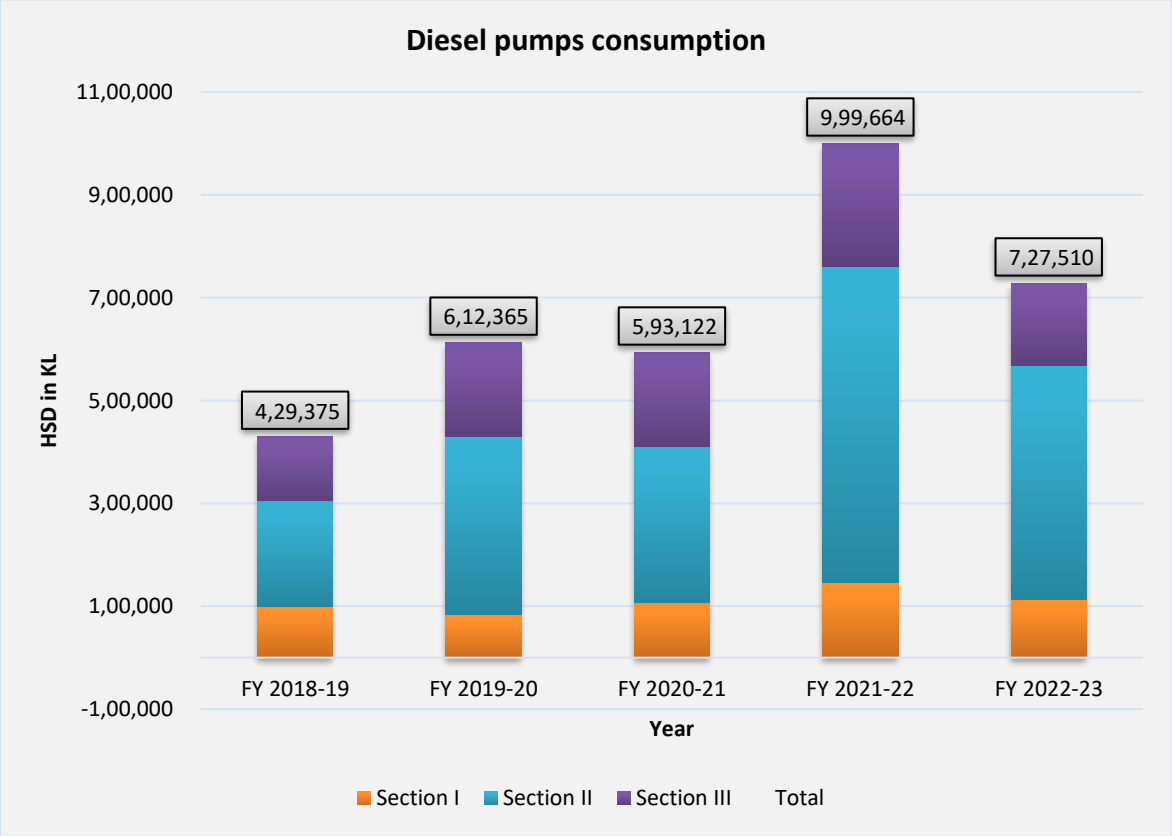
6 FOCUS SECTOR 3: WATER SUPPLY

6.1 Overview

Andaman and Nicobar Islands face a unique water challenge; despite the islands' rainfalls, major freshwater sources like rivers are absent, leaving saline and brackish groundwater as the main option. This poses a significant challenge for treating and protecting drinking water, especially in urban areas like Port Blair. Currently, rainwater harvesting in reservoirs and wells, alongside four treatment plants, serves as the primary source for domestic needs. However, demand outpaces supply, leading to alternate-day water availability in monsoon and every-third-day access in summer.

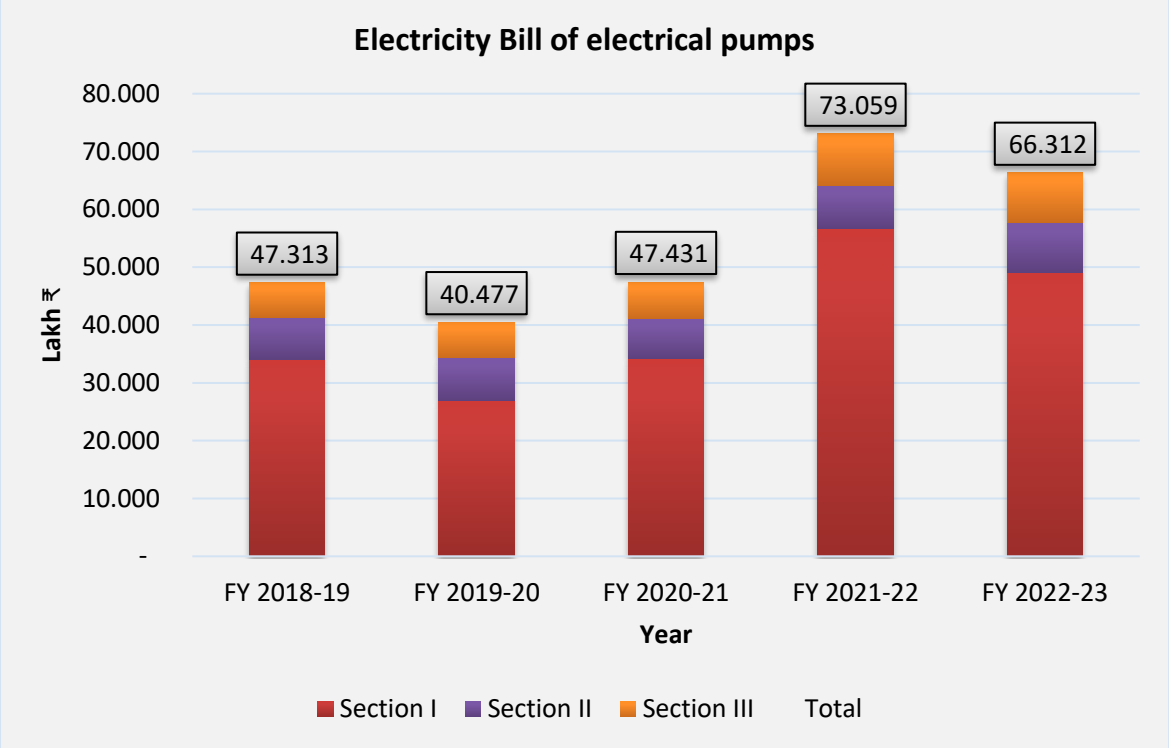
To bridge this gap, ongoing projects aim to increase water treatment capacity, while exploring options like transporting water from another island and creating a freshwater lake. Managing the projected sewage generation of 47 MLD (million litres per day) s per day) by 2030 is another crucial aspect, addressed by proposed pumping stations and treatment plants. However, diesel and electricity consumption for water supply operations remain significant, highlighting the need for exploring sustainable alternatives. The figures below display the diesel and electrical consumption by pumps by the water supply sector.

