**THE ADMINISTRATION OF UNION TERRITORY OF LADAKH**

OFFICE OF THE CHIEF ENGINEER DISTRIBUTION, PDD

LADAKH (Kargil)

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## Notice

**Subject: Notice inviting comments of the stakeholders on the draft State Energy Efficiency Action Plan (SEEAP) for Union Territory of Ladakh**

This is in line with the validation workshop for Draft State Energy Efficiency Action Plan held on 12th June 2023 at the Conference Hall of the DC Office in Leh, under the Chairmanship of Sh. Ravinder Kumar, IAS, Secretary Power, Ladakh Administration, wherein stakeholders from different departments participated in the validation of State Energy Efficiency Action Plan developed for UT Ladakh.

Accordingly, the draft State Energy Efficiency Action Plan is hereby uploaded on the official website of the Administration of Union Territory of Ladakh (ladakh.nic.in) and Ladakh Power Development Department official website (lpdd.ladakh.gov.in)

Objections/ Comments/ Observations if any, are hereby invited from all the stakeholders within a period of 21 days from the date of issuance of the publication of the draft document and may be sent through e-mail at cepdladakh@gmail.com / cepdd-kgl@ladakh.gov.in or by post at the following address: Office of Chief Engineer Distribution/Generation, PDD Complex Choglamsar, Leh 194101.

(Er. Tsewang Paljor)
**Chief Engineer**
**Distribution, LPDD**
**UT Ladakh**

No: CE/PDD/T 1405-14
Dated: 27 / 06/2023

**Copy to, The:**

1. All Administrative Secretaries/ ADGP, UT of Ladakh for information.
2. Deputy Commissioner/CEO LAHDC Leh and Kargil for information.
3. All Directors/HODs/Chief Engineers/ Registrar UoL, Ladakh for information.
4. Joint Director, Information Department, UT Ladakh for information and with the request to give wide publicity of the same through print and electronic media.
5. Technical Director, NIC Ladakh for information and with the request to upload the document of the above-mentioned websites.
6. Superintending Engineer, Distribution Circle LPDD for information and n/a.
7. All Executive Engineer LPDD for information and n/a.
8. OSD to Secretary Power and NRE, UT Ladakh for information of Secretary.
9. File Record.

MINISTRY OF POWER
GOVERNMENT OF INDIA

LADAKH POWER DEVELOPMENT DEPARTMENT

# STATE ENERGY EFFICIENCY ACTION PLAN (SEEAP)

## LADAKH - DRAFT ACTION PLAN



JUNE 2023

# ACKNOWLEDGEMENT

On behalf of the entire team at ASSOCHAM, I would like to express our gratitude to Sh. Ravinder Kumar, IAS, Secretary (Power), UT Administration, Ladakh, for his support and encouragement in development of State Energy Efficiency Action Plan.

We would also like to thank Sh. Abhay Bakre, Director General, and Sh. R K Rai, Secretary, Bureau of Energy Efficiency for entrusting our team and for their constant steering support in the said assignment. The guidance from Sh. Arijit Sengupta, Director, Bureau of Energy Efficiency on various aspects of this report have been valuable. We are thankful for his continuous guidance and support.

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We would like to express our sincere gratitude for the constant guidance and valuable suggestions given by Sh. Tsewang Paljor, Chief Engineer, and Sh. Stanzin Dodjoo, Technical Officer from Power Development Department (PDD), Ladakh.

The efforts of the team at Bureau of Energy Efficiency, including but not limited to Sh. Abhishek Sharma, Joint Director, Sh. Manish Kumar, Project Engineer, Sh. Vikas Jha, Project Engineer and Sh. Gautam Anand, Project Engineer have been commendable. Their prompt response to all our queries and the support rendered to us from time to time has helped us immensely in laying a solid foundation of the project.

The stakeholder departments, the head of departments, and various nominated officers have played a key role in assessing policy frameworks and the data thereof. Though it is difficult to individually name all senior officers from stakeholder departments, we are indebted to all the stakeholders.

Last but not the least I would like to acknowledge the efforts of my colleagues at ASSOCHAM, their constant hard work has constantly contributed to the development of this report.
Yours Sincerely,

**Neeraj Arora**
Assistant Secretary General
ASSOCHAM, New Delhi
www.assocham.org

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# Abbreviations

**AAGR -** Average Annual Growth Rate

**ASSOCHAM** - The Associated Chambers of Commerce and Industry of India

**AgDSM** - Agriculture Demand Side Management

**AMRUT** – Atal Mission for Rejuvenation and Urban Transformation

**BEE** - Bureau of Energy Efficiency

**BLDC** - Brushless Direct Current

**CAGR** - Compound Annual Growth Rate

**CEA-** Central Electricity Authority of India

**DISCOM** - Distribution Company

**DSM** - Demand Side Management

**ECBC** - Energy Conservation Building Code

**ECSBC** – Energy Conservation & Sustainable Building Code

**EE** - Energy Efficiency

**EESL** - Energy Efficiency Services Limited

**EIA** - Energy Information Agency

**ENS** – Eco Niwas Samhita

**ESCO-** Energy service companies

**FY** - Financial Year

**GSDP** - Gross State Domestic Product

**KUSUM** - Kisan Urja Suraksha Evam Utthaan Mahabhiyan

**HRIDAY** – Heritage City Development & Augmentation Yojana

**LPDD –** Ladakh Power Development Department

**MEEP** – Municipal Energy Efficiency Programme

**LED** - Light Emitting Diode

**MNRE** - Ministry of New and Renewable Energy

**MOSPI** - Ministry of Statistics and Programme Implementation

**Mtoe** - Million Tonne of Oil Equivalent

**MU** - Million Unit of Electricity (in kWh)

**MuDSM** - Municipal Demand Side Management

**NEMMP** - National Electric Mobility Mission Plan

**NHPC** - National Hydroelectric Power Corporation

**NMEEE** - National Mission on Enhanced Energy Efficiency

**PMKSY** - Pradhan Mantri Krishi Sinchai Yojana

**RBI –** Reserve Bank of India

**SLNP** – Street Light National Programme

**SEEAP** - State Energy Efficiency Action Plan

**SEEI** - State Energy Efficiency Index

**UNNATEE** - Unlocking National Energy Efficiency Potential

# Executive Summary

Increasing energy demand naturally strains the country's resources and impacts the environment. This warrants decoupling the country's economic growth and energy demand. This is also echoed through India's Intended Nationally Determined Contribution submitted in the run-up to the Paris Climate Conference, where the government has highlighted energy conservation as a key mitigation strategy. The Government of India in the 26$^{th}$ session of the Conference of the Parties (COP26) to the United Nations Framework Convention on Climate Change (UNFCCC) held in Glasgow, United Kingdom in 2021, presented the five nectar elements (Panchamrit) of India's climate action including the target of net-zero emissions by 2070 and get 50% of its energy from renewable resources by 2030.

In meeting the national level targets, States play a vital role in transitions to low-carbon development pathways. Bureau of Energy Efficiency under the guidance of Ministry of Power developed state specific energy efficiency action plan to ensure that the allocation of resources is as per the requirement of State that will help in meeting state-specific goals on sustainable development.

The State Energy Efficiency Action Plan for a particular State developed by identifying focus sectors of the State and estimate the potential of energy conservation in sectors which are predominant in the region. The State Energy Efficiency Action Plan is developed for short term-plan for a tenure of 5 years and a long-term plan targeting high-impact energy efficiency by the year 2030.

For the UT of Ladakh, SEEAP was developed under the guidelines of Bureau of Energy Efficiency, Ministry of Power, GOI and Ladakh Power Development Department (LPDD) and inputs & suggestions from various government departments and sector experts were considered. The objective of the State Energy Efficiency Action Plan is to arrive at sector-specific approaches for energy efficiency for the UT of Ladakh.

In FY 2021, Ladakh has total final energy consumption (TFEC) 0.099 Mtoe in which oil consumption is accounted for 87.5%, followed by electricity utilities consumption of 12.5% and the firewood which is 0.1%.

Based on energy consumption and economic growth of UT total final energy consumption of UT is projected and it is estimated that TFEC of Ladakh in FY 2030 will be 0.348 Mtoe. On the basis of projected GSDP of the state and projected energy consumption, Transport, Building and Industries sectors were identified as focus sectors and sector specific strategies were analyzed. List of sector specific focused strategies to ensure that the allocation of resources is as per the requirement of the UT is listed below:

**Transport Sector:**

- Infrastructure development for EV charging stations and incentives to consumers for quick transition to EVs.
- Ethanol Blending program
- Promotion of Standard and Labelling program of Tyres for Fuel Efficiency in Vehicles

**Buildings Sector:**

- Effective Implementation of Energy Conservation & Sustainable Building Code (ECSBC)
- Replacement program for inefficient appliances
- BEE Star Rating and Shunya Rating of Buildings
- Promotion of Geothermal Heating system in the Buildings.

**Industry Sector:**

- Energy Efficiency Intervention in MSME clusters

This action plan will result in a total energy consumption reduction of 0.049 Mtoe in the moderate scenario and 0.093 Mtoe in the ambitious scenario in the FY 2030. This plan will also create awareness at the mass level and create a market potential of approximate rupees 171 Crore in the field of energy efficiency and reduce the CO2 emission 0.155 $MtCO_2$ in moderate scenario and 0.290 $MtCO_2$ in ambitious scenario by FY 2030.

# 1. Introduction

## 1.1. Background

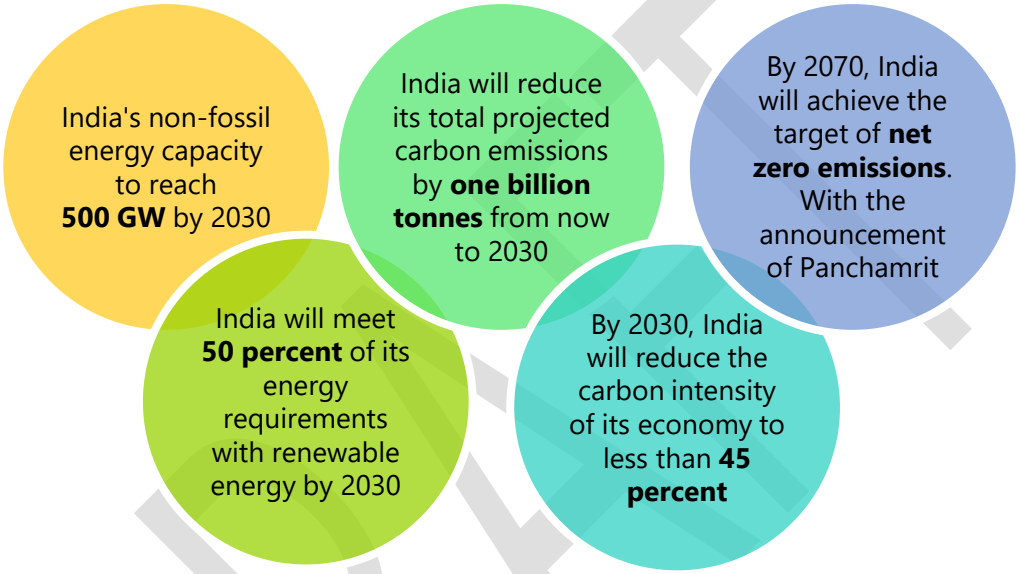
India's economy is characterized by an emerging and developing market. In 2019, India became the fifth-largest economy in the world in nominal terms, surpassing United Kingdom and behind the United States, China, Japan and Germany. The size of the Indian economy in Fiscal Year (FY) 2020 was estimated to be INR 145 Lakh Crores at constant prices of 2011-12. With the growth of the Indian economy, the demand for energy has increased significantly, resulting in high energy levels in some sectors and increase in the country's emissions.

As per International Energy Agency's (IEA) World Energy Outlook 2021 report, India currently has a share of 6.1% in the global primary energy consumption, which is projected to increase to 9.8% by the year 2050. India's Final Energy Consumption in FY 2020 was recorded at 533.44 MTOE (as per Domestic Conversion Factors) with coal and crude oil being the largest contributors to the total energy consumption. India's per capita energy consumption and per capita emissions are well below the global average per capita emissions. However, India continuously taking steps to reduce the energy consumption and emissions and ensure sustainable growth of nation.

India has set ambitious economic goals for the future and achieving these goals is expected to result in significant increase in the country's energy demand and emissions. In view of this, India has also set ambitious goals for energy and climate performance. The country has also emphasized on the importance of energy transition towards decarbonization of the economy and has recently emerged as one of the world leaders in Energy Transition. States and Union Territories of the country have a key role to play in the fulfilment of these goals. The key strategy adopted by the Government of India is the efficient use of energy resources and their conservation. This is essential since the efficient use of energy and its conservation is the least-cost option to meet the increasing energy demand, reduce wasteful consumption and in leading the country's economic growth in sustainable manner.

## 1.2. India's Nationally Determined Contributions (NDCs)

In the 2016 Paris Climate Conference, India in its Nationally Determined Contributions (NDCs) had committed that it will reduce the emission intensity of its GDP by 33% to 35% by 2030 from 2005 level. In the recent Conference of Parties (COP -26) at Glasgow, UK, India announced the Panchamrit, which lists down five ambitions:




India's earlier target of 33% to 35% reduction in emission intensity from 2005 level by 2030 has been revised to approximately 45%. In view of the enhanced target under Panchamrit, India's energy efficiency efforts need to be increased and States have a vital role in India's energy efficiency policy implementation and in meeting state-specific goals on sustainable development in the most energy-efficient way. It is imperative that the States actively participate in the schemes to facilitate the achievement of the overall goal of reducing the energy intensity of the country.

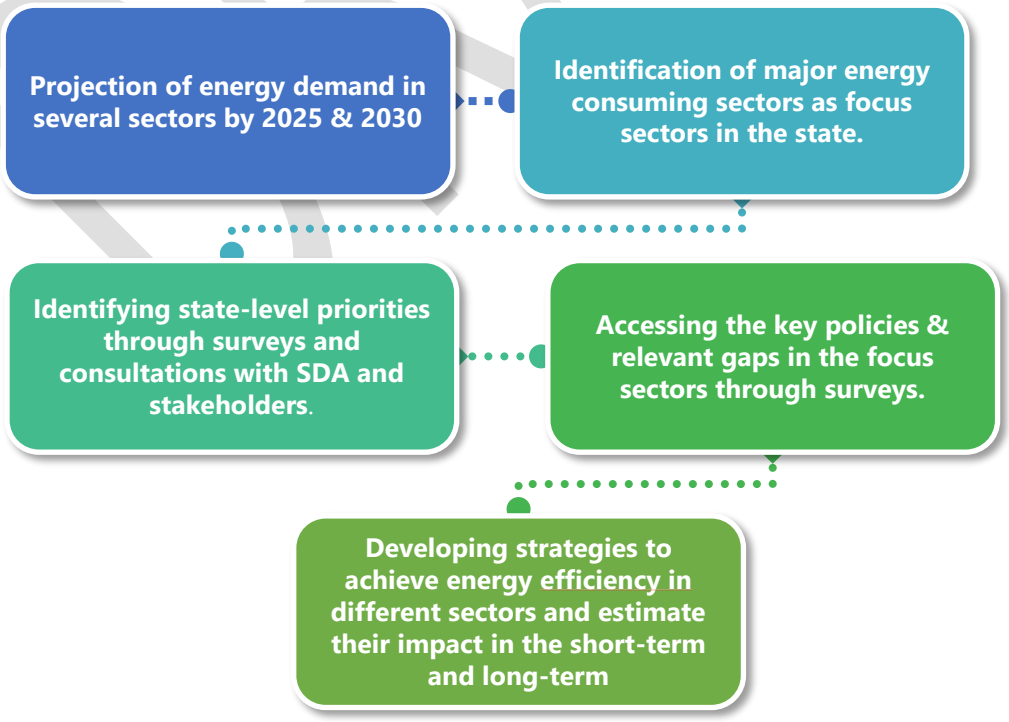
On 1st November 2021, during the 26th United Nations Climate Change Conference of the Parties (COP26) in Glasgow, Prime Minister Narendra Modi introduced the idea of 'Lifestyle for the Environment (LiFE)'. He urged individuals and institutions across the world to support LiFE as a global movement, aimed at promoting mindful and deliberate utilization instead of mindless and destructive

consumption to safeguard the environment. This means making choices that are better for the environment, such as using renewable energy sources, reducing waste, and conserving resources. The program aims to teach people about the impact their daily actions have on the environment and provide them with the tools and resources they need to adopt more eco-friendly practices.

