State Energy Efficiency Action Plan - Sikkim

MARCH 2023

विद्युत मंत्रालय
MINISTRY OF
POWER

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सत्यमेव जयते

Azadi Ka Amrit Mahotsav

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

Foreword

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

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

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

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

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

October, 2024

(Dr. Srikant Nagulapalli)

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RIGHT TO INFORMATION

Acknowledgement

The development of “State Energy Efficiency Action Plan (SEEAP)” is an important step towards the Central-State collaboration for mainstreaming energy efficiency at the state level to achieve India’s climate commitments. This strategic document has been prepared based on collaboration of Bureau of Energy Efficiency, Ministry of Power, Government of India along with State Designated Agencies and different stakeholder and ministries in the state level.

PwC extends its profound gratitude to Shri Pankaj Agarwal, Secretary of the Ministry of Power, Government of India, and Mr. Shrikant Nagulpalli, Director General of the Bureau of Energy Efficiency (BEE), for their exceptional leadership and guidance during the execution of the assignment. The team also recognizes and expresses its sincere appreciation to Mr. Milind Bhikanrao Deore, Secretary of BEE, for his invaluable contributions and insights throughout the assignment's execution. The team acknowledges the cooperation and unwavering support provided by Mr. Abhishek Sharma, Joint Director of BEE, for his supervisory role during the entire execution phase. The team also expresses its appreciation to Mr. Vikash Kumar Jha, Project Engineer at BEE, for his continuous support and effective coordination with various stakeholders.

PwC further extends its profound gratitude to Shri T T Lepcha, Principal Chief Engineer-cum-Secretary, Power Department, Government of Sikkim, Shri Pemba Lepcha Chief Engineer-cum-Nodal Officer (SDA Sikkim) and Smt. Sigratha Pradhan, Executive Engineer (SDA Sikkim) for their extended support for successfully completing the project. The team also extend its sincere thanks to all state government departments and stakeholders of the state of Sikkim for their valuable inputs towards the completion of the earmarked project tasks.

Sincere gratitude to all government and private sector participants of the physical survey whose inputs has been considered as part of the report. The team also extends its gratitude to the industry associations, building sector professionals and other stakeholders who were extensively consulted as part of the project

Lastly, we would like to thank internal team members for their hard work, dedication, and professionalism. Their collective efforts, expertise, and commitment to excellence have been the backbone of this project. In conclusion, this project stands as a testament to what can be achieved through collaborative efforts and shared goals.

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State Energy Efficiency Action Plan – East Zone

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Abbreviations

Abbreviation List	Full Form
GDP	Gross Domestic product
PAT	Perform, Achieve and Trade
EE	Energy efficiency
ECBC	Energy Conservation Buildings Code
EV	Electric Vehicle
DISCOM	Distribution Company
UT	Union Territory
UJALA	Unnat Jyoti by Affordable LEDs for all
LPG	Liquified petroleum gas
HSD	High speed diesel
LDO	Light diesel oil
FO	Furnace oil
GSDP	Gross state domestic product
SEC	Specific energy consumption
MSME	Micro, small and medium enterprises
ICE	Internal combustion engine
HDV	Heavy duty vehicle
SEEAP	State energy efficiency action plan
NDC	Nationally determined contributions
COP	Conference of parties
MW	Megawatt
MU	Million units
INR	Indian Rupee
CAGR	Compound annual growth rate
FY	Financial Year
DPIIT	Department for Promotion of Industry and Internal Trade
FDI	Foreign direct investment
UNNATEE	Unlocking National Energy Efficiency Potential
DC	Designated Consumer
NTPC	National Thermal Power Corporation
BEE	Bureau of Energy Efficiency
SME	Small and medium enterprise
IIT	Indian Institute of Technology
ECM	Energy Conservation Measures
BEEP	Buildings Energy Efficiency Programme
DSM	Demand side management
ECBC	Energy Conservation Building Codes
ULB	Urban Local Bodies
SDA	State Designated Agencies
PWD	Public Works Department
EV	Electric Vehicle
PM	Prime Minister
ESCO	Energy Services Company
GCV	Gross Calorific Value
TOE	Tonnes of oil equivalent
MTOE	Million tonnes of oil equivalent
SAIL	Steel Authority of India Limited
DMA	Directorate of Municipal Administration
SREDA	Sikkim Renewable Energy Development Agency

SSERC	Sikkim State Electricity Regulatory Commission
SPDCL	Sikkim Power Development Corporation Limited

Executive Summary

India is a diverse country with diverse energy consumption patterns in different states/UTs. Broadly, the energy consumption is divided in five major sectors i.e., Buildings, Transportation, Municipalities and DISCOMs, Agriculture and Industries. Although India remains progressive and one of the front runners to achieve its Energy Efficiency (EE) potential, through innovative programmes such as the PAT scheme, Standards & Labelling, UJALA scheme, Energy Conservation Building Code, Electric Vehicle mission and Smart metering etc. However, at a state level, there is still an immense potential to be realized from large-scale implementation of EE interventions in various afore-mentioned demand sectors.