Figure 15 Details of HSD Consumption (in Liters) of Section I, II and III under E&M Subdivision[27]



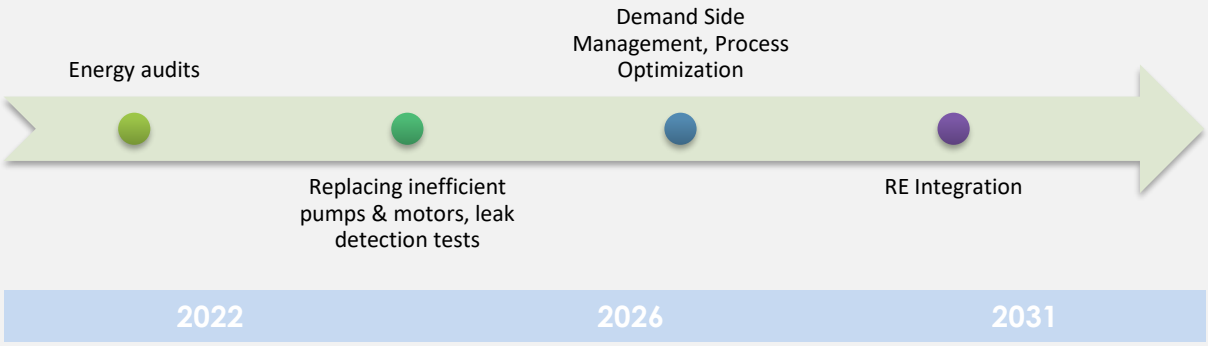
[27] As per data received from APWD

Figure 16 Details of Electricity Bill of Section I, II and III under E&M Subdivision[28]



6.2 Energy efficiency strategies in the water supply sector

The following strategies can be used to achieve the energy reduction targets in the water supply sector.



6.2.1 Strategy #1: Implementation of Energy Audits

Implementing comprehensive energy audits across the public water supply sector in Andaman & Nicobar Islands is crucial to identify and prioritize energy-saving opportunities. These audits will play a vital role in:

[28] As per data received from APWD

- Quantifying current energy consumption: This helps establish a baseline for measuring future improvements.
- Identifying inefficiencies: Audits pinpoint specific areas where energy is wasted, such as pumping operations, treatment processes, and distribution networks.
- Prioritizing cost-effective solutions: By evaluating potential savings and payback periods, audits help guide investments towards the most impactful measures.
- Informing policy development: Data from audits can be used to create targeted policies and regulations promoting energy efficiency in the sector.

The strategy and its implementation are explained below.

Scope Boundary
Implementing mandatory energy audits for water utilities with a phased approach, starting with larger treatment plants and high-energy-consuming pumping stations. Require audits to include detailed recommendations for energy efficiency improvements.
Implementing Agency
• Andaman Public Works Department • Port Blair Municipal Council • NRSE
Current Policy/Policies in Place
-
Implementation Period
Short Term • Phase 1: Organize workshops and training programs for water sector personnel on the importance and methodology of energy audits. • Phase 2: Conduct comprehensive audits across all identified facilities. • Phase 3: Develop detailed reports outlining energy consumption patterns, identified inefficiencies, potential savings, and recommended improvement measures. • Phase 4: Prioritize recommendations based on cost-effectiveness and implement high-impact measures. Conduct regular monitoring and evaluation to track progress and assess the effectiveness of implemented solutions.

Saving Potential

The saving potential identified for water sector through the implementation of energy audits and various energy efficient technologies is as follows:

Table 17: Energy Saving Potential

Particulars	*2026*		*2031*	
	Moderate	Ambitious	Moderate	Ambitious
Energy Saving Potential (toe)	242	363	508	719
GHG Emission Reduction Potential (tCO_2)	757	1,135	1,590	2,252

Action Plans

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

1. **Targeted Pump Replacement:**

   Replace aging and inefficient pumps with high-efficiency models equipped with VFDs, prioritizing critical infrastructure and high-energy-consuming locations like Port Blair. Consider submersible pumps with lower energy losses for deep wells.

2. **Network Rehabilitation:**

   Implement a comprehensive leak detection and repair program using acoustic leak locators and GIS mapping, focusing on areas with high Non-Revenue Water (NRW) levels. Upgrade aging pipelines with leak-resistant materials like polyethylene.

3. **Island-Specific Solar Integration:**

   Conduct feasibility studies for integrating grid-connected and off-grid solar power systems at treatment plants and pumping stations, considering variations in solar irradiation across different islands. Explore battery storage options for nighttime and cloudy periods.

4. **Rainwater Harvesting Potential Assessment:**

   Conduct island-specific studies to map suitable areas for rainwater harvesting, including rooftop harvesting in urban areas and community-level systems in rural areas. Develop guidelines and incentives for rainwater harvesting infrastructure.

5. **Demand-Side Management**:

   Implement tiered water tariffs based on consumption, incentivizing water conservation, particularly for high-volume users. Partner with NGOs for community awareness campaigns promoting water-saving practices.

6. **Treatment Process Optimization**: Conduct energy audits of treatment plants to identify inefficiencies. Implement energy-efficient aeration technologies in activated sludge processes, optimize coagulation/flocculation procedures, and explore advanced filtration systems like membrane bioreactors.

7. **Real-Time Monitoring and Control:**

   Implement Supervisory Control and Data Acquisition (SCADA) systems for real-time monitoring of water levels, pressure, and energy consumption across the entire network. Develop centralized control centers for optimizing pumping schedules and minimizing energy losses.

8. **Biogas from Sewage:**

   Implement biogas generation plants at sewage treatment plants, utilizing biogas for internal operations or feeding into the grid. Consider advanced co-digestion technologies to increase biogas production.

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 for water supply sector

Strategies	*Energy Saving Potential in 2031 (toe)*	
	Moderate	Ambitious
1. *Mandatory energy audits for the water supply*	508	719
Total	508	719
Emission Reduction Potential (TCO2)	1,590	2,250

Following are the monitoring mechanisms that could be implemented to track the progress and effectiveness of the policies in the water supply sector for the union territory:

Policy Type	Monitoring Mechanism
Metering and Data Collection	Implementing advanced metering systems to accurately measure water consumption at various stages of supply and distribution. Regular data collection for analysis.
Leakage Detection and Repair	Utilizing leak detection technologies and conducting regular inspections to identify and repair leaks in the water supply network promptly.
Pump Efficiency Monitoring	Monitoring the efficiency of water pumps and motors to identify opportunities for optimization and energy savings.
Energy Consumption Tracking	Tracking energy consumption associated with water extraction, treatment, pumping, and distribution to identify areas for efficiency improvements.
Demand Management Strategies	Implementing demand-side management strategies such as promoting water conservation practices and optimizing water usage patterns.
Performance Benchmarking	Comparing performance metrics against predefined benchmarks to assess the effectiveness of energy efficiency initiatives in the water supply sector.
Public Reporting and Transparency	Providing regular updates and reports on energy consumption, water quality, and efficiency measures to stakeholders and the public for transparency.
Stakeholder Engagement and Feedback Mechanism	Engaging with stakeholders including water utility operators, government agencies, and consumers to gather feedback and insights for continuous improvement.