## 1.3. About SEEAP

The State Energy Efficiency Action Plan for UT of Ladakh is being developed by identification of focus sectors, to ensure that the allocation of resources is as per the requirement of Ladakh and estimate the potential of energy conservation in sectors that are predominant in Ladakh. The State Energy Efficiency Action Plan has been developed 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 FY 2031 to achieve the targets committed in COP-26. This State Energy Efficiency Action Plan has been developed under the guidance and support of stakeholder departments/agencies of Ladakh and will be implemented by them in the UT after its adoption.

**Expected Outcomes of State Energy Efficiency Action Plan (SEEAP)**



## 1.4. Union Territory Profile

The UT of Ladakh shares its borders with the Tibet Autonomous Region to the east and Jammu and Kashmir, Pakistan and Afghanistan on the west. South part is connected with Himachal Pradesh. Ladakh became a Union Territory on 31st of October 2019. Ladakh is renowned for its remote mountain beauty and distinct culture.


**Figure 1**: Map of UT of Jammu & Kashmir and UT of Ladakh[1]

Ladakh is famous for its scenery, views, and travel-trekking, which provides Ladakh a destination of summer vacation to the people across the globe. The hospitality industry of Ladakh is the major revenue making segment where the livelihood is generated for the local population. It has a very tough terrain due to its high altitude and extremely cold climate. Drass, located in district Kargil has recorded the second lowest (coldest) temperature in the world after Siberia. After the restructuring of the State of Jammu and Kashmir, Ladakh has been identified as a Union Territory from the year 2019. Since 2019, a sharp growth has been recorded in terms of development and number of tourists. In the year 2023, it is expected to have record number of tourists in the season.

[1] https://pib.gov.in/PressReleasePage.aspx?PRID=1590112

**Table 1:** Basic Statistics of Ladakh[2]

| S. NO. | PARTICULARS | UNIT | NUMBER |
|---|---|---|---|
| **1** | No. of Districts | Number | 2 |
| **2** | Tehsils | Number | 15 |
| **3** | (Population 2011) | | |
| | Total Population | Lakhs | 2.74 |
| | Rural Population | | 2.12 |
| **4** | % of Rural to Total Population | % | 77% |
| **5** | Municipal Corporations | Number | 2 |
| **6** | Municipal Committees | Number | 13 |
| **7** | % of Urban to Total Population | % | 23% |
| **8** | Population Density | People Per Sq. Km | 4.6 |

**Table 2**: Basic Statistics of Districts (Kargil and Leh)

| S.NO. | PARTICULARS | KARGIL | LEH |
|---|---|---|---|
| **1** | Total Population (in Lakhs) 2011 Census | 1.40 | 1.34 |
| | Rural Population (in Lakhs) 2011 Census | 1.24 | 0.88 |
| | % Of Rural to Total Population | 86% | 66% |
| **2** | Population Density | 10 person/sq.km | 3 person/sqkm |
| **3** | Households | 18,338 | 21,909 |
| **4** | Avg. Household Size | 7.6 | 7.6 |
| **5** | Irrigated Land Area | 11,754 Hect. | 10,358 Hect. |
| **6** | Installed DG Set Capacity (2021) | 2.06 MW | 12.92 MW |
| **7** | DISCOM | Power Development Department, Ladakh | |

## 1.5. Union Territory Energy Scenario

Ladakh is endowed with abundant natural resources that have the potential to provide ample energy to the UT. The UT's energy mix is a majorly renewable source of energy contributing to its overall energy supply. An overview of the UT

[2] Statistical Handbook – Kargil & Leh

energy scenario of Ladakh is divided in different sources. Ladakh has seen strong growth in power demand in the past decade. It has several small hydroelectric power plants (<25 MW) and DG based energy generation. Based on the below table, it can be observed that the generation is increasing significantly as compared to the previous years.

There are mini hydro power plants being managed by PDD Generation Wing, Ladakh and a few mini hydro power plants are being managed by NHPC, which is further taken care by PDD at the distribution side. The below table depicts the capacity and design parameters of all the installed hydroelectric power plants:

## Generation Statistics: Hydro Power Plants

**Table 3:** Total Hydro Power Plants in Ladakh

| S.NO. | NAME OF HEP | COD | INSTALLED CAPACITY | DESIGN ENERGY |
|---|---|---|---|---|
| 1 | Iqbal, Kargil | 1996 | 3.75 MW | 21.23 MU |
| 2 | Marpochoo, Drass, Kargil | 2006 | 0.75 MW | 3.79 MU |
| 3 | Haftal Zanskar, Kargil | 2007 | 1.0 MW | 4.88 MU |
| 4 | Sanjak, Shakar-Chiktan, Kargil | 2012 | 1.26 MW | 4.46 MU |
| 5 | Igo Mercellong, Leh | 1986 | 3 MW | 15.88 MU |
| 6 | Hunder, Leh | 2005 | 0.4 MW | 1.77 MU |
| 7 | Basgo, Leh | 1994 | 0.3 MW | 1.09 MU |
| 8 | Sumoor, Leh | 1995 | 0.1 MW | 0.45 MU |
| 9 | Nimoo Basgo, Leh | 2013 | 45 MW | 239.33 MU |
| 10 | Chutak, Kargil | 2013 | 44 MW | 212.93 MU |

Small hydro power plants have high conversion efficiency, cost competitive renewable energy source. It has advantage of low operating cost alongside. Total recorded generation from above power plants is given below:[3]

[3] Data available with Power Development Department, Ladakh

**Table 4**: Electricity Generation from Individual Plants

| | | FY 2018 | FY 2019 | FY 2020 | FY 2021 |
|---|---|---|---|---|---|
| **S.No.** | NAME OF HEP | Gross (MU) | Gross (MU) | Gross (MU) | Gross (MU) |
| **1** | Iqbal | 4.79 | 4.71 | 3.81 | 1.95 |
| **2** | Marpochoo | 0.72 | 0.32 | 0.24 | 0.24 |
| **3** | Haftal | 0.72 | 0.68 | 0.89 | 0.82 |
| **4** | Sanjak Shakar | 0.50 | 0.16 | 0.33 | 0.56 |
| **5** | Igo Mercellong | 2.77 | 1.54 | 1.68 | 3.99 |
| **6** | Hunder | 0.59 | 0.51 | 0.48 | 0.37 |
| **7** | Basgo | 0.10 | 0.32 | 0.36 | 0.29 |
| **8** | Sumoor | 0.06 | 0.08 | 0.09 | 0.11 |
| **Sub Total** | | 10.25 | 8.33 | 7.88 | 8.33 |
| **9** | 3x15 MW Nimoo Bazgo | Unavailable | Unavailable | 163.40 | 202.5 |
| **10** | 4x11 MW Chutak | Unavailable | Unavailable | 50.70 | 121.0 |
| **DG Set** | | 5.30 | 6.10 | 5.70 | 8.50 |
| **Total Generation** | | | | 227.68 | 340.33 |

## Generation Statistics: DG Sets

Hydro-electric power plants are the major source of electricity in Ladakh. Except HSD Set consumption, there are neither coal-based power plants nor natural gas-based power plants to generate the electricity. Even the HSD consumption in DG Sets is decreasing every year and the goal is to use it as emergency backups only and not as primary energy generating plants. A drop of 6% energy generation from DG Sets has been noticed.[4]

The total generation is led by various sources including UT based hydro plants, Independent Power Producers (IPPs), Open Access (OA), Renewable Energy Sources (RES) and imported energy (from Jammu and Kashmir) etc. Number of DG Sets as on Dec 2021:

[4] Data available with PDD, Ladakh

**Table 5:** Details of DG Set

| | KARGIL | LEH | TOTAL |
|---|---|---|---|
| **Number of DG Sets** | 13 | 40 | 53 |
| **Capacity** | 3.64 MVA | 5.9 MVA | 9.54 MVA |

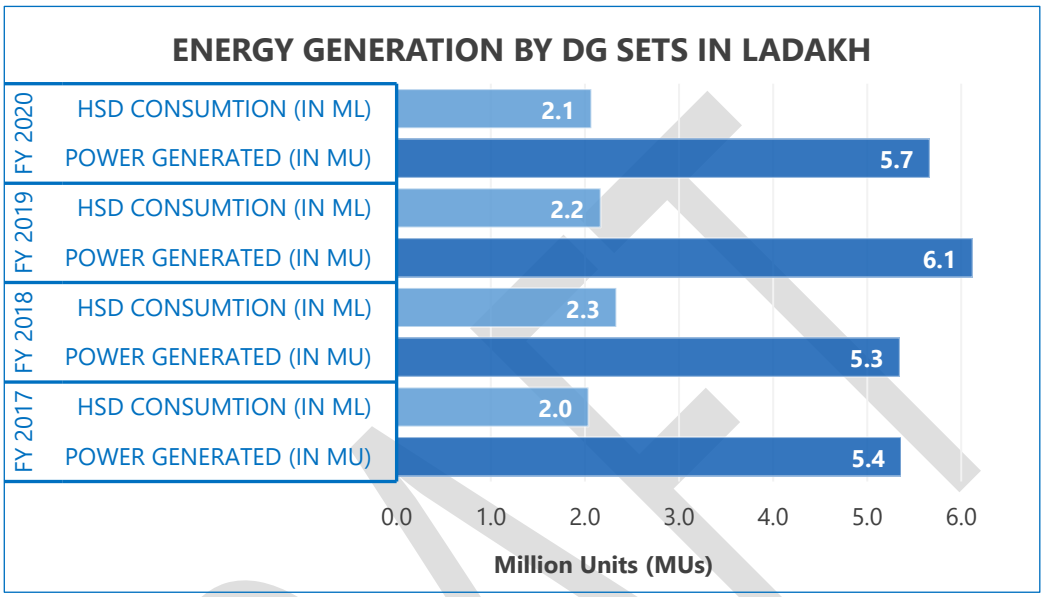



**Figure 2:** Energy Generation by DG Sets in Ladakh

As per the above chart it is observed that the energy generation from DG Set is decreasing gradually from year 2018 onwards.[5] After the formation of Union Territory, and based on the information, DG Sets are now being phased out progressively. Many years before, rebates were given to install the DG set due to unavailability of power at very difficult terrains, however the same is now being discouraged and it is planned to phase out DGs in near future. It is expected that in next two years, the DG sets will be completely phased out.[6] Additionally, DG Sets are being used as a backup in many government and private building. National grid Nubra / Zanskar: RECPDCL (RECTPCL) is implementing the 220 KV Nubra Zanskar transmission Line and expected to be completed by October 2023.

[5] Data available with Power Development Department, Ladakh
[6]https://www.thehindubusinessline.com/business-tech/ladakh-to-switch-off-diesel-generators/article36683360.ece

Additionally, Central Government has cleared eight hydropower projects of 144 MW on the Indus river. These projects will come in Kargil and Leh districts of Ladakh. Some plants will be developed by KREDA which are listed below:

**Table 6:** Overall Power Plants

| **NHPC** | | | |
|---|---|---|---|
| **Sr. No.** | **Powerplant Name** | **Type of PP** | **MW** |
| 1 | Nimoo Basgo, Leh | Small Hydel | 45 |
| 2 | Chutuk,Kargil | Small Hydel | 44 |
| **PDD** | | | |
| **Sr. No.** | **Powerplant Name** | **Type of PP** | **MW** |
| 1 | Igo Martselong, Leh | Small Hydel | 3.00 |
| 2 | Basgo, Leh | Small Hydel | 0.30 |
| 3 | Hunder,Leh | Small Hydel | 0.40 |
| 4 | Summer, Leh | Small Hydel | 0.10 |
| 5 | Iqbal, Kargil | Small Hydel | 3.75 |
| 6 | Sanjak,Kargil | Small Hydel | 1.26 |
| 7 | Haftal, Kargil | Small Hydel | 1.00 |
| 8 | Marpachoo, Kargil | Small Hydel | 0.75 |
| 9 | DG Genset, Leh | HSD | 5.90 |
| 10 | DG Genset, Kargil | HSD | 3.63 |
| **KREDA** | | | |
| **Sr. No.** | **Powerplant Name** | **Type of PP** | **MW** |
| 1 | Bairas | Small Hydel | 1.50 |
| 2 | Chilong | Small Hydel | 1.00 |
| 3 | Sangrah | Small Hydel | 1.50 |
| 4 | Matayen | Small Hydel | 0.55 |
| 5 | Ladakh Renewable Energy Initiative (LREI) | SPV | 0.16 |
| 6 | Ladakh Renewable Energy Initiative (LREI) | SPV | 0.08 |
| 7 | Ladakh Renewable Energy Initiative (LREI) | SPV | 0.23 |
| 8 | Ladakh Renewable Energy Initiative (LREI) | SPV | 0.24 |
| 9 | Ladakh Renewable Energy Initiative (LREI) | SPV | 0.17 |
| 10 | Ladakh Renewable Energy Initiative (LREI) | SPV | 0.12 |
| 11 | Ladakh Renewable Energy Initiative (LREI) | SPV | 0.20 |
| 12 | University of Ladakh Funded (UOL) | SPV | 0.10 |
| 13 | University of Ladakh Funded (UOL) | SPV | 0.10 |
| 14 | Model Degree College Zanskar funded (MDCZ) | SPV | 0.03 |
| 15 | Employment Office (EMP) | SPV | 0.01 |
| 16 | Fisheries | SPV | 0.02 |
| 17 | Others | SPV | 0.67 |
| **LREDA** | | | |
| **Sr. No.** | **Powerplant Name** | **Type of PP** | **MW** |
| 1 | Cumulative | Small Hydel | 1.55 |
| 2 | Cumulative | SPV | 1.40 |