Therefore, there is a dire need for a focused sector-based energy efficiency approach by states/UTs. In view of this, the Bureau of energy efficiency has taken on this endeavor to state specific Energy Efficiency Action Plan through identification of focus sector, undertaking gap analysis, adopting best practices followed in peer group with implementation plan strategy; that can act as platform for developing State's Energy Policy and Programms.

The overall scope of work for this assignment is as follows:-

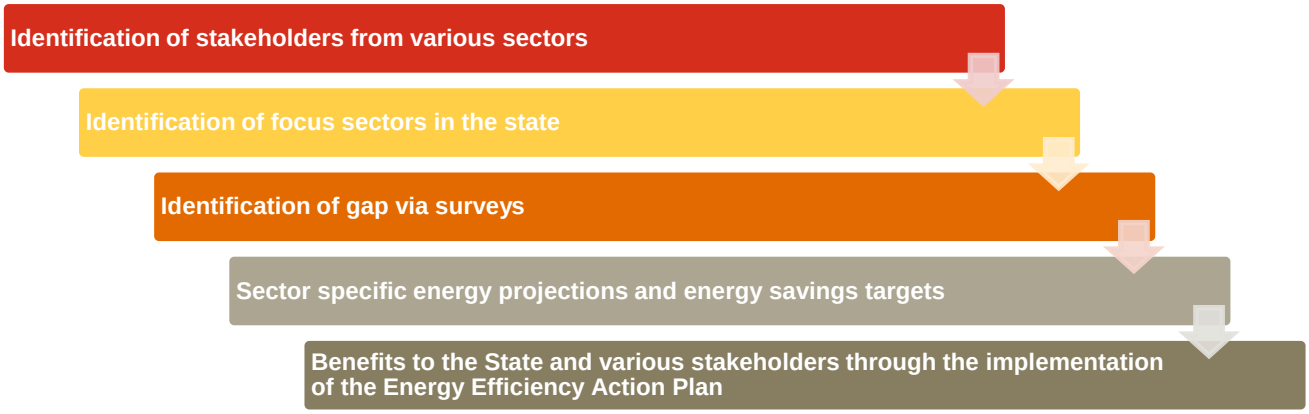


Figure 1: Broad scope of work

State context

Sikkim encompasses Lesser Himalaya, Central Himalaya, and the Tethys Himalaya. The area is like a stairway leading from the western border of the Tibetan plateau down to the plains of West Bengal. The habitable areas exist only up to the altitude of 2,100 m constituting only 20% of the total area of the state. More than 64% of the population of Sikkim depends on agriculture for their livelihoods, directly or indirectly cultivating 1,09,963 hectares which is only 15% of the total land area of Sikkim. The Gross State Domestic Product (GSDP) of Sikkim expanded at a high CAGR of 12.66% between 2015-16 and 2020-21.

From an energy supply standpoint – oil in the form of LPG, Petrol, Kerosene, HSD, LDO & FO and hydro-electric powerplant is the most prominent source of energy. Following flowchart illustrates energy supply and consumption scenario in Sikkim:-