INDUSTRY
SECTOR

7 FOCUS SECTOR 4: INDUSTRY

7.1 Overview

In Andaman and Nicobar Islands, the industrial landscape is dominated by micro, small, and medium enterprises (MSMEs), with no large-scale industries present. While over 3,893 registered MSMEs employ over 15,000 individuals as of FY 2022-23, the islands' unique geography and demographics pose significant challenges to industrial growth.

Isolation from the mainland translates to limited infrastructure, including unreliable internet, transportation bottlenecks, and a lack of skilled labour. The scattered population across various islands makes market access difficult, further compounded by resource constraints like limited raw materials and insufficient local markets. Additionally, heavy rainfall seasons hinder progress for several months each year.

Despite these challenges, the MSME sector plays a vital role in the islands' economy. Key industries include agro-processing, manufacturing of paints, plastics, and beverages, and renowned wood and shell-based handicrafts. The Andaman and Nicobar Integrated Development Corporation (ANIIDCO) further supports the growth of civil supplies, tourism, and other industries.

However, the islands' inherent limitations create a crucial need for energy efficiency in the industrial sector. With unreliable and expensive fuel sources, coupled with limited infrastructure for power generation and transmission, reducing energy consumption is not just an environmental concern but an economic imperative.

7.2 Energy efficiency strategies in the industry sector

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

7.2.1 Strategy#1: Energy audits in MSMEs

Energy audits are an important tool for identifying areas where energy efficiency improvements can be made. An energy audit involves a detailed assessment of a facility's energy consumption patterns and the identification of opportunities for improvement. The audit can help to identify areas where energy consumption is particularly high, as well as areas where simple changes can lead to significant energy savings.

Energy efficiency promotion can involve a variety of measures, including awareness-raising campaigns, technical training, and financial incentives to encourage the adoption of energy-efficient technologies and practices. These measures can be particularly beneficial for MSMEs, which often have limited resources and may lack the knowledge and expertise to implement energy-efficient solutions.

The strategy and its implementation are explained below.

Scope Boundary
Phase-in mandatory energy audits for larger MSMEs, starting with high-energy consuming industries. This will drive periodic assessments, identify new improvement opportunities, and ensure sustained efficiency gains.

Implementing Agency
• The Bureau of Energy Efficiency (BEE) • Directorate of Industries, A&N Administration • NRSE
Current Policy/Policies in Place
No policy in place currently.
Implementation Period
Long Term

Saving Potential

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

Particulars	*2026*		*2031*	
	Moderate	Ambitious	Moderate	Ambitious
Energy Saving Potential (toe)	99	123	284	340
GHG Emission Reduction Potential (tCO_2)	309	386	888	1,066

Action Plans:

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

1. **Energy and Resource Mapping Studies in MSMEs:**

   Conduct in-depth feasibility studies to assess energy consumption patterns, identify inefficiencies, and estimate potential savings across various industries. This data will guide tailored interventions.

2. **Vendor Technology Workshops:**

   Organize industry-specific workshops featuring technology vendors showcasing cutting-edge solutions like:

   a) High-efficiency motors and variable speed drives for industrial processes.
   b) LED lighting with occupancy sensors and daylight harvesting systems.
   c) Renewable energy options like rooftop solar PV systems and biomass gasifiers.
   d) Advanced HVAC systems with demand-controlled ventilation and energy recovery.
   e) Industrial process optimization software and monitoring tools.

3. **Implementation of Demonstration Projects:**

   Implement above technologies among others as pilot projects showcasing successful energy-efficient technologies in select MSMEs. This will provide tangible evidence of benefits and encourage wider adoption.

4. **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.

Case Study: PAE guidelines by BEE

Objective

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

Key Features:

Key features include the following:

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

Benefits to MSMEs:

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

Case Study: Promoting energy efficiency and renewable energy in selected micro, small and medium enterprises (MSME) clusters in India[29]

Objective

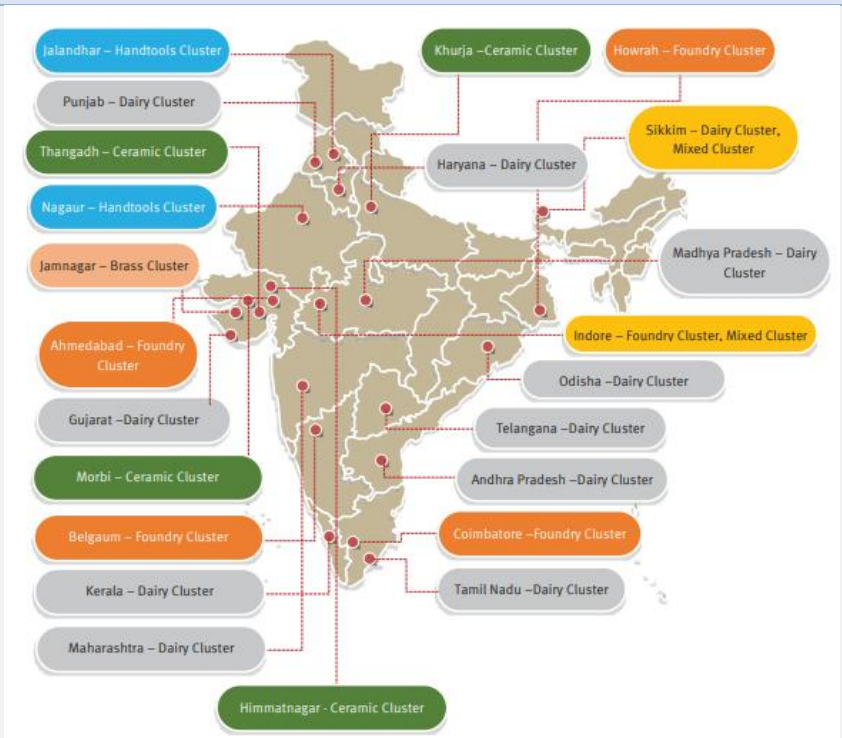
The objective of the UNIDO-BEE project "Promoting EE/RE in selected MSME Clusters in India" was to provide support and assistance to Micro, Small, and Medium Enterprises (MSMEs) in implementing Energy Efficiency (EE) and Renewable Energy (RE) technologies. The project aimed to enhance energy efficiency,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



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

7.3 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 19 Summary of energy saving from the strategies

Strategies	*Energy Saving Potential in 2031 (toe)*	
	Moderate	Ambitious
1. *Mandatory energy audits for MSMs*	284	340
Total	284	340
Emission Reduction Potential (TCO2)	888	1,064