## Renewable Energy

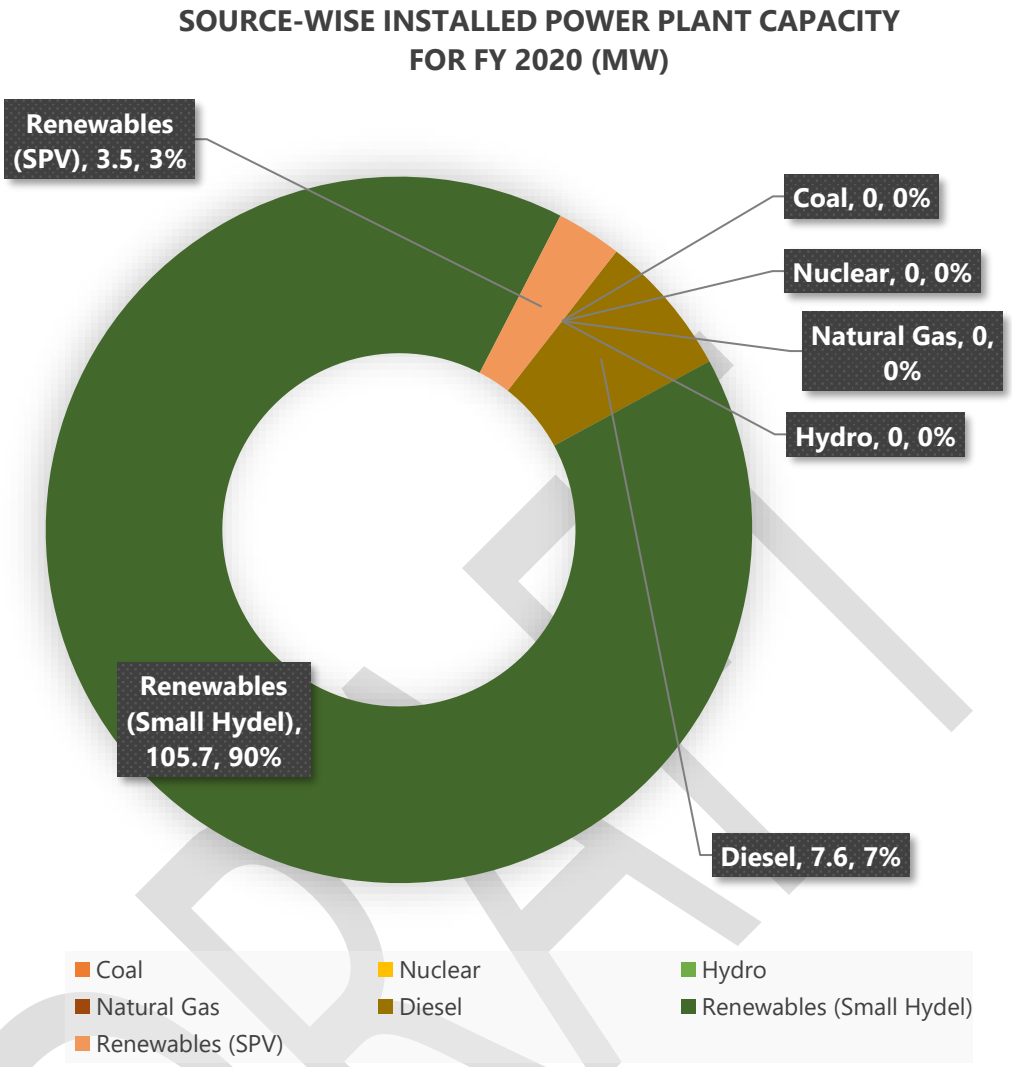



**Figure 3:** Source-Wise Installed Power Plant Capacity

## 1.6. Energy Consumption Scenario (TFEC)

**Table 7:** Primary Energy Usage in Ladakh

| Primary Energy Supply (TOE) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Primary Energy Sources** | **FY2015** | **FY2016** | **FY2017** | **FY2018** | **FY2019** | **FY2020** | **FY2021** |
| Coal (Total) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coal (Industries) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oil | 62,911 | 72,442 | 75,362 | 82,725 | 87,673 | 89,059 | 86,269 |
| Firewood | - | 827 | 563 | 383 | 200 | 214 | 96 |
| **TOTAL PRIMARY (TOE)** | **62,911** | **73,269** | **75,925** | **83,107** | **87,872** | **89,272** | **86,364** |

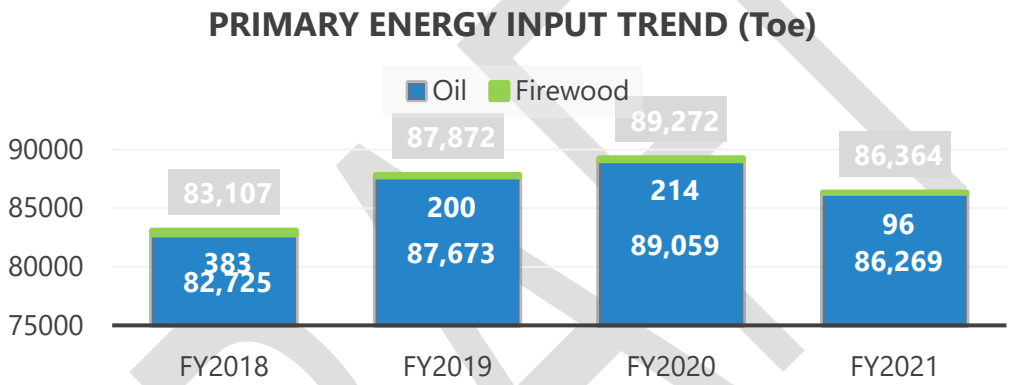



**Figure 4:** Primary Energy Input Trend (Toe)

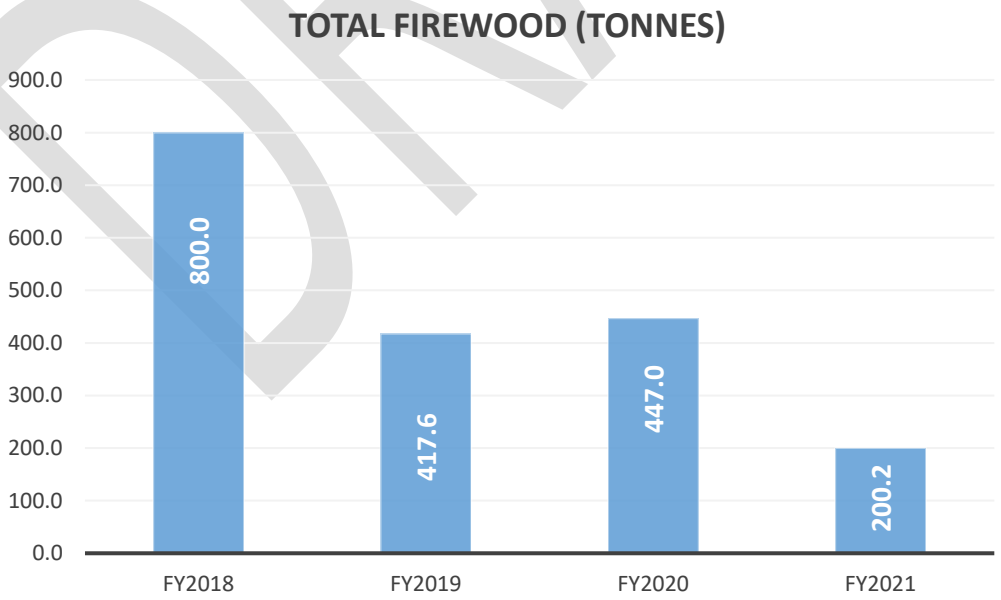
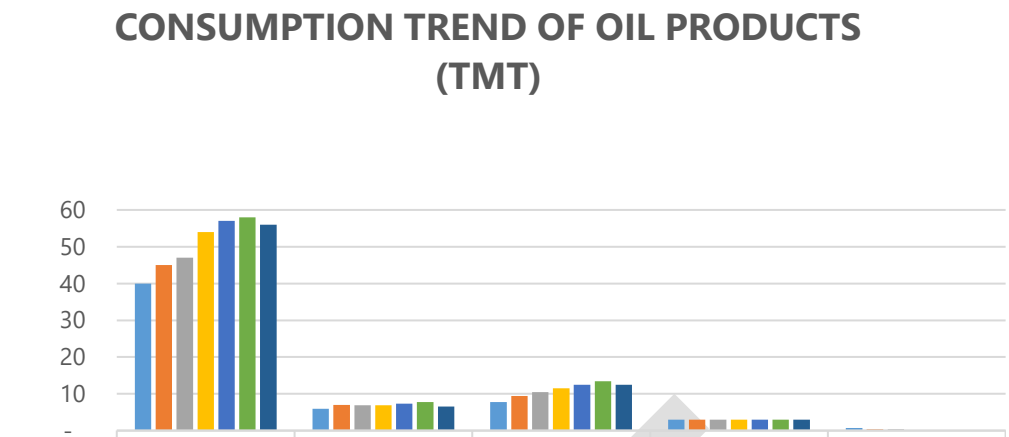



**Figure 5:** Firewood Consumption in UT of Ladakh




| | High Speed Diesel | LPG | MS (Petrol) | Kerosene | Light Diesel Oil |
|---|---|---|---|---|---|
| FY2015 | 40 | 6 | 8 | 3 | 1 |
| FY2016 | 45 | 7 | 9 | 3 | 0 |
| FY2017 | 47 | 7 | 11 | 3 | 0 |
| FY2018 | 54 | 7 | 12 | 3 | 0 |
| FY2019 | 57 | 7 | 13 | 3 | 0 |
| FY2020 | 58 | 8 | 13 | 3 | 0 |
| FY2021 | 56 | 7 | 13 | 3 | 0 |

**Figure 6:** Oil Consumption Trend in Ladakh

**Electricity Consumption:** Electricity production and distribution is challenging in Ladakh due to its high altitude terrain. Inadequate T&D network, huge transmission losses, low power tariff, and low electricity generation during winters where water stream discharge is little, is being the major challenge to supply the electricity across the UT. Further, post reorganization of Jammu & Kashmir State, Ladakh is going through a major development due to heavy investments by Central Government and private players. To mitigate such surge in demand, new power plants are also under consideration by the governments at respective levels. To further understand its distribution, DISCOM of Ladakh has monitored the data as per the sectors, such as, domestic buildings (residential), commercial (including government buildings, private buildings and metered energy consumed by defense agencies), industries, municipal usage, agriculture and transport. In the below chart, the sector wise electricity usage share is shown for Leh and Kargil separately, which represents that the domestic sub sector of the buildings dominates to all other sectors in UT.

**Table 8:** Electricity Usage Distribution across the sectors for Leh

| **Sectors** | 2015-16 | 2016-17 | 2017-18 | 2018-19 | 2019-20 | 2020-21 | 2021-22 |
|---|---|---|---|---|---|---|---|
| Domestic | 23.6% | 22.4% | 20.5% | 21.7% | 23.0% | 37.9% | 58.5% |
| Commercial + Defense | 69.0% | 71.4% | 73.1% | 71.3% | 69.9% | 56.8% | 37.9% |
| Industry | 2.8% | 2.5% | 2.8% | 3.3% | 2.9% | 2.1% | 1.7% |
| Municipal | 4.6% | 3.7% | 3.6% | 3.6% | 4.1% | 3.1% | 1.9% |
| Agriculture | 0.0% | 0.0% | 0.1% | 0.1% | 0.0% | 0.0% | 0.0% |

**Table 9:** Electricity Usage Distribution across the sectors for Kargil

| **Sectors** | 2015-16 | 2016-17 | 2017-18 | 2018-19 | 2019-20 | 2020-21 | 2021-22 |
|---|---|---|---|---|---|---|---|
| Domestic | 65.6% | 66.1% | 70.4% | 63.6% | 66.0% | 67.9% | 61.0% |
| Commercial + Defense | 32.5% | 32.5% | 28.0% | 32.2% | 32.6% | 30.8% | 33.6% |
| Industry | 1.5% | 1.1% | 1.3% | 3.8% | 1.0% | 0.8% | 1.3% |
| Municipal | 0.4% | 0.3% | 0.3% | 0.4% | 0.4% | 0.5% | 1.9% |
| Agriculture | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 2.2% |

*Transport sector has not been shown here due to non-availability of EV Policy and no electric vehicles and charging stations have entered into the market.*

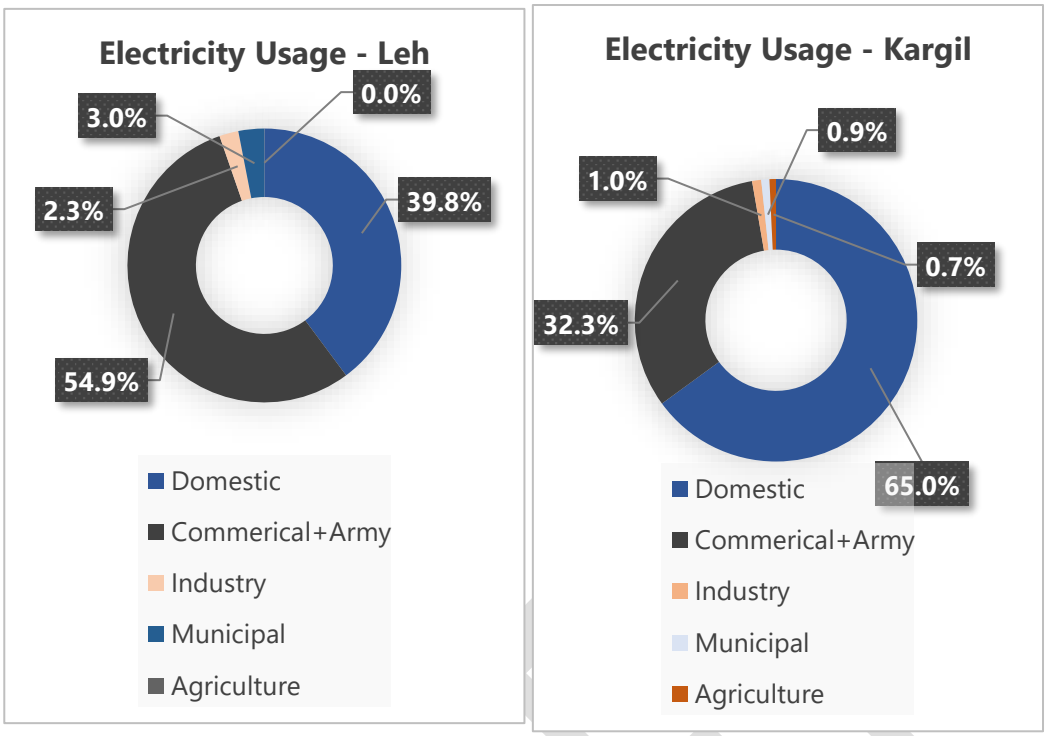



**Figure 8:** Electricity Consumption in Leh and Kargil

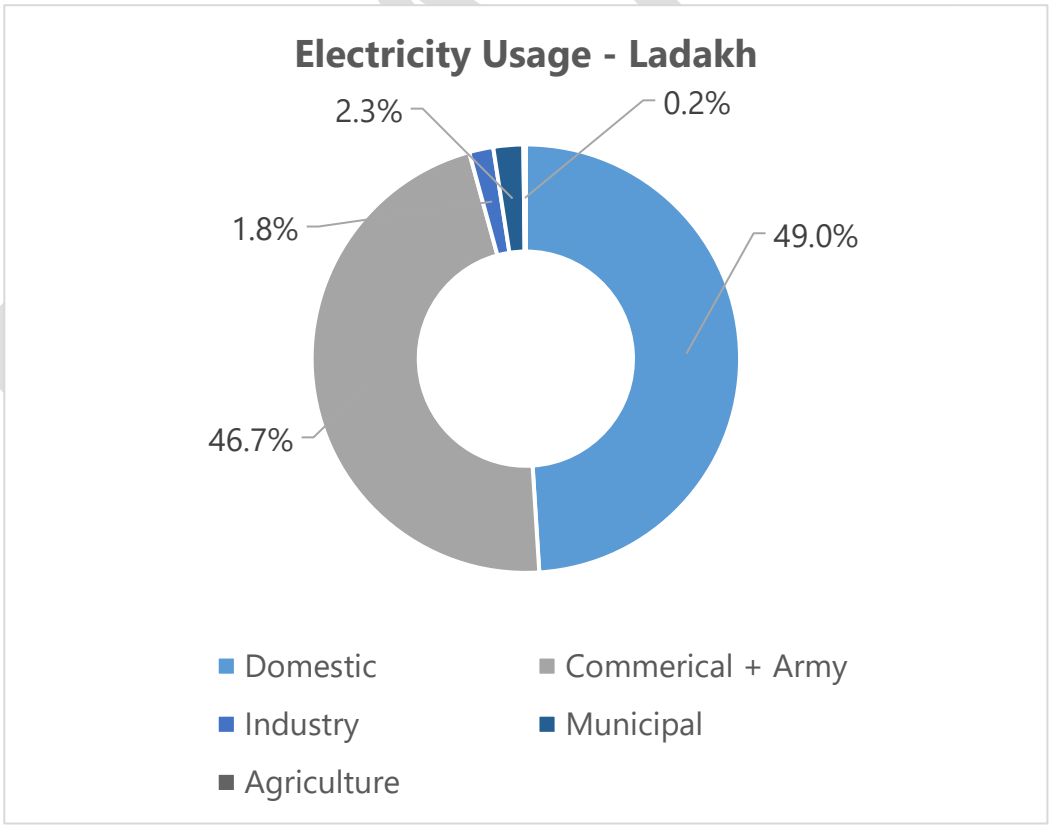



**Figure 7:** Electricity Usage in Ladakh FY 2021

## Renewable Energy

Renewable energy sources are the future for Ladakh in terms of its power and energy needs. In Ladakh, there is a significant potential for solar, geothermal and wind energy. Mini-hydel generated energy is the backbone of the UT which is supplying more than 75% of energy demand of Ladakh.