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

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

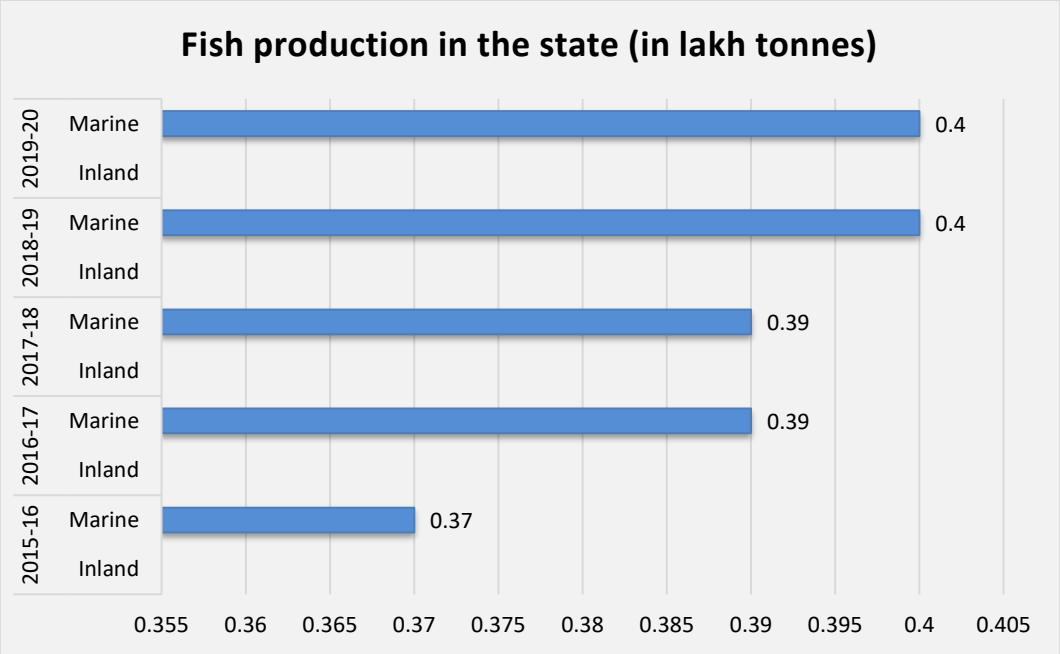
FISHERIES SECTOR

8 FOCUS SECTOR 5: FISHERIES

8.1 Overview

Fisheries Sector:

According to Handbook on Fisheries Statistics 2020 by Department of Fisheries, Andaman and Nicobar Islands produced 0.4 lakh tonnes of marine fishes as seen in the figure below:

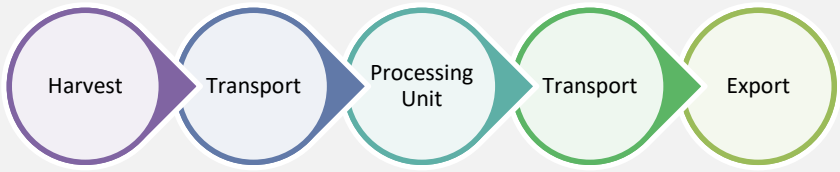


In the fisheries sector, energy is mainly used for fishing operations, ice production, and transportation. The state government should promote the use of energy-efficient fishing boats, which are equipped with solar-powered lights and GPS systems. In addition, the government should also promote the use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

8.2 Energy efficiency strategies in the fisheries sector

8.2.1 Strategy #1: Energy efficiency across value chain of fisheries

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 • Directorate of Fisheries, Andaman & Nicobar Islands • NRSE
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 centres. Phase 4 (Next 10 years): Aim for widespread implementation of energy-saving measures across all aspects of the fisheries value chain in the union territory.

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 20: Energy Saving Potential

Particulars	*2026*		*2031*	
	Moderate	Ambitious	Moderate	Ambitious
Energy Saving Potential (toe)	2,103	2,403	3,004	4,806
GHG Emission Reduction Potential (tCO_2)	6,581	7,521	9,402	15,043

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 to develop and deliver state-specific training modules on efficient fishing practices and gear selection for A & N Islands' diverse fishing grounds.
2. **Awareness Campaigns:**
   a) Conduct workshops in major fish processing centres 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 Hindi 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 the islands, there are around 2,000 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 the A & N Islands.

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	Elements	Resource savings (%)				GHG
		Electrical energy	Thermal energy	Water	Ice	
Aquaculture shrimp	Farm	16%	-	-	-	15%
	Processing	7%	43%	3%	40%	10%
IMC	Farm	20%	-	-	-	19%

	Processing	8%	24%	18%	40%	13%
Finfish	Processing	11%	-	-	-	11%
Crab and Lobster	Processing	6%	-	-	-	5%

- 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.

8.3 Energy saving potential of the sector & monitoring mechanism

Energy saving potential of the fisheries sector is displayed below.

Table 21 Summary of energy saving from the strategies

Strategies	*Energy Saving Potential in 2031 (toe)*	
	Moderate	Ambitious
1. *Energy efficiency across all value chain in fisheries sector*	3,004	4,806
Total	3,004	4,806
Emission Reduction Potential (TCO2)	9,402	15,043

Following are the monitoring mechanisms that could be implemented to track the progress and effectiveness of the policies in the fisheries sector of A & N Islands:

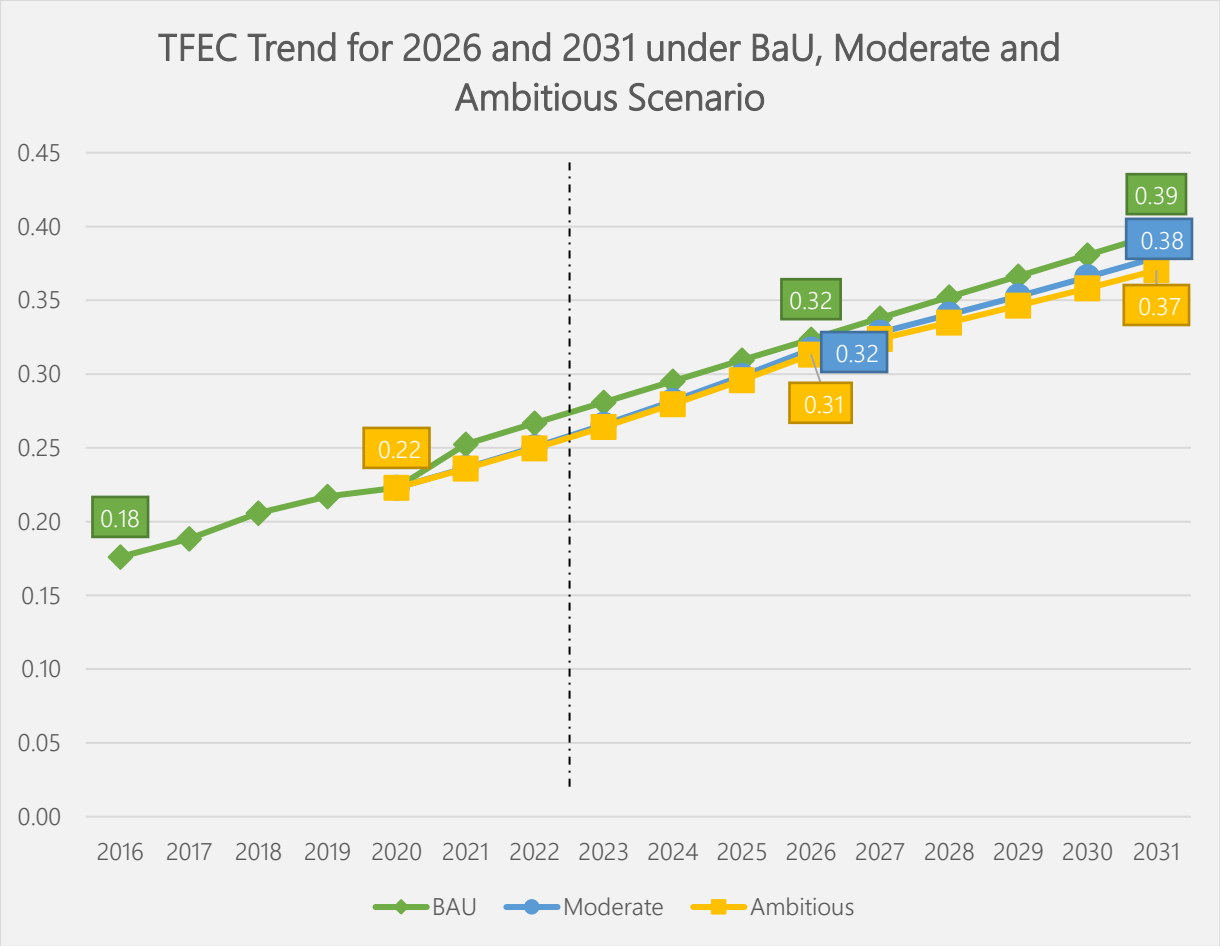
Policy Type	Monitoring Mechanism
Fuel Consumption Tracking	Implementing systems to monitor fuel consumption in fishing vessels, including diesel, petrol, and other fuels, to assess energy efficiency measures.
Vessel Performance Monitoring	Monitoring vessel performance metrics such as speed, engine load, and fuel efficiency to identify opportunities for optimization and energy savings.
Fishing Gear Efficiency Assessment	Evaluating the efficiency of fishing gear and practices to minimize energy-intensive methods and promote sustainable fishing practices.
Compliance with Regulations	Ensuring compliance with environmental regulations and guidelines related to fuel efficiency, emissions, and sustainable fishing practices.
Adoption of Alternative Energy Sources	Tracking the adoption of alternative energy sources such as solar power for auxiliary equipment and lighting on fishing vessels to reduce reliance on fossil fuels.
Data Collection and Analysis	Collecting data on fishing activities, catch volumes, fuel usage, and operational parameters for analysis to identify trends and areas for improvement.
Stakeholder Engagement and Training	Engaging with fishermen, fishing associations, and industry stakeholders to raise awareness about energy-efficient practices and provide training and support.
Emissions Monitoring and	Monitoring greenhouse gas emissions from fishing activities and implementing measures to reduce emissions through engine upgrades

Reduction	and operational changes.
Fisheries Management and Policy Evaluation	Assessing the impact of fisheries management policies and regulations on energy efficiency and sustainability in the sector.
Technology Adoption and Innovation	Tracking the adoption of new technologies and innovations in fishing practices, gear, and vessel design to enhance energy efficiency and sustainability.
Economic and Social Impact Assessment	Conducting assessments to evaluate the economic and social impacts of energy efficiency policies and initiatives on fishermen and fishing communities.

9 SUMMARY

The state energy efficiency action plan identifies significant energy-saving potential in the Andaman & Nicobar Islands through the implementation of energy efficiency and conservation strategies. The union territory has the opportunity to save 0.016 Mtoe by 2031 under the moderate scenario and nearly 0.025 Mtoe under the ambitious scenario. The TFEC Trend for 2026 and 2031 under BaU, Moderate and Ambitious Scenario is displayed below.

Figure 17 TFEC Trend for 2026 and 2031

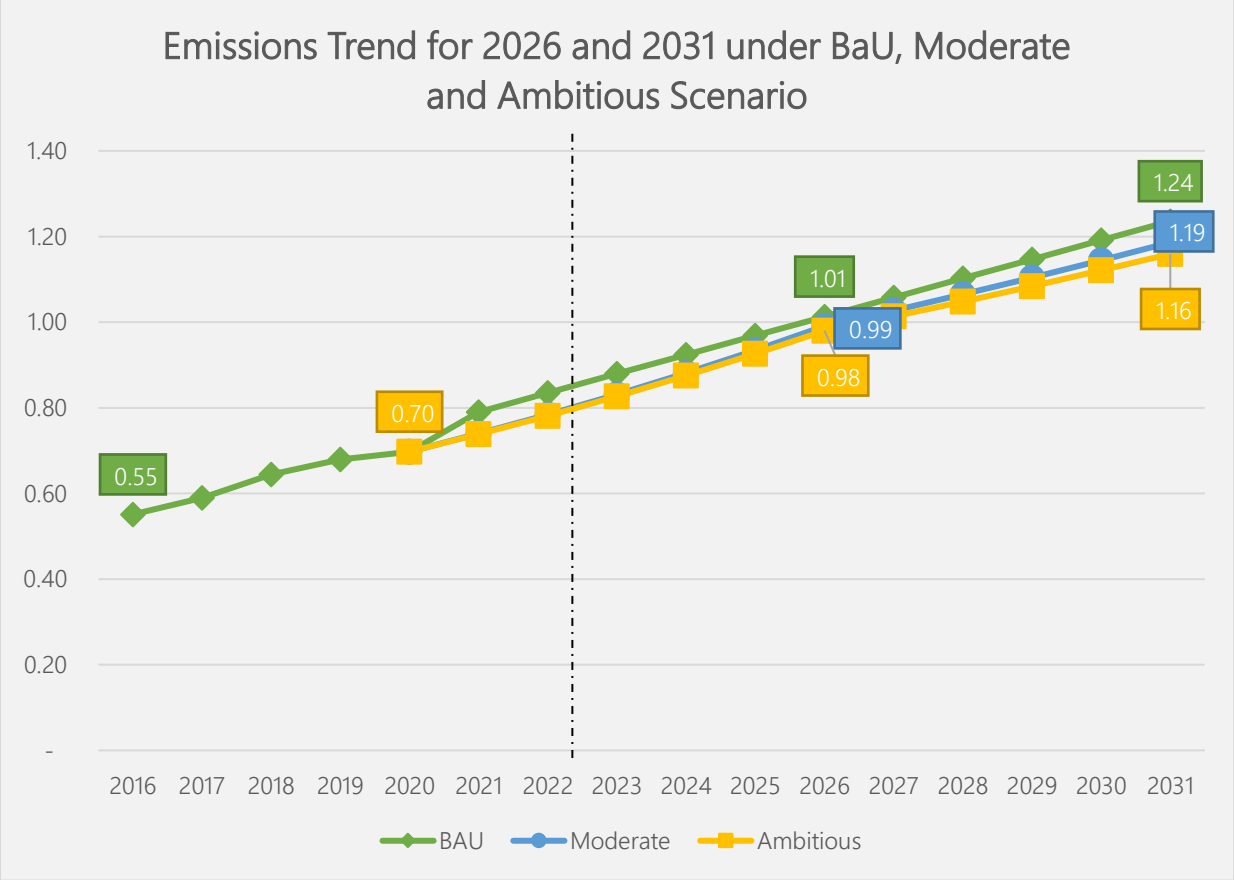


In the Business as Usual (BaU) scenario, TFEC is projected to reach nearly 0.39 Mtoe by 2031. This scenario assumes that present energy consumption patterns will continue without significant changes in policies, technology, or behavior. The BaU scenario helps understand the likely trajectory of energy 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 0.38 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 0.37 Mtoe by 2031.