Ladakh has ample amount of sun radiation intensity in the country. Along with this, due to the optimum climatic temperature, solar panels also work very efficiently. It is estimated that around 60 GW solar potential is there in Ladakh (35 GW in Leh and 25 GW in Kargil)[7]. Currently the electricity generated from Solar PV is not connected to the grid and is being generated via captive power plants which does not come under the preview of DISCOM. All the Solar Power Projects are installed in off-grid in Kargil and the cumulative generation from the PV Plants installed during the period 2015-22 is around 4.28 Million Units annually[8].

Geothermal power is the energy utilized from the earth crust in the form of heat exchange with water which is further used in the buildings using heat pumps. Geothermal energy is being promoted at large scale. Smaller buildings to district level of geothermal heating systems are being proposed and designed to utilize the ground heat during harsh winters. This helps in avoiding migration during peak cold weather. Centralized geothermal heating system will be the best option for UT to promote development in industrial sector and commercial sector during winters. Government departments are including the geothermal design in the tenders to make it possible for even small projects also. In February 2021, an MoU was signed between Oil and Natural Gas Corporation (ONGC) and the UT administration of Ladakh to develop a geothermal field development project with a power potential of 200 MW.

Green Hydrogen is the another renewable source. In this, hydrogen is created by splitting water using renewable energy and electrolysis. For the transport sector,

[7] Gupta, U. (2020). Ladakh could generate 60 GW from solar plants. PV Magazine [Website].
[8] Information provided by KREDA, Ladakh

hydrogen based vehicles having battery electric vehicles can be a perfect solution in coming future. At the Sonam Norboo Memorial Hospital in Leh, it is expected that 200 kW Green Hydrogen Pilot project is already initiated.[9]

All the renewable projects related monitoring and implementation work, are undertaken by two agencies (LREDA and KREDA). The Ladakh Renewable Energy Development Agency (LREDA) is the nodal agency for implementation in Ladakh of all non-conventional energy programmes of the Ministry of New and Renewable Energy, Government of India. Further, Kargil Renewable Energy Development Agency (KREDA) is the nodal agency for the implementation of renewable energy projects in Kargil, Ladakh.

**Table 10:** List of Renewable Power Plants in Ladakh

| **NHPC** | | | |
|---|---|---|---|
| **Sr. No.** | **Powerplant Name** | **Type of PP** | **MW** |
| 1 | Nimoo Basgo, Leh | Small Hydel | 45 |
| 2 | Chutuk,Kargil | Small Hydel | 44 |
| **PDD** | | | |
| **Sr. No.** | **Powerplant Name** | **Type of PP** | **MW** |
| 1 | Igo Martselong, Leh | Small Hydel | 3.00 |
| 2 | Basgo, Leh | Small Hydel | 0.30 |
| 3 | Hunder,Leh | Small Hydel | 0.40 |
| 4 | Summer, Leh | Small Hydel | 0.10 |
| 5 | Iqbal, Kargil | Small Hydel | 3.75 |
| 6 | Sanjak,Kargil | Small Hydel | 1.26 |
| 7 | Haftal, Kargil | Small Hydel | 1.00 |
| 8 | Marpachoo, Kargil | Small Hydel | 0.75 |
| **KREDA** | | | |
| **Sr. No.** | **Powerplant Name** | **Type of PP** | **MW** |
| 1 | Bairas | Small Hydel | 1.50 |
| 2 | Chilong | Small Hydel | 1.00 |
| 3 | Sangrah | Small Hydel | 1.50 |
| 4 | Matayen | Small Hydel | 0.55 |
| 5 | Ladakh Renewable Energy Initiative (LREI) | SPV | 0.16 |
| 6 | Ladakh Renewable Energy Initiative (LREI) | SPV | 0.08 |

[9] Ladakh, Unleashing Potential by ASSOCHAM and Primus Partners, September 2021

| | | | |
|---|---|---|---|
| 7 | Ladakh Renewable Energy Initiative (LREI) | SPV | 0.23 |
| 8 | Ladakh Renewable Energy Initiative (LREI) | SPV | 0.24 |
| 9 | Ladakh Renewable Energy Initiative (LREI) | SPV | 0.17 |
| 10 | Ladakh Renewable Energy Initiative (LREI) | SPV | 0.12 |
| 11 | Ladakh Renewable Energy Initiative (LREI) | SPV | 0.20 |
| 12 | University of Ladakh Funded (UOL) | SPV | 0.10 |
| 13 | University of Ladakh Funded (UOL) | SPV | 0.10 |
| 14 | Model Degree College Zanskar funded (MDCZ) | SPV | 0.03 |
| 15 | Employment Office (EMP) | SPV | 0.01 |
| 16 | Fisheries | SPV | 0.02 |
| 17 | Others | SPV | 0.67 |
| **LREDA** | | | |
| **Sr. No.** | **Powerplant Name** | **Type of PP** | **MW** |
| 1 | Cumulative | Small Hydel | 1.55 |
| 2 | Cumulative | SPV | 1.40 |

## Overview of Institutional framework and stakeholder mapping

The Energy Conservation (EC) Act of 2001 establishes a legal framework for developing and executing energy efficiency (EE) policies and programmes. The Act authorizes the Bureau of Energy Efficiency (BEE) to develop national policies and programmes, and State Designated Agencies (SDAs) to administer EE programmes and enforce EE norms and regulations at the UT level. The power institutional framework of Ladakh is explained below.

Ladakh region was a part of Jammu and Kashmir state before year 2019. In the year 2019, two independent union territories were formed and Power development department of Ladakh was separated from Jammu Kashmir PDD. Ladakh is one of the highest altitude inhabitations in the world. Due to its difficult terrain, the region is not connected to the central grid and power demand of the area is met by local small Hydel and diesel generators. During winters, generation from hydro projects reduces considerably whereas power demand increases. While in summers, hydel generation is at maximum level whereas demand is generally low. Therefore, to have uninterrupted power supply in and around

Ladakh area, connectivity with Northern Region Grid was envisaged. Moreover, due to presence of defense establishments in the area and its strategic importance, it was felt essential to get connected with rest of the grid.

Subsequent to reorganization of the erstwhile State of Jammu & Kashmir (J&K) into UTs of J&K and Ladakh, Ministry of Power re-designated 220 kV Srinagar-Leh Transmission System as ISTS and has transferred to POWERGRID with effect from 31.10.2019, i.e. effective date of formation of the two UTs of J&K and Ladakh.

Since 2019, the department is functioning as nodal agency/state designated agency for implementation of energy efficiency activities in the UT. Further the agency is working as DISCOM (Distribution) for the UT of Ladakh.

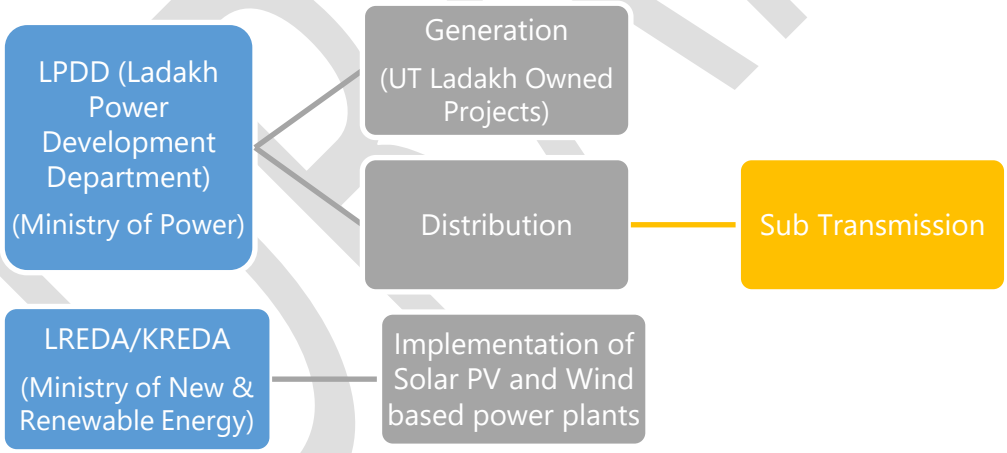



**Figure 9:** Institutional Framework in Ladakh

# 2. Identification of Focus Sectors

The economic sectors of the UT of Ladakh can be broadly classified into the sectors namely Transport, Building Industry, Agriculture, Municipalities and Cross Sectors. These sectors can be further divided into sub-categories, as shown below:

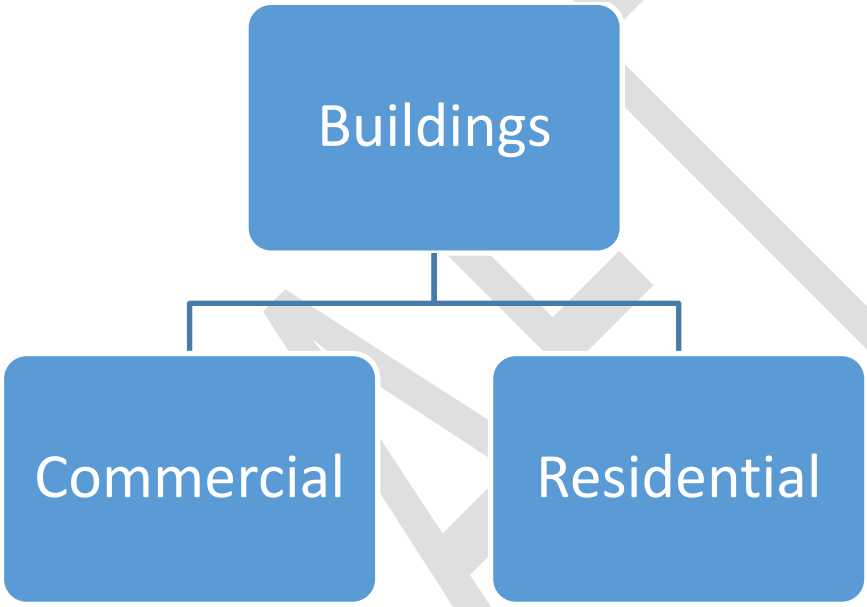



**Figure 10:** Sub-categorization of Ladakh's Building sector

Identification of focus sectors or focus areas is important because it is a general characteristic of UT that a major portion of energy is being consumed by few particular energy-guzzling sectors. Focusing efforts towards these sectors is necessary to ensure that the allocation of resources is as per the UT's priorities and towards sectors that have the highest potential of energy savings and emissions reductions.

## 2.1. Methodology of Focus Sector Identification

The methodology used to determine the focus sectors in the UT of Ladakh includes multiple factors. The first factor is the energy consumption profile of the UT. This information provides a clear understanding of where energy is being

used and which sectors are consuming the most. The analysis reveals that the Transport sector is the largest energy consumer in the UT.

The second factor is the input from stakeholders. Stakeholders include individuals, organizations, and communities that have a vested interest in energy consumption and production in the UT. Their inputs are valuable as they have a direct impact on the sector they represent.

The third factor is priority areas of the UT. Priority areas are determined based on the UT's development goals, energy policies, and future aspirations. These priority areas help in identifying sectors that require immediate attention and support.

After considering these factors, the focus sectors are identified, which are the Transport, Buildings, and Industry sectors. The transport sector is the primary focus as it is the largest energy consumer in the UT. The Building sector is important as it accounts for a significant amount of energy consumption in the domestic and commercial sectors with 37.5% of the total electricity consumption. The Industry sector is also a critical focus as it is one of the largest energy consumer and relies heavily on electricity and oil.

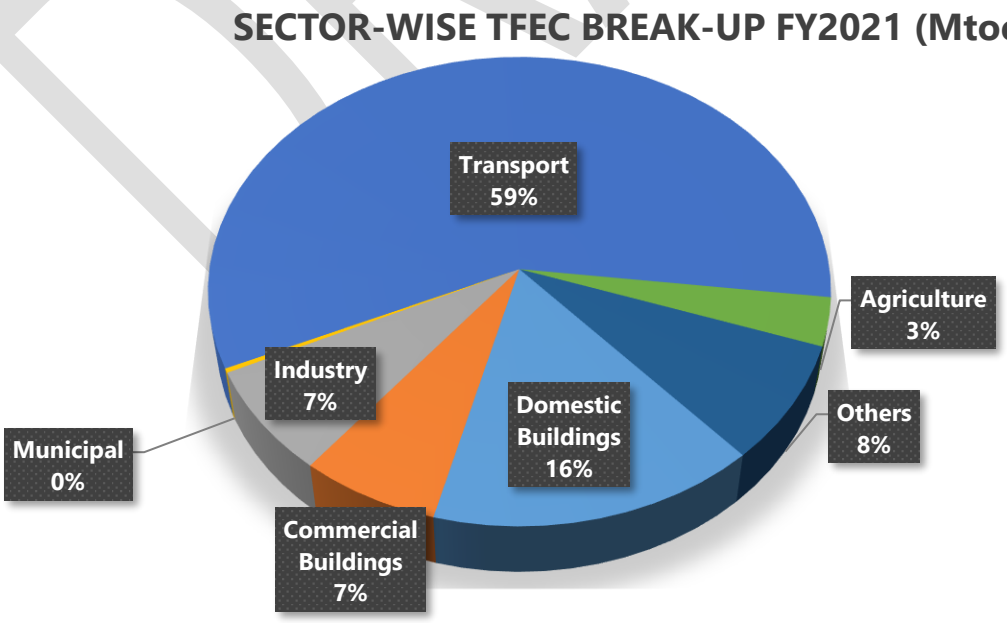



**Figure 11:** Total Final Energy Consumption FY2021 (GWh)

**Source:** PDD, Ladakh and MoPNG

### Stakeholder Consultation

Inputs and suggestions from stakeholders identified for the UT of Ladakh were invited at different stages in the development of the action plan. Feedback and inputs received from stakeholders play a key role in highlighting the areas of focus in their respective sectors going forward and helps understand the implementation of practices and the feasibility of proposed energy efficiency strategies within the sector.

## 2.2. Identified Focus Sectors

Based on the above parameters and other important considerations, the following have been identified as the focus sectors for devising energy efficiency strategies in the UT of Ladakh.


Total Final Energy Consumption (TFEC) of the focus sectors Transport, Buildings and Industry is contributing major portion of the total energy consumption in the UT of Ladakh for FY 2021.

# 3. Projections and Forecasting

Economic and energy projections for the UT of Ladakh to the target year FY 2031 are performed in order to predict the future growth patterns of the respective sectors and to assess the impact of possible energy efficiency interventions in these sectors. The Gross State Domestic Product (GSDP) projections and the energy consumption projections form the basis of defining the actions for energy conservation in the UT, which is important in developing the consumption reduction targets for the UT and in aligning the UT with the national goals.

Fiscal Year (FY 2021), implying the period from April 2020-March 2021 has been selected as the base year for projections in this study keeping in view the years FY 2020 was new UT formulated.

The Gross State Domestic Product (GSDP) of the UT of Ladakh was estimated at INR 0.099. Lakh Crore in FY 2020 and is projected to reach INR 0.232 Lakh Crore in FY 2031, at constant prices of 2011-12. The GSDP for the period FY 2023-FY 2031 is forecasted by taking weightage of the GSDP growth rate recorded in the years FY 2015-FY 2020 and the projection of GSDP growth rate of Jammu & Kashmir State before reformation of Ladakh. The historic and forecasted GSDP for the UT of Ladakh is shown in the figure below.

The Total Final Energy Consumption (TFEC) has been projected for the UT up to FY 2031 taking into account the historic average energy intensity (Mtoe/ INR Lakh Crore) from FY 2015 to FY 2020 along with the historic and projected GSDP growth for the UT of Ladakh. The methodology used to project the energy consumption takes into consideration economic aspects along with the total final energy consumption trend of the UT.

The Total Final Energy Consumption of the UT in the Business-as-Usual (BAU) scenario is projected to reach 0.39 MTOE in FY 2031 from 0.099 MTOE in FY 2021, with a projected CAGR of 13.4%.