Figure 18 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 0.025 Mtoe and the total emission reduction is 0.079 MtCO2 under ambitious scenario. The biggest reduction in energy consumption is in the transport sector, followed by the industry sector. The biggest reduction in emissions is in the transport sector, followed by the buildings sector and then fisheries sector.

Table 22 Summary of energy consumption reduction and emission reduction- sector wise.

Sector	Emissions Reduction (tCO2) - FY2031		Energy Consumption Reduction (toe) - FY2031	
	Moderate	Ambitious	Moderate	Ambitious
	tCO2 reduction	tCO2 reduction	toe Reduction	toe Reduction
TRANSPORT	25,885	38,935	8,270	12,439
BUILDINGS	12,271	21,764	3,920	6,954
WATER SUPPLY	1,590	2,252	508	719
INDUSTRY	888	1,066	284	340

FISHERIES	9,402	15,043	3,004	4,806
TOTAL	50,036 tCO2	79,060 tCO2	15,986 toe	25,258 toe
TOTAL	0.050 MtCO2	0.079 MtCO2	0.016 Mtoe	0.025 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, Andaman & Nicobar Islands can effectively reduce energy consumption, enhance sustainability, and contribute to a greener and more energy-efficient future.

10 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 23 Investment Potential[30]

Sector	Energy Consumption Reduction (Mtoe) - FY2031		Investment Potential
	Moderate	Ambitious	
	toe Reduction	toe Reduction	INR Crores
TRANSPORT	8,270	12,439	₹ 22.89
BUILDINGS	3,920	6,954	₹ 12.79
WATER SUPPLY	508	719	₹ 1.32
INDUSTRY	284	340	₹ 0.63
FISHERIES	3,004	4,806	₹ 8.84
TOTAL	15,986 toe	25258 toe	₹ 46.47

The energy saving investment potential of the state is estimated to be nearly ₹46 crores by the year 2031, under the ambitious savings scenario, with the transport sector constituting highest energy saving investment potential followed by building sector.

[30]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.

11 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:

11.1 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.

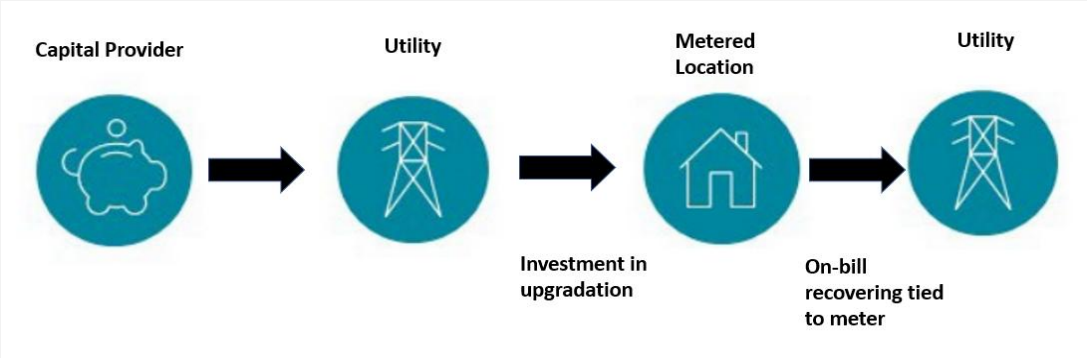
It has been demonstrated that basic energy efficiency measures like insulation, air sealing, heat pumps, and lighting upgrades produce an average energy savings of 25%. Through on-bill initiatives, an electric company or a third-party financier can cover the initial cost of energy-saving upgrades and 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 19 Major common energy consuming appliances and equipment in buildings sector

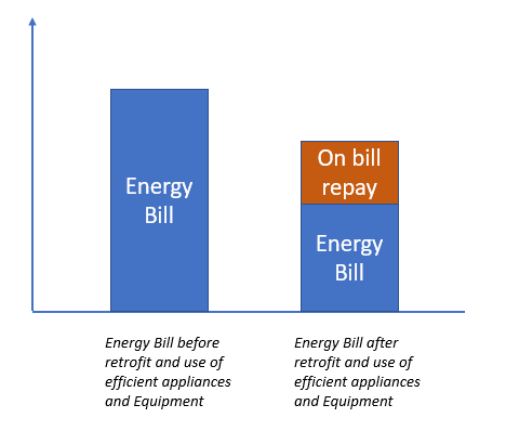
Energy efficiency is frequently the fastest-acting alternative to reduce the consumption of fossil fuels. The plan of delivering EE appliances to consumers may be more significant in order to offer them significant benefits. With the OBF model, consumers won't be put at a financial disadvantage because 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 20 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 21 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

11.2 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.

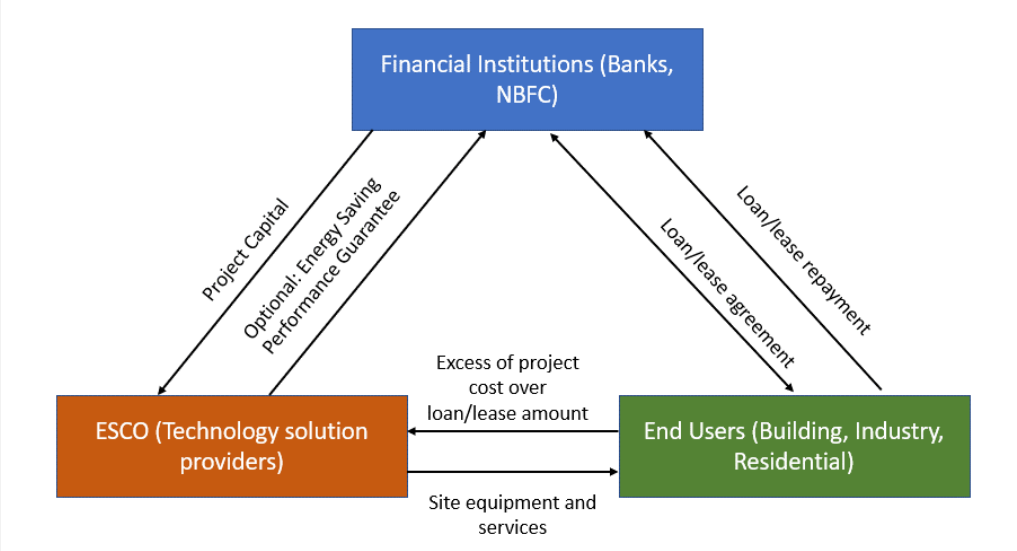
In an EPC, the ESCO guarantees energy savings as long as predetermined operational and maintenance guidelines are followed. Processes for measurement and verification are also put in place to make it easier to calculate the actual energy savings. The ESCO reimburses the energy end user with an amount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

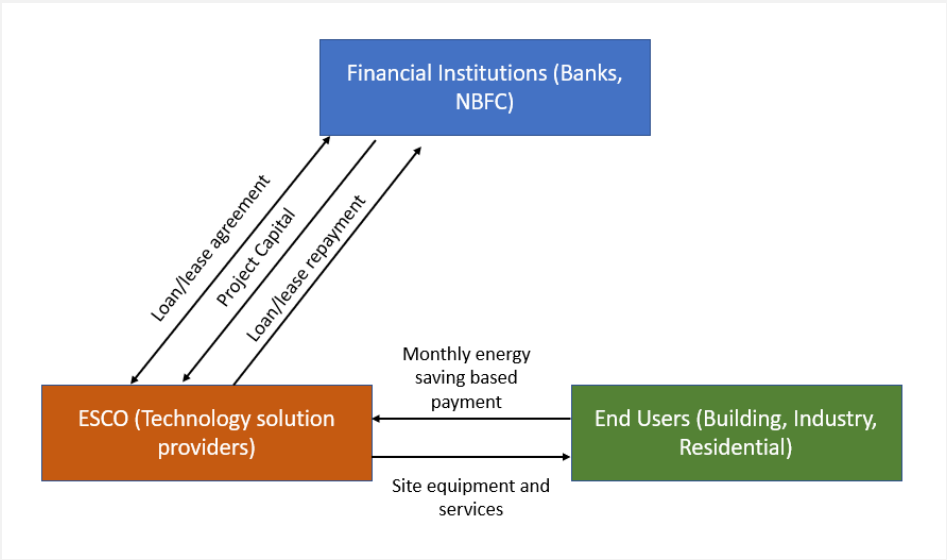
Figure 22 Guaranteed Saving Model



- 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 23 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 24 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

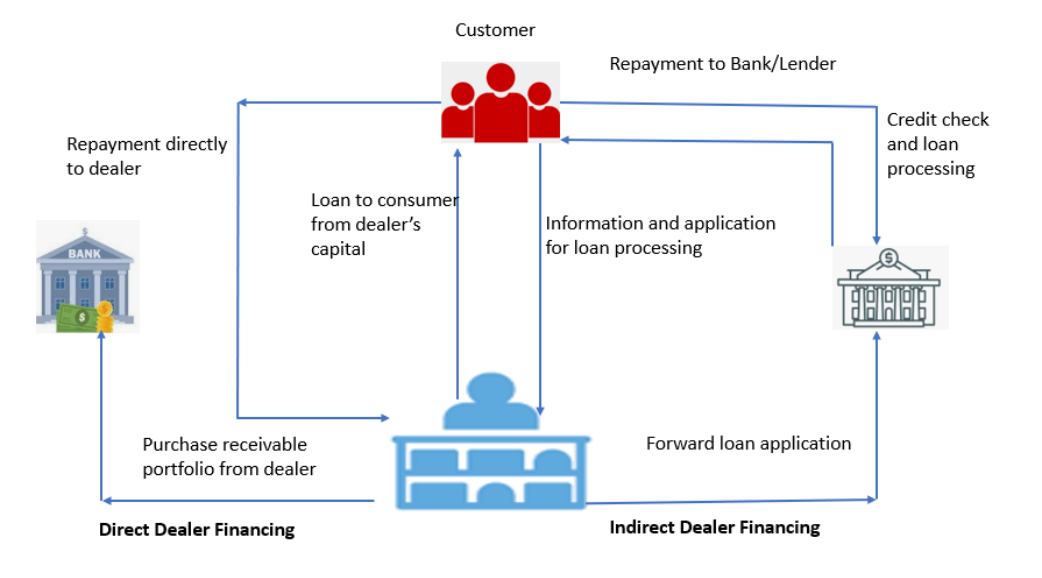
Source: Climate Policy Initiative, 2021

11.3 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.

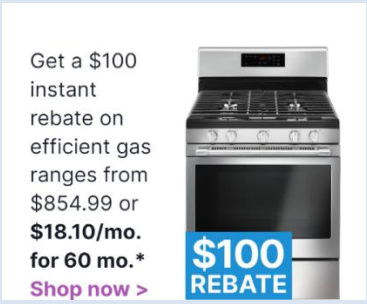
Dealer financing lowers the cost of loan for consumers and easier access to credit facility. Dealer also helps the consumer to do all paperwork, credit risk assessments etc. Dealer can negotiate with multiple finance provider for lending at discounted interest rates.

Figure 24 Dealer and retailer financing model



Case study: ECO-Financing Model by Enervee

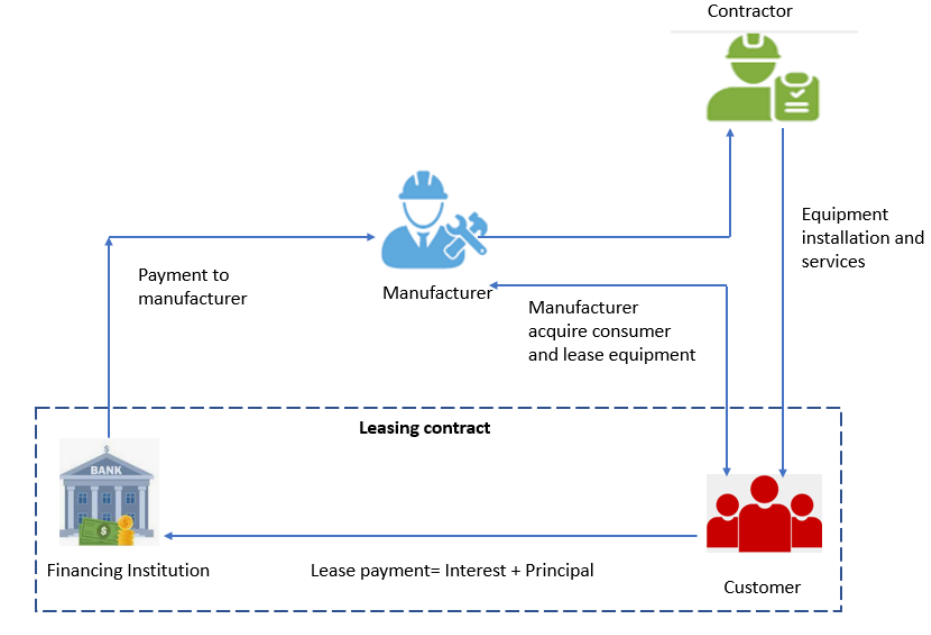
Los Angeles based Enervee company, a provider of energy efficient appliances through online marketplace announced the ECO-Financing model for making energy efficient appliances affordable. The program was launched in collaboration with lenders Southern California Gas Company & the Sate of California. 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.