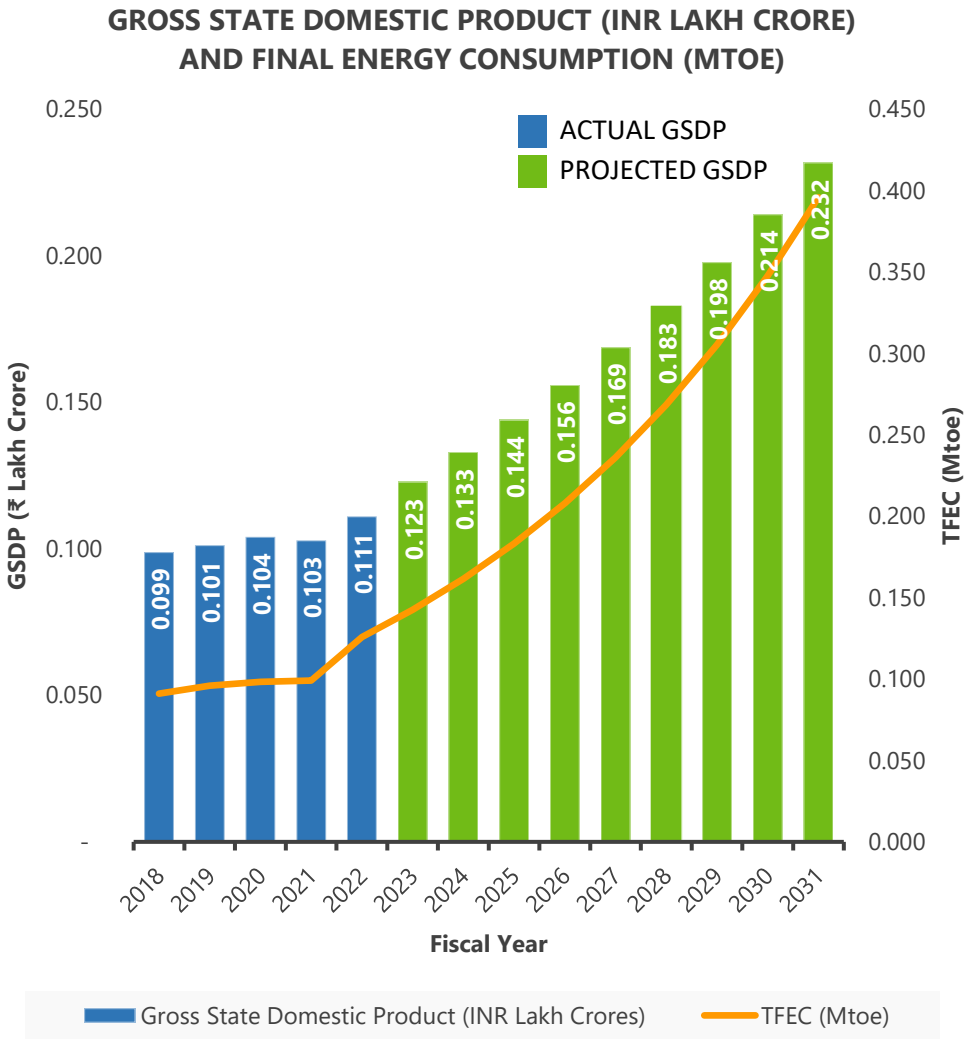



**Figure 12:** GSDP (INR lakh crore) and Final Energy Consumption (Mtoe)

# TRANSPORT SECTOR

# 4. Focus Sector 1: Transport

## 4.1 Current Scenario

The UT of Ladakh is one of the most preferred tourist locations across South Asia, a major set of migrating tourist population use local transportation for general commuting. The number of registered motor vehicles has shown a persistent rise over the years. As per the data received from dept. of Transport an average increment of 13% is observed when compared with the base year FY 2016. Further, there has been a steady increase in private vehicles under four wheelers and two wheeler category which exhibits a potential of positive EV transition in Ladakh. It may also be noted that, the commercial vehicle sector used for cargo transportation owns 13% of the total share, however considering the market availability of EVs for this category in the whole country, this transition will require some time and can be a part of the long term strategy towards achieving the desired target of Panchamrit.

Adding to that, the sectoral transport share of the UT is led by LMV (Light Motor Vehicle) which holds 77% of the total registered vehicles. Further, the two wheeler sector also shows potential of transition when compared with the market availability. The data for the number of vehicles has been sourced from the office of the Regional Transport Officer, Ladakh The number of registered vehicles in the UT has increased from 1,192 in FY 2016 to 3,366 in FY 2022, with an Average Annual Growth Rate (AAGR) of 13%. In the study, tractors, ambulance, tankers and private trailers have been excluded which is negligible in the numbers as compared to the total registered vehicles.

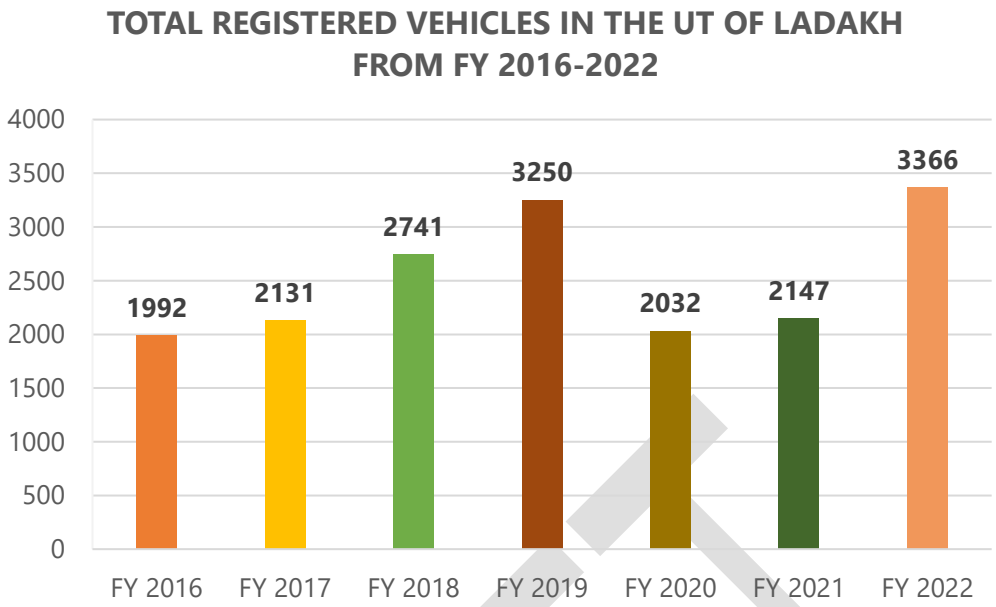



**Figure 13:** Total registered vehicles in the UT of Ladakh

This AAGR is further treated as CAGR to project the number of registered vehicles by the years 2025 and 2030, with base year as 2021.

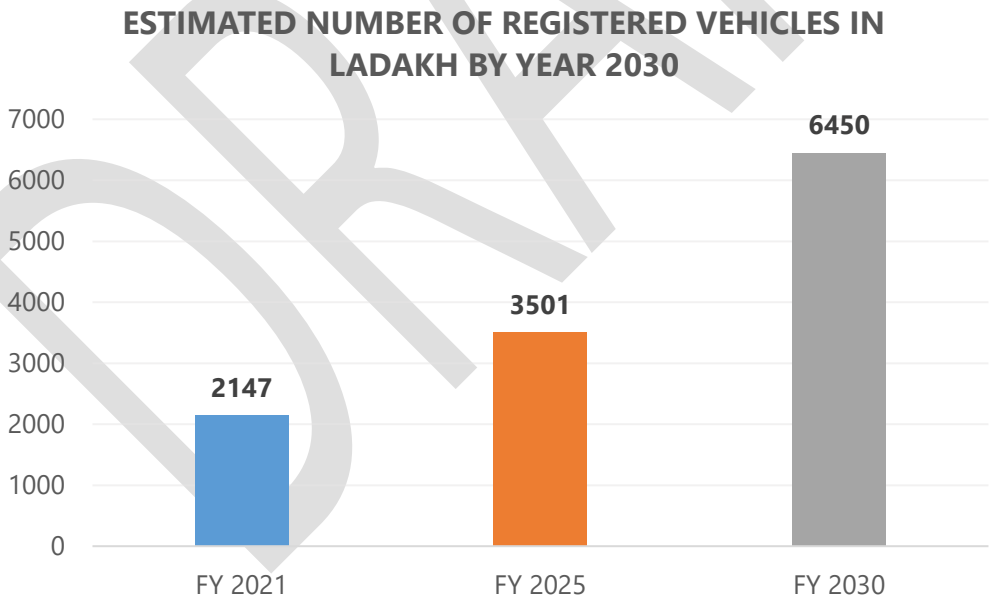



**Figure 14**: Projected number of registered vehicles in Ladakh by 2030

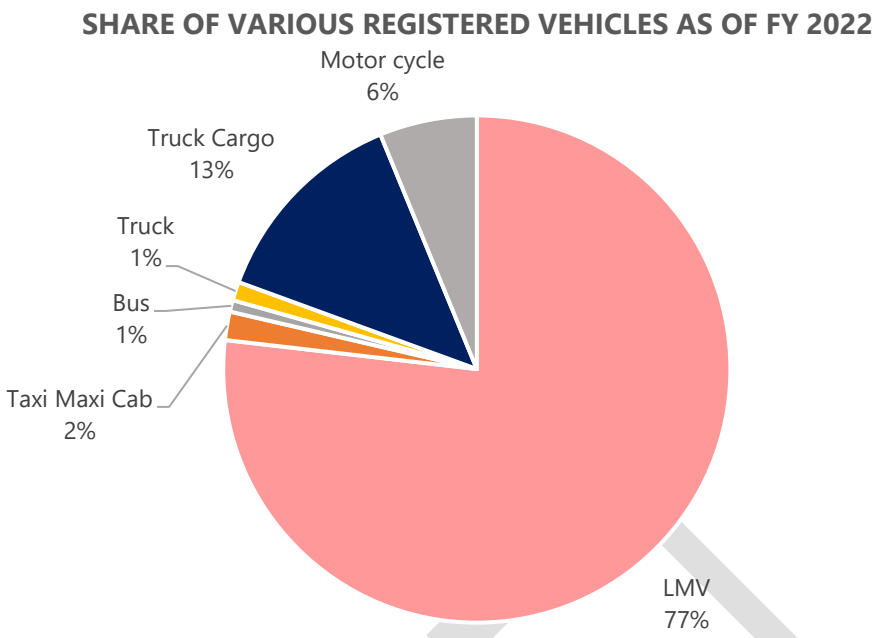



**Figure 15**: Share of vehicle types for no. of registered vehicles

It can be seen that LMV (small four wheelers/cars) (77%) make up the largest share in the vehicle category type. The next-highest is truck cargos at 13% share. Hence, targeting four-wheelers for transition to electric vehicles can bring about significant reduction in primary energy consumption in the transport sector of Ladakh.

## 4.2 Strategies in the Transport Sector:

The Ladakh Electric Vehicle and Allied Infrastructure Policy, 2022 was notified w.e.f. 17.08.2022 (valid for five years), to make the UT self-sustainable, SMART, integrated and carbon neutral. Under the policy, all commercial/non-commercial e-vehicles purchased/procured from the date of implementation of this policy shall be entitled to avail incentives. The policy aims to transform Ladakh into a torch bearer in adoption of EVS in the country and encourage the transporter and individuals avail subsidy to create a carbon-neutral future for Ladakh. The policy will help reduce dependence on fossil fuel-powered vehicles, which was high due to the tourism and required transport services.

The policy and the proposed strategy encompass a number of aspects of the transport sector ranging from incentives to consumers to undergo EV transition,

converting UT's bus fleet to electric, electric transition in logistics transport, and development of charging station across the UT. Ethanol blending in petrol is proposed as another strategy to bring about emissions reduction in the transport sector. The strategy has been proposed in line with the national policy on ethanol blending.

### Strategy #1 Infrastructure Development for EV charging stations and Incentives to Consumers for quick transition to EVs

**Implementation Period:** Long Term (Till FY 2031)

The transition to Electric Vehicles (EVs) across all segments of vehicles will be instrumental in decarbonization of the sector and in bringing significant savings in fossil-fuel based energy consumption. In this strategy, it is proposed to convert new vehicles registered in the UT till FY 2031 to electric vehicles along two different scenario trajectories, namely moderate scenario and ambitious scenario. The highest EV conversion rate is proposed for 2-wheelers because of the affordability of 2-Wheeler electric vehicles and public buses as that are under UT administration control. The EV conversion considerations for moderate and ambitious scenarios are given in the table below.

**Table 11**: EV transition considerations for moderate and ambitious scenarios

| Moderate Scenario | Ambitious Scenario |
|---|---|
| • 50% of conventional 2-Wheelers convert to electric by 2030<br>• 40% of conventional 4-Wheelers convert to electric by 2030<br>• 50% buses in the UT to transition to electric buses by 2030<br>• 50% of 3-Wheelers to convert to electric by 2030<br>• 25% of heavy vehicles (trucks and lorries) to convert to electric by 2030 | • 100% of conventional 2-Wheelers convert to electric by 2030<br>• 80% of conventional 4-Wheelers convert to electric by 2030<br>• 100% buses in the UT to transition to electric buses by 2030<br>• 100% of 3-Wheelers to convert to electric by 2030<br>• 50% of heavy vehicles (trucks and lorries) to convert to electric by 2030 |

The EV transition strategy can result in potential energy savings of 0.032 MTOE and 0.065 MTOE in the moderate scenario and ambitious scenario respectively.

**Table 12**: Energy Savings Potential

| Particulars | Moderate Scenario | Ambitious Scenario |
|---|---|---|
| **Energy Saving Potential (MTOE)** | 0.032 | 0.065 |

**Actionable Items:**

1. **Establishment of regulatory mechanism to develop EV charging Infrastructure**-

There are several regulatory mechanisms that can be put in place to develop EV charging infrastructure in Ladakh. Some possible approaches are mentioned below:

- Incentives for private companies to install charging infrastructure: The UT administration can provide incentives such as tax breaks or subsidies to private companies that install EV charging infrastructure in Ladakh.
- Public-private partnerships: The UT administration can enter into partnerships with private companies to develop and operate EV charging infrastructure. This can include agreements on revenue sharing, investment, and maintenance.
- Zoning regulations: The UT administration can zone certain areas of the city for EV charging infrastructure, such as near highways or in commercial areas, to ensure that the infrastructure is developed where it is most needed.
- Time-of-use pricing: The UT administration can introduce time-of-use pricing for EV charging to encourage drivers to charge their vehicles during off-peak hours when electricity is cheaper.

By implementing some or all of these regulatory mechanisms, the Ladakh administration can encourage the development of a robust EV charging infrastructure that will help to support the transition to electric vehicles in the UT.

2. **Pilot projects on Battery Swapping stations**

As per the guidelines of Ministry of Power, establishment of a wide network of charging stations and swappable battery station is on high priority. The policy recognizes the importance of charging infrastructure for the growth of the EV

industry and aims to create a robust charging infrastructure network across the UT.

Establishment of a wide network of swappable battery station is a key of success for EV infrastructure in the state. Pilot projects on battery swapping stations can provide valuable information and insights into the feasibility and effectiveness of this technology.

Battery swapping pilots can be tried in key Government offices and through private, specially IT buildings, with large car ownership. As UP has many highways, battery swapping stations could be setup along a major highway to demonstrate how this technology can enable long-distance electric vehicle travel. This pilot project can provide valuable data on how battery swapping affects driving patterns and charging behaviour.

These pilot projects can provide valuable information on the practicality, cost, and user acceptance of battery swapping stations, which can inform the development and implementation of future policy initiatives.

**3. Pilot projects on Hydrogen Fuel Cell Vehicles (HCVs)**

Pilot projects on hydrogen fuel cell vehicles (HCVs) can be an effective way to explore the potential of this technology and to identify any barriers or challenges to its widespread adoption. The results of the pilot project should be shared with stakeholders, including the public, to raise awareness of the potential of HCVs.

## Strategy #2 Ethanol Blending Program

**Implementation Period:** Long Term (Till FY 2031)

The Ethanol Blending Program is proposed to ensure mixing of ethanol in motor spirit (petrol) in a fixed ratio to offset a part of the energy consumed by petrol and bring about reduction in emissions. In the proposed strategy and in line with the country's target of 20% blending of ethanol blending in petrol by 2030, a 10% blending target is suggested in the moderate scenario and a 20% blending target is suggested in the ambitious scenario.