11.4 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 25 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

11.5 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:

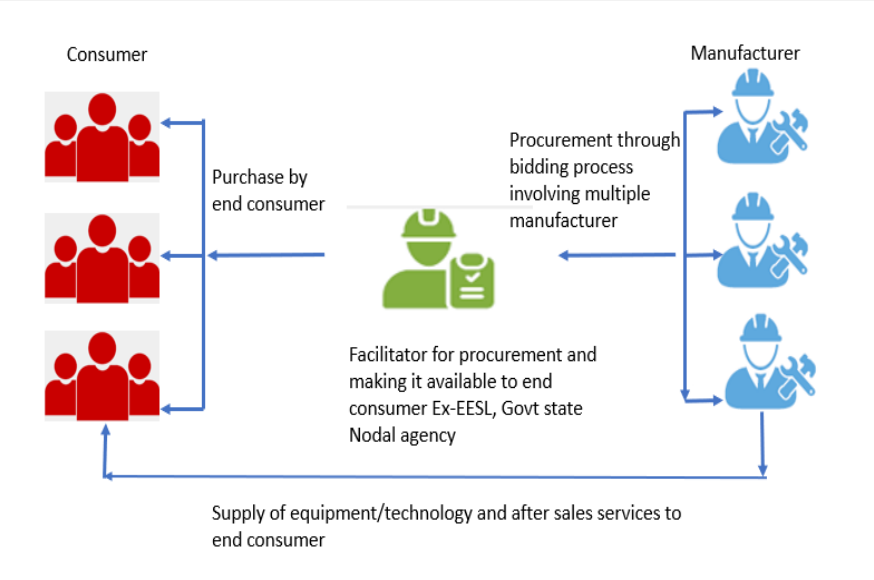
- Component 1: Increasing capacity of suppliers in the category of Renewable and Energy efficient products.
- Component 2: Facilitate the implementation of energy efficient and Renewable energy technologies, best practices in MSMEs cluster of India.
- Component 3: Scaling up the project at national level.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

And key outcomes of the project is as given below:

11.6 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 26 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.

Motor specification (IE-	*No of motors procured.*	*Market price of Motor (Rs Lakh)*	*EESL Procured price (Rs Lakh)*

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

12 WAY FORWARD

The "State Energy Efficiency Action Plan" report for Andaman & Nicobar Islands serves as a roadmap towards achieving energy efficiency goals tailored to the unique characteristics and needs of this union territory. Covering diverse sectors such as transport, maritime, buildings, industries, and fisheries, the report identifies specific opportunities for energy savings and greenhouse gas emissions reductions. As we chart the course forward, it is imperative that the state prioritizes the implementation of the action plan's recommendations to realize its energy efficiency potential fully.

Establishment of a Collaborative Task Force

A pivotal initial step in advancing towards energy efficiency is the formation of a dedicated task force or working group. This collaborative body should comprise representatives from government agencies, industry stakeholders, non-governmental organizations, energy experts, and local communities. Tasked with overseeing the implementation of the action plan, this group will be responsible for setting priorities, establishing timelines, and monitoring progress across sectors. By fostering collaboration and synergy among diverse stakeholders, the task force will ensure a coordinated and effective approach towards energy efficiency initiatives.

Securing Adequate Funding

Securing adequate funding is paramount for translating the action plan into tangible outcomes. The union territory must explore a spectrum of funding options, ranging from grants and loans to public-private partnerships, to ensure sufficient resources are available for implementation. Innovative financing mechanisms, including energy efficiency bonds and carbon financing, can also be explored to attract private investment in energy efficiency projects. By diversifying funding sources and leveraging financial instruments, the Islands can mobilize the necessary resources to drive impactful energy efficiency interventions across sectors.

Tailored Strategies for Sectoral Integration

Given the unique socio-economic and geographical characteristics of Andaman & Nicobar Islands, sector-specific strategies for integration are essential. In sectors such as maritime and fisheries, where reliance on fossil fuels is significant, promoting the adoption of alternative energy sources and implementing energy-efficient practices in vessel operations can yield substantial energy savings. In the building sector, emphasizing energy-efficient design standards and promoting renewable energy integration can enhance sustainability in the urban and rural landscapes.

In conclusion, the successful implementation of the State Energy Efficiency Action Plan for Andaman & Nicobar Islands hinges on concerted efforts, collaboration, and resource mobilization. By establishing a collaborative task force, securing adequate funding, and tailoring strategies to sectoral needs, the union territory can accelerate progress towards its energy efficiency goals. Through these proactive measures, Andaman & Nicobar Islands can not only achieve its energy efficiency targets but also contribute to a more sustainable and resilient future for generations to come.

13 REFERENCES

[1] a) Central Electricity Authority of India- General Review Report 2015-2020 (Electricity data)
b) Ministry of Petroleum and Natural Gas - Indian PNG Statistics Report 2015-2020 (Oil data)

[2] RBI- Handbook of Statistics on Indian States- Gross State Domestic Product (Constant Prices) from 2015 to 2022

[3] Socio-Economic Survey, Andaman & Nicobar Islands

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

[5] United Nations Industrial Development Organization (UNIDO)

Promoting energy efficiency and renewable energy in selected micro, small and medium enterprises (MSME) clusters in India

https://isid4india.org/promoting-energy.php

[6] E-AMRIT, NITI Aayog, Govt of India- Benefits of Electric Vehicles

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

[7] Vahan Dashboard – Statewise vehicles data as on FY 2021

[8] BEE Eco Niwas Samitha- Star Label for Energy Efficiency Homes

https://econiwas.beeindia.gov.in/star-label-foree-homes.php

[9] BSES Rajdhani Power Limited (BRPL) website

[10] Impact of Energy Efficiency Measures for The Year 2021-22- Bureau of Energy Efficiency

[11] Impact of Energy Efficiency Measures for The Year 2020-21- Bureau of Energy Efficiency

[12] Urban Population- Census of India 2011

[13] BEE 5 star rated Super Energy Efficient Fan Replacement Scheme- BSES Rajdjani Power Limited (BRPL)

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

[14] Energy Efficient Air Conditioners in India by BEE and CLASP

https://www.clasp.ngo/updates/increasing-access-to-air-conditioners-in-a-heating-india/

☆☆☆

Bureau of Energy Efficiency

Ministry of Power, Govt. of India 4th Floor, Sewa Bhawan, R. K. Puram, New Delhi - 110066 (INDIA) T: +91 11 26766700 | F : +91 11 26178352 Email: admin@beenet.in | www.beeindia.gov.in