The ethanol blending can lead to potential fossil fuel energy savings of 0.010 MTOE and 0.015 MTOE in the moderate and ambitious scenarios respectively.

**Table 13:** Moderate and ambitious scenarios for infrastructure development and incentives to consumers for Ethanol Blending

| Particulars | Moderate Scenario | Ambitious Scenario |
|---|---|---|
| **Energy Saving Potential (MTOE)** | 0.010 | 0.015 |

**Implementing Agency:** Regional Transport Office (RTO)

**Actionable Items:**

1. **Financial Assistance on Biofuel production plants (Capital Subsidy for MSMEs)–**

   To ensure a steady supply of ethanol for blending with petrol, it is recommended to offer financial assistance for the installation of biofuel production plants. Micro, small, and medium-sized enterprises (MSMEs) interested in setting up these plants could receive capital subsidies. The aim is to establish a strong supply chain for feedstock to meet production targets and create a supportive environment for ethanol blending in fuel. By promoting the growth of biofuel industries, new technologies can be introduced and the market can be strengthened.

## Strategy #3 Promotion of Standard and Labelling program of Tyres for Fuel Efficiency in Vehicles

The Bureau of Energy Efficiency (BEE) in India has implemented a standard and labeling program for tyres to promote fuel efficiency in vehicles The promotion of a standard and labeling program for tyres with regard to fuel efficiency in vehicles can be an effective way to encourage the adoption of more fuel-efficient tyres by consumers.

**Actionable Items:**

1. **Awareness campaigns:** The first step is to create awareness among consumers about the importance of fuel-efficient tyres and the benefits of using them. This can be done through advertising campaigns, social media, and other public outreach efforts. The government can provide education to consumers on how to maintain their tyres for optimal fuel efficiency. This can include tips on proper inflation, regular rotation, and alignment.

2. **Capacity Building of Tyre Manufacturer and Vehicle OEMs-** Capacity building workshops shall be organized in the UT to enhance the knowledge of Tyre Manufacturers and Vehicle OEMs about Star Rating of Tyre and its benefits and compliance methodology to encourage them to produce or use star rated tyres.

   By promoting a standard and labeling program for tyres with regard to fuel efficiency, consumers can make informed decisions about which tyres to purchase, and manufacturers can be encouraged to develop more fuel-efficient tyre technology. This can result in significant reductions in fuel consumption and greenhouse gas emissions, contributing to a more sustainable future.

## 4.3 Energy Saving Targets & Monitoring Mechanism

On the basis of the two strategies proposed for the transport sector, the total energy saving estimated is 0.043 MTOE in the moderate scenario and 0.081 MTOE in ambitious scenarios. The potential savings under moderate and ambitious scenarios is the overall estimated savings from individual strategies under the respective scenarios, and can be considered as the energy saving targets for FY 2031 for the Transport Sector.

**Table 14:** Energy Savings from Transport Sector

| Strategies | Energy Savings in 2031 under moderate scenario (Mtoe) | Energy Savings in 2031 under ambitious scenario (Mtoe) |
|---|---|---|
| Transition to electric vehicles | 0.032 | 0.065 |

| | | |
|---|---|---|
| Ethanol blending | 0.010 | 0.015 |
| **Total** | **0.043** | **0.081** |

**Monitoring Mechanism:**

The monitoring framework for achieving the target of the transport sector can be easily set up by defining annual reduction targets of the sector. Monitoring of points mention below through the dashboard will support in monitoring of energy efficiency initiatives in the UT.

- Development of dashboard to monitor the sale of electric vehicles sold in a year categorized under 2-wheelers, 3-wheelers, 4-wheelers, buses, and heavy vehicles.
- The dashboard can also include city-wise mapping of EV charging infrastructure across the UT.
- The dashboard may be scalable to include alternative fuel vehicles such as Hydrogen Fuel Cell Vehicles.

Mechanism for data collection and reporting from various clusters and various energy efficiency initiatives may be done through Setting up a Sector Specific Energy Efficiency Cell (SSEEC) and Cluster Level Energy Efficiency Cell (CLEEC)

**Setting up a Sector Specific Energy Efficiency Cell (SSEEC)**

- The working of this cell will be different from the operations of SDA, the SSEEC will be responsible to collect data from all the cluster energy efficiency cells in the UT and share the same with the SDA for tracking the achievement of the targeted goal.

**Cluster Level Energy Efficiency Cell (CLEEC)**

- The CLEEC will be responsible for gathering information and will report the same to the SSEEC at the end of each quarter.

# BUILDING SECTOR

© Photo by Shivansh Singh /Unsplash

# 5. Focus Sector 2: Buildings

## 5.1. Current Scenario

In Ladakh, around 23% population resides in urban areas as per census 2011. The cultivated land area is around 10% however, agriculture and hospitality (home stays) are the major dependent sectors for economy. After the formation of Ladakh UT, the number of tourists have been increasing every year. Accordingly, the domestic and commercial building sectors are also expected to be affected and number of buildings are expected to be increased. The energy consumption in building sector can also be seen from below graph showing a peak growth of 40% and 30% in FY 2013 and FY 2021 respectively.

People migrate out of Ladakh during the harsh cold weather days. Now to avoid this migration, UT administration is making investments to provide heating system to the maximum buildings whether it is electricity-based heating system, LPG gas-based heating systems or solar based heating systems. In the digital world, the usage of electrical equipment, electronic gadgets, appliances, has also increased which needs electricity to run.

Furthermore, geothermal heating systems are being explored by Public Works Department and other related departments to have renewable based heating system which will help the UT to become carbon balance region, earlier than the target year of 2050.

It is expected that after implementation of ECBC and ENS in the UT, the rate of increment in energy consumption will drop down. Currently the code is not notified yet, however with the support of agencies, the ECBC cell is established in the UT and process for making the code mandatory is being followed.

Building sector is divided into two sub sectors, i.e. commercial and domestic. Below is the sharing pattern of commercial and domestic sector electricity consumption for on an average for latest years.

The pattern has consumption in defense infrastructure included in the Commercial sub sector. To maintain consistency across the analysis, the same has

been considered in it. Additionally, all the consumption related to public buildings is also included in Commercial sub-sector of the building sector.

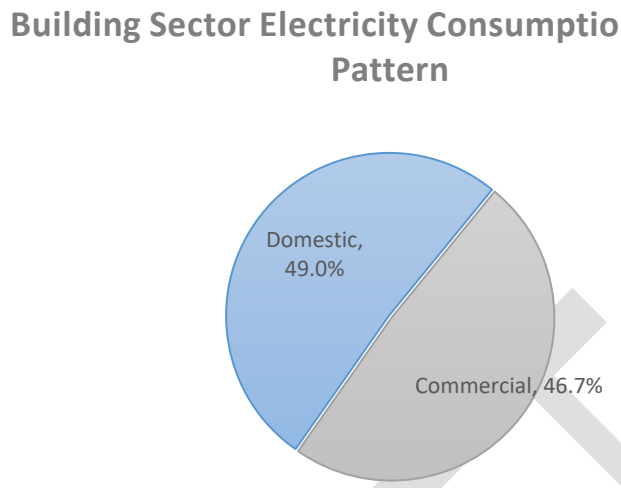



**Figure 16:** Sub sector wise breakup of building sector

On the other hand, domestic sub sector is predominant to the commercial sub-sector. Domestic sub-sector is further expected to grow with the same rapid increment as the technologies, comfort and increment in the number of buildings. Based on this it is understood that the ENS compliance for residential buildings is necessary to adopt in bye-laws, which will help to make buildings more passive buildings in terms of heating energy use.

If a fraction of effort is made towards residential/domestic buildings, it is projected to have significant reduction in energy usage through energy efficiency policies in the UT.

A gradual increase has been seen in the electricity consumption since FY 2015, with the increase in urbanization. This includes an increase in use of electronic appliances and comfort systems which has increased in the recent years and expected to rise furthermore.

In Recent, The Energy Conservation (Amendment) Act, 2022. A unified code for building sector "Energy Conservation and Sustainable Building Code (ECSBC)" has been introduced. The ECSBC code will be applicable for both commercial and residential buildings.

Building sector is a major energy guzzling sector in Ladakh. As per below graph it can be witnessed that the energy consumption in building sector is continuously increasing since FY 2015.

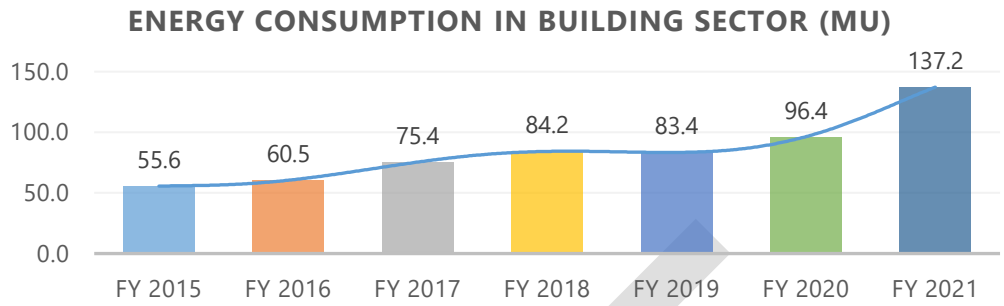



**Figure 17:** Energy Consumption in Building Sector (Million Units)[10]

The commercial sector supports in urbanization in Ladakh, but still caters to only 49% of the total electricity consumption in the building sector. The domestic sector on the other hand, retains 51% of the electricity consumption, this indicates that the UT requires a policy to encourage energy efficiency in the both the sub-sectors. It may be noted that even if a fraction of the both sub-sectors are addressed by following energy efficiency plans, then a huge some of electricity consumption can be eradicated.

## 5.2. Energy Efficiency Strategies in the Buildings Sector:

This section presents the proposed strategies in the domestic buildings and commercial buildings sector along with their impact in terms of energy saving potential. The following strategies are proposed in the buildings sector, as part of the State Energy Efficiency Action Plan:

1. **Effective Implementation of ECSBC**
2. **Replacement program for inefficient appliances**
3. **Promotion of BEE Star Rating and Shunya Rating of Buildings**
4. **Promotion of Geothermal Heating System in the Buildings**
5. **Passive Solar Heating (PSH) Mainstreaming**
6. **Lead-Acid Battery House cum Sentry Post**
7. **Phase Change Material Integration in Building Component**

[10] Data available with Ladakh PDD

Although programs like Standards & Labeling and ECBC are prevalent in the UT, the proposed strategies focus on enhancing the extent of their implementation by increasing the penetration of technology into the population and rate of implementation of these strategies.

## Strategy #1 Effective Implementation of ECSBC (previously known as ECBC & ENS)

Ladakh is in the process of adopting Eco-Niwas Samhita (ENS) for residential buildings, and ECBC for commercial buildings. However, in the recent EC Act Amendment 2022, unified code "Energy Conservation and Sustainable Building Code" (ECSBC) is introduced which will cover both commercial and residential buildings. Till the implementation of ECSBC in states/UTs, ECBC and ENS will be known as ECSBC.

Effective implementation of Energy Conservation and Sustainable Building Code (ECSBC) by increasing the penetration of ECBC and ENS compliant buildings in the UT is proposed for upcoming commercial and domestic buildings in the UT as a strategy for energy savings in the building sector.

In order to estimate the savings through ECBC, the electricity consumption of the commercial buildings sector was projected till FY 2031. After forecasting the energy demand in the commercial building sector from FY 2023 to FY 2031, the annual increment in the electricity consumption in the commercial buildings sector was projected.

The total incremental electricity consumption of commercial buildings in the UT is projected to be 152 GWh between FY 2023 to FY 2031. This increment in electricity consumption accounts for all the categories of commercial buildings of varying loads.

The Energy Conservation Building Code (ECBC) sets minimum energy standards for commercial buildings having a connected load of 30 kW or more (Proposed for the UT of Ladakh). It has been taken into consideration that around 5% of the buildings in the UT have connected load of 30 kW or more. Considering this

percentage, the Total Incremental Electrical Consumption contributing to buildings having load >30kW is estimated to be almost 8 GWh.

Based on the energy savings percentage from ECBC and ECBC+, the moderate and ambitious savings in the commercial building sector are found to be **1.9 GWh** and **2.7 GWh** respectively.

An effective approach to reduce long-term unnecessary electricity usage in residential buildings is by making them more energy-efficient. Implementing Energy-saving measures as per Eco Niwas Samhita (ENS) can be helpful in achieving this goal in the residential sector.

In the residential sector, by FY 2031, the electricity consumption is projected to be around 278 GWh. The overall incremental electrical consumption is estimated to be 219 GWh based on the anticipated household electricity demand by FY2031. In order to assess the savings that can be achieved from successful implementation of ENS, it is assumed that 4% of all the residential building stock would be ENS compliant by FY2031. The strategy is expected to result in electricity savings of **1.1 GWh** in the moderate scenario and that of **1.3 GWh** in the ambitious scenario.

The cumulative energy savings expected from the enhanced implementation of ECBC and ENS in the UT is shown below:

**Table 15:** Moderate and ambitious scenarios for effective implementation of ECSBC

| Particulars | Moderate Scenario | Ambitious Scenario |
|---|---|---|
| **Energy Saving Potential (MTOE) in ECBC** | 0.000164 | 0.000229 |
| **Energy Saving Potential (MTOE) in ENS** | 0.000096 | 0.000116 |
| **Total** | **0.000260** | **0.000345** |

**Implementing Agency:** Bureau of Energy Efficiency, LPDD, ULB

**Actionable Items:**

1. **Setting-up of effective enforcement plan with ULBs and SDA as monitoring agencies-** Effective implementation of ECBC and ENS depends

on the effectiveness of rules & regulation adopted by the State/UT. To ensure the same role & responsibility of all concerned departments, check points, monitoring mechanism and penalties must be properly defined in ECSBC rules & regulations.

SDA being an extended arm of Bureau of Energy Efficiency shall monitor the process of ESCBC compliance and record the data of total energy savings achieved through the implementation of ECSBC.

2. **Development and maintenance of ECSBC compliance portal, directory of energy efficient materials/technologies** – For effective and aggressive implementation, it is proposed that the UT shall has its own ECSBC online portal to aid in quick ECBC & ENS approval and monitoring process online. The portal would ensure a faster process of compliance application, third party verification and certification. The portal may also contain educational resources, directory of materials and vendors and user-friendly guides for enhanced awareness and capacity building of developers and professionals. Investment would be needed in the development and annual maintenance of the ECSBC portal for which LPDD will be the implementing agency.
3. **Market Outreach for ECBC compliant Products, Radio Jingles, Social Media Awareness** – Market outreach for ECBC compliance products or products utilized in sustainable construction such as building materials used in passive building design would enable a conducive market for such materials which will promote construction practices necessary to comply with ECBC and ENS guidelines. The market outreach can take place through professional conventions and seminars, radio jingles and awareness campaigns on social media.
4. **Pilot projects for Super ECBC buildings as case studies (initial 10 Buildings)** – It is proposed that the UT Administration also undertake the development of Super-ECBC buildings in the UT and publish its case studies for the understanding of stakeholders. Initially upcoming government building can be taken as a pilot project and best energy efficient technologies can be implement to achieve the Super ECBC level. Case Study can be

published in social media to encourage developers and other stakeholders to make Super ECBC compliant buildings.

5. **Home Energy Auditor Training, compliance structure and incentive on energy savings for first few residential projects** – BEE has developed a Home Energy Auditing tool. SDA may run awareness and capacity development programs in Ladakh to train building professionals about the benefit of auditing and implementation of Energy Conservation Measures (ECMs) in residential housed. SDA may encourage by providing some incentive based on energy savings on implementation of ECMs in their societies. These action items will help in the promotion of ENS in the Ladakh and create technical capacity of the professionals.
6. **Periodic upgradation of PWD Schedule of Rates (SoR) to incorporate latest energy efficient materials and technologies**

   Regular upgradation of PWD Schedule of Rates (SoR) to incorporate latest energy efficient materials and technologies is required as technologies in the field of energy efficiency is developing on some very regular intervals. Adoption of new innovative technologies become easier if it is mentioned in PWD Schedule of Rates (SoR) document.
7. **Inclusion of curriculum on energy efficiency in buildings, in universities and Schools**

   Raising awareness about energy conservation among children is crucial. To instill a fundamental understanding of this concept and promote a behavioral shift in children, it is suggested that the curriculum on energy efficiency and conservation be developed and integrated into schools and universities in the UT of Ladakh.

## Strategy #2 Replacement program for inefficient (below than 3 Star Rated) appliances

**Implementation Timeline:** Long Term (Till FY 2031)

The Standards & Labelling (S&L) Programme[28] of Bureau of Energy Efficiency (BEE) has seen a successful implementation across the country, leading to significant savings in energy through mandatory and voluntary use of energy

efficient electrical appliances by consumers in a wide range of applications. The S&L programme encompasses appliances and equipment that have applications in multiple sectors, however the buildings sector is the most widely covered sector in terms of types and number of appliances.

At present, the S&L Programme covers the 29 appliances, with 11 appliances subject to mandatory regulation and the remaining 18 appliances subject to voluntary regulation. The list of mandatory and voluntary appliances is given in below table**Table 16**.

**Table 16:** List of mandatory and voluntary appliances under S&L Programme

| **Mandatory Appliances** | **Voluntary Appliances** |
|---|---|
| 1. Room Air Conditioners | 12. Induction Motors |
| 2. Frost-free refrigerators | 13. Agriculture Pump Sets |
| 3. Tubular Florescent Lamps | 14. LPG Stoves |
| 4. Distribution Transformer | 15. Washing Machine |
| 5. Room Air Conditioner (Cassette, Floor Standing) | 16. Office Equipment's (Printers & Copier) |
| | 17. Ballast |
| 6. Direct Cool Refrigerator | 18. Computers (Laptop/Notebooks) |
| 7. Colour TV | 19. Diesel Engine driven monoset pumps |
| 8. Electric Geysers | 20. Solid State Inverter |
| 9. Variable Capacity Inverter Air Conditioners | 21. DG Sets |
| | 22. Chillers |
| 10. LED Lamps | 23. Microwave Oven |
| 11. Ceiling Fans | 24. Solar Water Heater |
| | 25. Light Commercial Air Conditioner |
| | 26. Deep Freezers |
| | 27. High Energy Li Battery |
| | 28. Air Compressor |
| | 29. UHD TV |

*In addition to these 29 appliances, tyres/Tires are also covered in S&L programme

The current strategy has been proposed for the complete buildings sector covering both Domestic and Commercial Buildings. However, a majority of the mandatory and voluntary appliances have a significantly higher penetration in the domestic buildings sector than in the commercial buildings sector.

The electricity consumption pattern varies greatly between urban and rural areas. This is due to the variation in type and number of appliances being used by urban and rural residents. This entails the inclusion of number of urban and rural households in the savings calculation. Based on the estimated population of the UT as per the report UT Statistical report and "Population Projections for India and States 2011 – 2036" and Household Size as per census, the number of households were estimated out for urban and rural regions. Different categories of appliances have different penetration among the urban and rural households, based on the usage pattern.

Some appliances viz. Fans, refrigerators, washing machines, LEDs, air-conditioners and microwave have higher penetration as compared to other appliances. Taking into account the study given in the report "Impact Assessment of BEE's Standard & Labeling Program", penetration of different appliances among urban and rural areas was estimated. List of appliances considered in strategies is mentioned in this Table 17.

**Table 17**: Appliances taken into consideration for the strategy

| | |
|---|---|
| Window AC | Colour TV - LCD/Plasma/LED |
| Split AC | Washing Machines |
| Refrigerator-DC | TFL (Tubular Flourescent Light) |
| Refrigerator-Frost Free | Electric Geysers |
| Ceiling Fans | LPG Stoves |
| Coulor TV CRT | Computer/Laptop/Notebooks |

According to the study conducted by CLASP (Collaborative Labeling and Appliance Standards Program)[11] to assess consumer awareness of energy labelling, 48% of consumers are aware of the scheme and 15% have some knowledge of it. Appropriate number of 3-Star rated appliances have been taken from the calculation of total number of appliances. Saving strategies in the moderate scenario include replacement of 3-star rated equipment to 5-star rated appliances, whereas in the ambitious scenario, replacement of non-star rated to 5-star rated equipment has been considered as a saving strategy. The percentage savings achieved upon transitioning from Non-Star to 5-Star Labelled

[11]https://www.clasp.ngo/wp-content/uploads/2021/01/2007-05_IndiaLabelingProgramImpacts.pdf

equipment's (efficiency) were taken into account for calculating savings in above mentioned scenarios.

The strategy is estimated to result in energy savings of 0.0020 MTOE in the moderate scenario and 0.0026 MTOE in the ambitious scenario till FY 2031.

**Table 18:** Moderate and ambitious scenarios for deepening of S&L Programme

| Particulars | Moderate Scenario | Ambitious Scenario |
|---|---|---|
| **Energy Saving Potential (MTOE)** | 0.0020 | 0.0026 |

**Implementing Agency-** LPDD**,** ESCOs

**Actionable Items:**

The action items to be carried out in order to implement the strategy at ground level mainly involve dissemination of the scheme's guidelines and specification amongst stakeholders such as manufacturers, retailers and consumers in a way that can ensure meeting the implementation timeline proposed for the strategy. The following action items are suggested in order to ensure effective implementation:

1. **Development of UT-specific implementation models and identification of relevant agencies-** A detailed phase-wise plan need to layout based on consumer's priority and reachability. It is important to develop a transparent model that can reach out to every household in the UT. Financial implications will play a major role in replacement scheme so ESCOs and PPA models can we analyzed in details. UJALA scheme is a successful case study in this area, can be referred for the development of UT specific plan. Identification of implementing departments and agencies and listing of ESCOs in the UT is required.
2. **Issuance of directive to government offices and buildings in the UT to replace all existing inefficient appliances (lower than 3 Star Rated) with BEE 5-star rated appliances-**UT Administration shall issue directives to all departmental offices and buildings owned by UT administration to replace all

appliances which are lower than 3 star rated or purchased/installed before 2015 with BEE 5-Star rated appliances.

3. **Phase-wise plan for replacement of existing inefficient appliances (lower than 3 Star Rated) with BEE 5-star rated appliances in all buildings, through DSM schemes** Development of phase-wise Demand Side Management (DSM) plan based on the consumer's priority and market scenario shall be developed in consultation with DISCOMs. Implementation can be done with support of DISCOM's and various ESCOs listed with UT Administration.
4. **Workshops & Campaigns on behavioral change interventions for energy conservation –** Capacity building of these stakeholders is key to develop a market environment for energy efficient appliances. UT Administration shall organize workshops at various levels to encourage people for behavioral change and run mass campaigns to reach out maximum people to increase awareness about benefits of behavioral changes and promote Lifestyle for Environment (LiFE). Workshops and campaigns shall be carried out to target maximum people by organizing through online platforms, print media, social media, nukkad nataks, and radio jingles etc.

## Strategy #3 Promotion of BEE Star Rating and Shunya Rating of Buildings

**Implementation period:** Long Term (Till FY 2031)

The Star Rating and Shunya Rating of buildings is currently at a voluntary stage which is used as a benchmarking system for buildings in order to classify them in terms of 'Star-Rating' & 'Shunya Rating' on the basis of their energy performance. It is proposed that to promote Star Rating & Shunya Rating in all Public & commercial buildings and conduct an assessment for their energy performance along with the ECBC Compliance process. Assessment of buildings on a scale of 1-5 stars or Shunya Rating will promote the development of energy efficient buildings in the UT. Certification of Star Rating or Shunya Rating can be provided based on this assessment.

The strategy is estimated to result in energy savings of 0.000022 MTOE in the moderate scenario and 0.000033 MTOE in the ambitious scenario till FY 2031.

**Table 19:** Moderate and ambitious scenarios for BEE Star Rating and Shunya Rating for Buildings Programme

| Particulars | Moderate Scenario | Ambitious Scenario |
|---|---|---|
| **Energy Saving Potential (MTOE)** | 0.000022 | 0.000033 |

**Implementing Agency:** Bureau of Energy Efficiency; LPDD; ULB

**Actionable Items:**

1. **Issuance of directives to all departments to conduct energy audits and target to achieve BEE Star Rating for their buildings**-
   UT Administration shall issue directives to all government departments and buildings owned by UT government to conduct energy audit and implement energy conservations measures and target to achieve BEE Star Rating or Shunya Rating for their buildings.
2. **Periodic energy audits for commercial buildings on load basis and incentives on achieving specific level of star rating for buildings**-
   A notification from UT Administration shall be issued for conducting mandatory energy audits of commercial buildings based on their connected load and incentives can be given on the achievement of star rated energy efficient buildings to encourage more building owners to reduce their EPI and save more energy.
3. **Capacity Building of Architects & Building Professionals and Developers**-
   Capacity building programs of Architects & Building Professionals and Developers will ensure to increase the technical capacity of and awareness about innovative technologies. Capacity building of these stakeholders is key to develop a market environment for energy efficient buildings. The capacity building programs can be taken up periodically, preferably quarterly. Capacity building workshops may be carried out either district-wise or zone-wise and target maximum stakeholder to participant in these programs.

4. **Market Outreach for Star & Shunya Rating by Radio Jingles, Social Media Awareness-**

   Promotion of the Star & Shunya Rating is an important part to promote energy efficiency in buildings. In order to increase awareness about these rating program, promotion campaigns shall be carried to reach masses by advertising in print media, social media, conduct nukkad nataks, plays and run radio jingles etc.

5. **Mandatory maximum set point of 24 degrees for heating systems in all departmental buildings –** The Bureau of Energy Efficiency has been raising awareness on the energy savings and cost benefit of lowering the operating set point of air conditioners and have advised consumers across the country to maintain set point below 24 degrees Celsius to ensure optimal temperature/heating and energy consumption from the use of air heaters. It is recommended that departments take lead in the implementation of this practice across the UT.

6. **Transformation of iconic government buildings to Net-Zero energy buildings** -Transforming public buildings to net zero will ensure maximum energy performance of these buildings. It will further boost the market and professional environment of sustainable construction products, energy efficient appliances, and energy audit and consulting services. The SOR of public building construction projects can be regularly updated with energy efficient and climate responsible materials through the help of this strategy.

## Strategy #4 Promotion of Geothermal Heating System in the Buildings

**Implementation period:** Long Term (Till FY 2031)

Ladakh, a region located in the northernmost part of India, is known for its harsh winters and extreme weather conditions. Due to the region's location and climate, the residents of Ladakh have to rely heavily on electricity for heating purposes in buildings. This heavy reliance on electricity for heating puts a strain on the region's power grid and contributes to high energy costs. To address this issue, implementing a geothermal heating system is necessary for Ladakh.

Ladakh is a region that experiences snowfalls and extreme winters. During the winter months, water sources can freeze, making it challenging for residents to obtain water for domestic use. Additionally, many people in the region migrate during the winter months to avoid the harsh conditions, leading to economic challenges for the region.

A geothermal heating system uses the natural heat of the earth to warm buildings. The system uses pipes buried underground to circulate water that absorbs the earth's natural heat. The heated water is then used to warm buildings through a series of radiators or underfloor heating systems. Unlike traditional heating systems, geothermal heating systems are highly efficient and have significantly lower operating costs. Implementing a geothermal heating system in Ladakh would provide several benefits. Firstly, it would significantly reduce the region's reliance on electricity for heating, leading to lower energy costs and reduced strain on the power grid. Secondly, the geothermal system can provide a reliable source of hot water for domestic use, even during the winter months when traditional water sources can freeze. This would improve the quality of life for residents and eliminate the need to migrate during the winter months. Thirdly, geothermal heating would provide a more comfortable working environment for residents, allowing them to work from hotels or homes throughout the year.

To understand the impact of geothermal heating in Ladakh, we calculated potential energy savings based on the current trend of electricity usage. According to our calculations, approximately 80% of the electricity used in buildings in Ladakh is for heating purposes. By implementing geothermal heating, we estimate that up to 70% of energy savings can be achieved compared to traditional electrical resistance-based heating systems. Moreover, we propose implementing geothermal heating systems in 20% of the buildings, where the system can provide hot water for comfort and domestic use.

The strategy is estimated to result in energy savings of 0.0049 MTOE in the moderate scenario and 0.0097 MTOE in the ambitious scenario till FY 2031.

**Table 20:** Moderate and ambitious scenarios for Geothermal Heating System

| Particulars | Moderate Scenario | Ambitious Scenario |
|---|---|---|
| **Energy Saving Potential (MTOE)** | 0.0049 | 0.0097 |

**Implementing Agency:** Bureau of Energy Efficiency; LPDD; PWD; ULB

**Actionable Items:**

1. **Conduct a feasibility study on Geothermal Heating System in Ladakh**

   The administration of Ladakh should initiate a comprehensive feasibility study to determine the suitability of implementing a geothermal heating system in the region. This study should involve identifying potential locations for the system, analyzing the geological conditions, assessing the energy demand of the region, and estimating the costs and benefits of the project. The study should also explore potential funding options and partnerships with private entities to help finance the project.

2. **Develop regulatory frameworks for Geothermal Heating System in Ladakh**

   The Ladakh administration should develop regulatory frameworks for the installation and operation of geothermal heating systems in the region. This framework should include licensing and permit requirements, safety standards, and environmental regulations to ensure that the installation and operation of the systems do not pose any harm to the environment or public health. The framework should also outline the roles and responsibilities of the various stakeholders, including government agencies, private entities, and consumers.

3. **Provide incentives and subsidies for Geothermal Heating System adoption in Ladakh**

   To encourage the adoption of geothermal heating systems in Ladakh, the administration should provide incentives and subsidies to homeowners, businesses, and institutions that install these systems. This could include tax breaks, rebates, and low-interest loans to help offset the initial costs of installation. The government should also consider providing technical

assistance and training to help installers and consumers better understand the technology and its benefits.

4. **Promote public awareness and education on Geothermal Heating System**

   The administration should undertake a public awareness campaign to educate residents, businesses, and institutions about the benefits of geothermal heating systems. This campaign should include workshops, seminars, and public outreach programs to provide information on the technology, its environmental benefits, and cost savings. The administration should also consider partnering with local schools and universities to introduce geothermal energy education into the curriculum.

5. **Collaborate with international organizations and experts on Geothermal Heating System**

   The Ladakh administration should collaborate with international organizations and experts to gain knowledge and expertise in the installation and operation of geothermal heating systems. This could involve partnering with organizations such as the International Geothermal Association and the Global Geothermal Alliance to access funding and technical expertise. The administration should also consider hosting international conferences and workshops to promote the adoption of geothermal heating systems in Ladakh.

## Strategies #5: Passive Solar Heating (PSH) Mainstreaming

Ladakh has an extreme long winter climate and buildings currently are poorly insulated, using fuels such as coal and biomass for heating. Since the early 1980s, several NGOs have promoted PSH buildings in the region as appropriate technology. However, despite 40 years of promotion, PSH houses have not been mainstreamed and new construction using modern building materials still uses climatically inappropriate building methods without taking advantage of PSH design concepts. Therefore, usage of Passive Solar Heated (PSH) buildings should be promoted to realize the Hon'ble Prime Minister's vision of a Carbon Neutral Ladakh. It should aim to identify and address the major hurdles in the path to

mainstreaming the PSH concept and come up with design thumb rules, capacity-building modules, and recommendations for its uptake.

### Strategies #6: Lead-Acid Battery House cum Sentry Post

Building designs should be such that maintain the indoor temperature of above 15 Degree Celsius. Thus, ensuring the batteries maintain their performance throughout the year.

The intervention required is to place the lead-acid batteries in a PSH room and using the thermal mass of the batteries as thermal banks, besides already being an electrical bank. Simple Lead-Acid Batteries having a lot of water act as an efficient thermal mass (water has 2x the volumetric heat capacity as concrete). This thermal bank releases heat to the indoors after sunset. This battery house can also double as a PSH guard house or sentry post with its own power-generating system (rooftop SPV) which can be used to power lights around the fences or sentry post itself.

Thus, preventing avoidable injuries to our soldiers from accidental fires, which happen very often in Ladakh.

### Strategies #7: Phase Change Material Integration in Building Component

To improve the self-sufficiency of passive solar space heating, integrating phase change materials into building components can significantly increase their thermal capacity. Consequently, this integration will greatly enhance the autonomous heating capabilities of the future buildings in Ladakh.

## 5.3. Energy Saving Targets & Monitoring Mechanism

The proposed strategies can together achieve maximum potential energy savings of 0.011 MTOE by FY 2031. The energy saving and emissions reduction targets for the moderate scenario and ambitious scenario for the buildings sector are shown in table 21:

**Table 21:** Moderate and ambitious scenarios energy savings for buildings sector

| Action Plan | Energy Savings in 2030 under moderate scenario (Mtoe) | Energy Savings in 2030 under ambitious scenario (Mtoe) |
|---|---|---|
| Effective implementation of ECSBC | 0.000260 | 0.000345 |
| Replacement program for inefficient appliances | 0.0011 | 0.0014 |
| BEE Star Rating and Shunya Rating of Buildings | 0.000022 | 0.000033 |
| Geothermal Heating System | 0.0049 | 0.0097 |
| **Total** | **0.00628** | **0.01148** |

**Monitoring Mechanism:**

The monitoring framework for achieving the target of the building sector can be easily set up by defining annual reduction targets of the sectoral reduction goal. Monitoring of points mention below through the dashboard will support in monitoring of energy efficiency initiatives in the UT.

- Development of strategy-specific dashboards to monitor the impact and track progress of ECBC buildings, ENS buildings, Net Zero buildings in the UT and the energy savings achieved from these strategies.
- Monitoring of Geothermal Heating system by empaneling the experts and having pilot projects in the UT for the successful demo.
- Regular reporting and updating of dashboard can be done with the support of LPDD or ECBC/ENS cell.
- Development of dashboard to monitor the sale of different star-labelled appliances sold in a year categorize according to star rating level.

Mechanism for data collection and reporting from various clusters and various energy efficiency initiatives may be done through Setting up a Sector Specific Energy Efficiency Cell (SSEEC), Cluster Level Energy Efficiency Cell (CLEEC) and Building Level Energy Manager/Auditor.

**Setting up a Sector Specific Energy Efficiency Cell (SSEEC)**

- The working of this cell will be different from the operations of SDA, the SSEEC will be responsible to collect data from all the clustur energy efficiency cells in Ladakh and share the same with the SDA for tracking the achievement of the targeted goal.

**Cluster Level Energy Efficiency Cell (CLEEC)**

- The CLEEC will be responsible for gathering information from specific type of buildings, industries on their operations, energy effciiency goals and will report the same to the SSEEC at the end of each quarter.

**Building Level Energy Manager/Auditor**

- The building level energy auditor and energy manager will be responsible for sharing data with the cluster level cell for specifc building type in the specified format.

# I NDUSTRY SECTOR

# 6. Focus Sector-3: Industry

## 6.1. Current Scenario

Union territory of Ladakh has picked the exponential growth in industrialization after the reorganization of Jammu Kashmir state in year 2019. Ladakh has majorly micro and small scale enterprises. There are no large industries present in the UT. Agriculture has been mainstay of the Ladakhi economy even when the cultivated land is nearly about 10% of the total land.

***New Industrial Development Scheme for UT Ladakh:***

*Advisor to Hon'ble Lt. Governor, advised that additional incentives should be given to industrial & service sectors units using solar energy, constructing passive solar structures, and water-efficient systems such as flushes with sensors, to reduce the wastage of water and using new solar-based space heating devices which will reduce carbon emissions.* [12]

Following are the major industries in Ladakh:[13]

1. Woolen and Silk based clothes
2. Metal Fabrication
3. Wooden/Furniture based
4. Food Processing

Following are the potential new MSMEs in the UT:

1. Ceramic Bricks
2. Cement Bricks and Blocks
3. Milk Products
4. Soft Toys
5. Bakery Products



[12] https://ladakh.nic.in/advisor-reviews-proposed-new-industrial-development-scheme-for-ut-ladakh/

[13] Brief Industrial Profile of Leh District by MSME – Development Institute DPS_Leh.pdf (dcmsme.gov.in)

## 6.2. Energy Efficiency Strategies in the Industry Sector:

This section presents the proposed strategies in the prominent sectors and focus areas identified in the industry sector along with their impact in terms of energy efficiency.

### Strategy #1: Energy Efficiency Interventions in MSME clusters

**Implementation Timeline**: Short Term (Till FY 2026) for lower coverage; Long Term (Till FY 2031) for higher coverage.

The strategy is proposed for the Small and Medium Enterprises (SME) sector industries which consist of MSMEs in identified prominent sectors such as Metal Fabrication, Handicrafts, Wooden and Food Processing clusters for moderate scenario and ambitious scenario. The strategy would involve the implementation of energy efficient technologies and new & innovative decarbonization technologies in the market in order to enable SMEs to meet their energy saving targets.

It was assumed that 25% industries will be able to adopt the strategy in moderate scenario and 50% industries will be covered in the ambitious scenario. The strategy is expected to result in energy savings of 0.00009 Mtoe and 0.0002 Mtoe in the moderate and ambitious scenarios respectively.

**Table 22:** Moderate and ambitious scenarios

| Particulars | Moderate Scenario | Ambitious Scenario |
|---|---|---|
| **Energy Saving Potential (MTOE)** | 0.00009 | 0.0002 |

**Implementing agency(s) –** Bureau of Energy Efficiency (BEE); LPDD, Department of Industries and Commerce

**Actionable items:**

A number of action items will need to be adopted by the relevant departments and implementing agencies for achieving the energy savings estimated for this strategy. These action items include:

1. **Workshops on technology interventions for energy conservations in MSMEs –** It is proposed to organize cluster wise workshops for MSMEs on technology interventions that can be implemented in respective industries. It is important to disseminate technical information about new technologies among owners and maintenance team of MSMEs so that they can implement latest technologies in their units.
2. **Demonstration projects on latest Energy Efficiency Technologies in SME clusters –** Demonstration projects are proposed to be carried out every year on a periodic basis in all prominent SME clusters to promote these technologies and make stakeholders aware about the monetary and energy performance impact of these technologies.
3. **Periodic standardized energy audits for MSMEs on load basis and reimbursement of energy audit cost with a maximum cap** – Government of UT of Ladakh shall develop a standard format of energy audit and issue notification for conducting mandatory periodic (in every 3 Years) energy audits by every unit above a certain limit of connected load. Government can also provide reimbursement of energy audit cost with a maximum cap of INR 75,000. Monetary support to small industries and MSMEs can be provided to maintain the standard of conducted energy audit.
4. **Sector-specific policy development for financial assistance on implementation of ECMs suggested in energy audit-** A policy shall be developed at state level to provide the financial assistance for implementation of ECMs recommended in the energy audits. Policy development shall consider the sector specific requirements, energy saving potential of sector and its importance in state level GSDP.
5. **Issuance of directives for implementation of ISO 50001, Energy Management System in organizations on load basis-** ISO 50001 is an international standard that outlines the requirements for an energy management system (EnMS). It provides a framework for organizations to establish, implement, maintain, and improve energy performance and efficiency. UT administration shall issue directive to all units in UT which are above a limit of connected load, to implement ISO 50001 and adopt Energy

Management System in organizations. Implementation of ISO 50001 can help organizations identify and address energy efficiency opportunities, reduce energy consumption and costs, and improve their environmental performance.

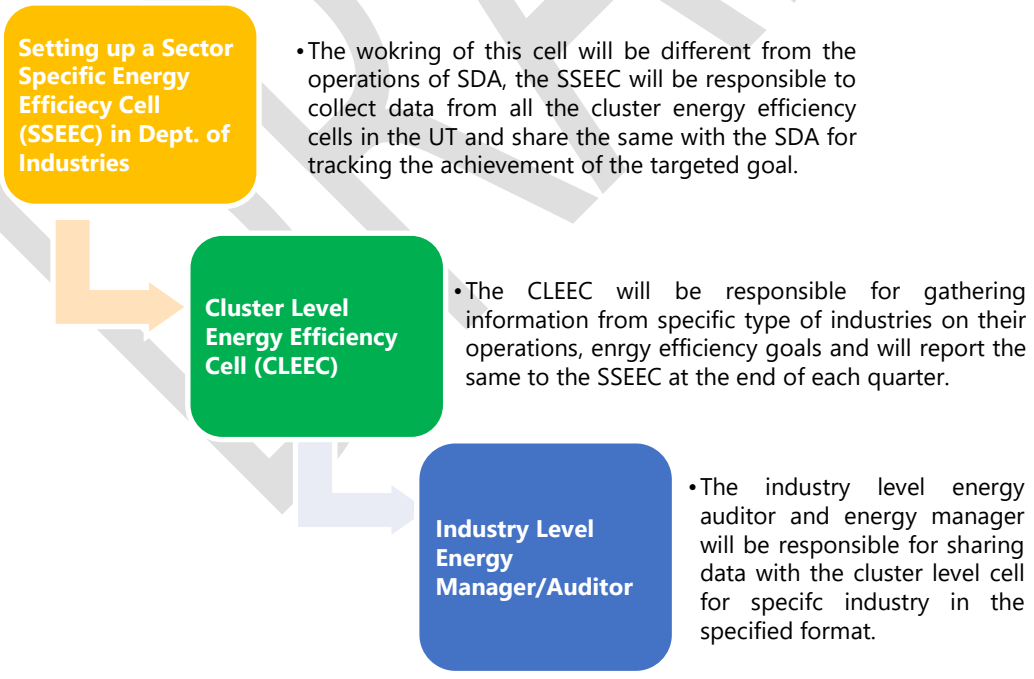
6. **Phase wise plan to implement DSM scheme for replacement of existing inefficient (non-star rated) pumps through DISCOM/PDD-**

   UT administrative department shall develop a demand side management (DSM) plan to replace all existing pumps which are lower than 3 star rated or purchased/installed before 2015 with BEE 5-Star rated appliances. Phase wise plan can be executed through PDD or listed ESCOs in the UT of Ladakh.

**Monitoring Mechanism:**

The monitoring framework for achieving the target of the industry sector can be easily set up by defining annual reduction targets of the sectoral reduction goal.

The reduction target verification can be later done for monitoring the following for each quarter:



## OTHER INTERVENTIONS

### 1. Artificial Vertical Glaciers - Ice Stupas for Conservation of Waste-Winter Water for Irrigation in Spring

The Ice Stupa Artificial Glaciers solve the problem of water shortage in the face of climate change, using which the ecologically damaged valleys are being restored. The Ice-Stupas use waste- winter streaming water and store it in the form of conical ice structures resembling a stupa, and melts during the spring, providing water to the farmers in the driest period.

### 2. Solar Photovoltaic Technology (SPV) Greenhouse

The Government of India is planning a 25 GW Solar PV installation in Ladakh. While the huge capacity will not be used entirely in Ladakh, the region can benefit immensely if the space under the SPV systems can be use to grow food or fodder. The idea has the potential to address the issue of severe food scarcity in the region throughout the year, and potentially address saving the Pashmina Goats in Changthang from dying in the cold winters, when there is no grass. SPV system further acts as a car shed and charging station for fleet of electric vehicles.

### 3. Desert Greening with Native Plants

High valley desert greening for increasing water absorption and flow reduction in extreme rainfall. Plantation of native species to be promoted to ensure minimum water consumption. Water retention on account of vegetation cover will help in mitigating disasters such as the leaching of nutrients from the soil, water run-off, and damage to houses and property in the event of floods or severe rainfalls.

# 7. Investment Potential in Focus Sectors

The energy saved as a result of the proposed strategies in all sectors will lead to avoided generation of equivalent amount. In order to implement the suggested strategies, there will be need for investments in energy efficiency projects, development of new policies, and modification of existing policies. In order to estimate the investment potential generated from the suggested strategies in the focus sectors, the equivalent cost of the saved energy in terms of metric tonnes of oil equivalent has been calculated. The Ministry of Power, Government of India, in consultation with the Bureau of Energy Efficiency (BEE) has notified the price of per metric tonne of oil equivalent as INR 18,402 only for the year 2018-19. The same amount has been applied to energy savings under ambitious scenario for the estimation of maximum investment potential. Total energy saving potential by implementing various strategies in Ladakh is shown in the graph below:

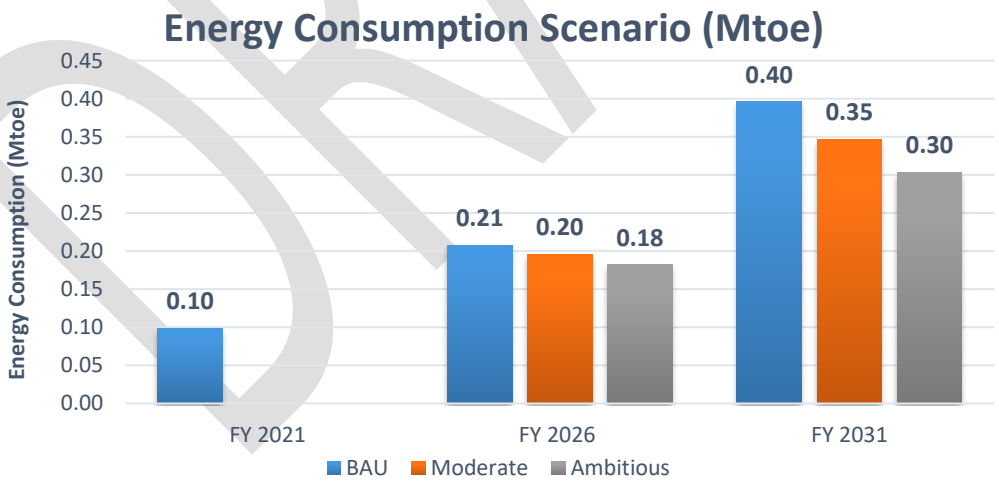



**Figure 18:** Energy Consumption Scenario (Mtoe)

It is estimated that with the implementation of various proposed strategies of Transport, Building, and Industry Sectors, energy saving of 0.049 Mtoe in moderate scenario and 0.093 Mtoe in ambitious scenario can be achieved. In moderate scenario 12.47% energy saving can achieved and in ambitious scenario 23.40% can be achieved.

**Table 23:** Savings Summary and Investment Potential

| Sector | Emissions Reduction ($MtCO_2$) - FY2031 | | Energy Consumption Reduction (Mtoe) - FY2031 | | Investment Potential (INR Crores) |
|---|---|---|---|---|---|
| | Moderate | Ambitious | Moderate | Ambitious | |
| | $MtCO_2$ reduction | $MtCO_2$ reduction | Mtoe Reduction | Mtoe Reduction | |
| Industry | 0.0001 | 0.0002 | 0.0003 | 0.0006 | 0 |
| Buildings | 0.0063 | 0.0115 | 0.0197 | 0.0359 | 21 |
| Transport | 0.0430 | 0.0810 | 0.1346 | 0.2535 | 149 |
| **Total** | **0.049** | **0.093** | **0.155** | **0.290** | **~ 171** |

# 8. Way Forward

The state energy efficiency action plan, through the research and interaction with various stakeholders, identifies the need, opportunity, and the potential of energy efficiency in the UT of Ladakh. While addressing the key focus sectors – Transport, Buildings and Industry the action plan envisages to analyze consumption pattern, growth rates in alignment with GDP growth rate of the state and potential strategies for achieving savings.

The action plan lays out a plan for the state to implement the strategies, while at the same time being able to monitor implementation. It is imperative that implementation is carried out in the state through various stakeholders.

A market-based mechanism is anticipated to be developed through the implementation of the action plan which drives energy efficiency through better availability of energy efficiency products, financial instruments for improving the product reach and a wider adoption of energy efficiency schemes and policies curated by both state and central governments.

A collaborative approach, on the part of the government, industry and academia is the ideal way forward to implement the vision and targets of this action plan and continue to put the country on a high pedestal of energy efficiency achievements at the global platform.

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