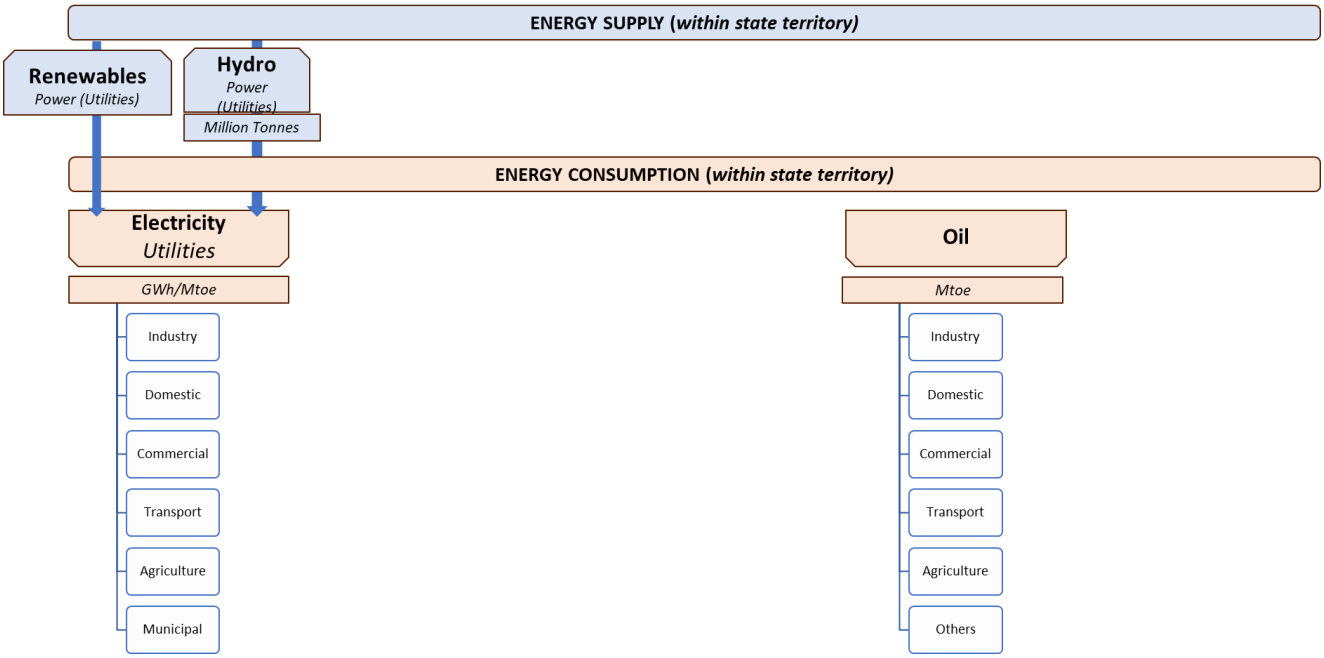


Figure 2: Sikkim's energy supply and consumption characteristics

From a consumption standpoint - the total energy consumption of Sikkim for the year has been estimated to be approximately 0.18 Mtoe for the year 2019-20.

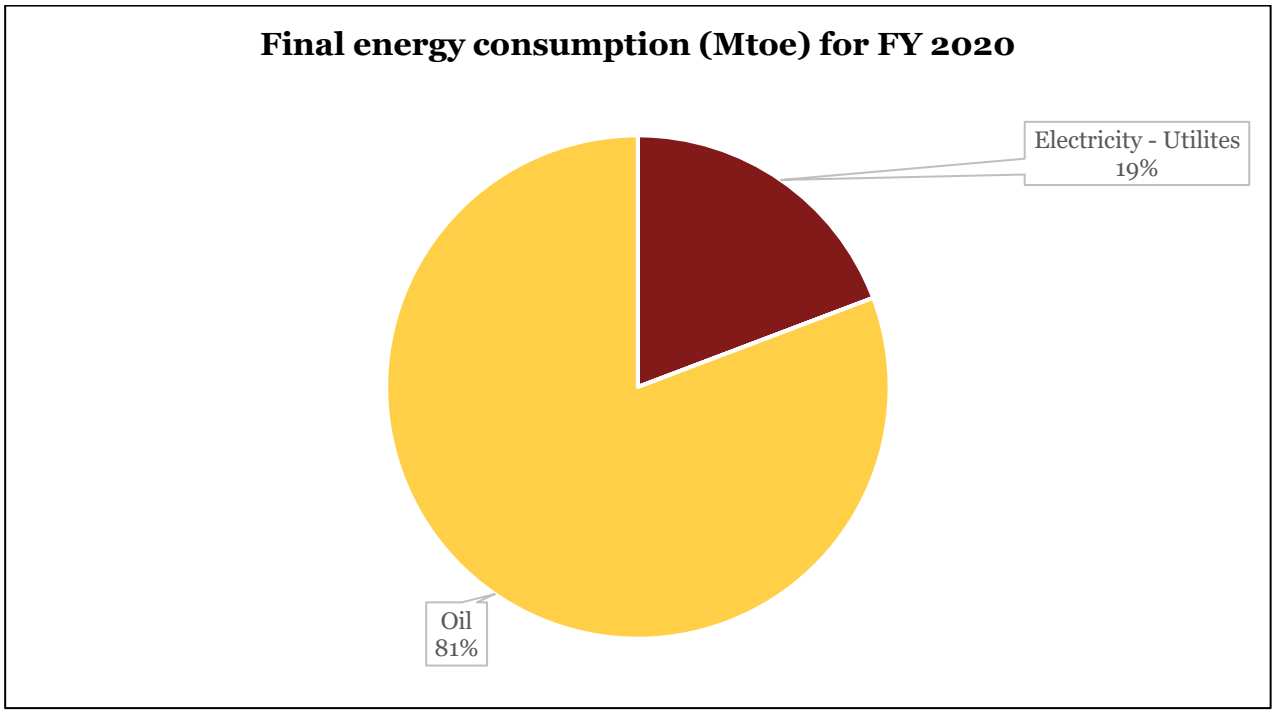


Figure 3: Sikkim's final energy consumption (fuel wise)

Identification of focus sectors

For identifying the major energy guzzling sectors in the state, energy consumption data of a number of sectors was researched and analyzed. This data was gathered via primary consultations with the various stakeholders and through secondary domain research.

Based on this assessment, following sectors were identified as the most energy intensive in the state: -

Figure 4: Identified focus sectors

Following table illustrate the sector wise energy consumption in the state:-

Projection and forecasting

It has long been axiomatic that economic growth and energy demand are linked. As an economy grows – its energy demand increases; if energy is constrained, GDP growth pulls back in turn. Following graph forecasts Sikkim's GSDP and its energy consumption from 2015 to 2030:-

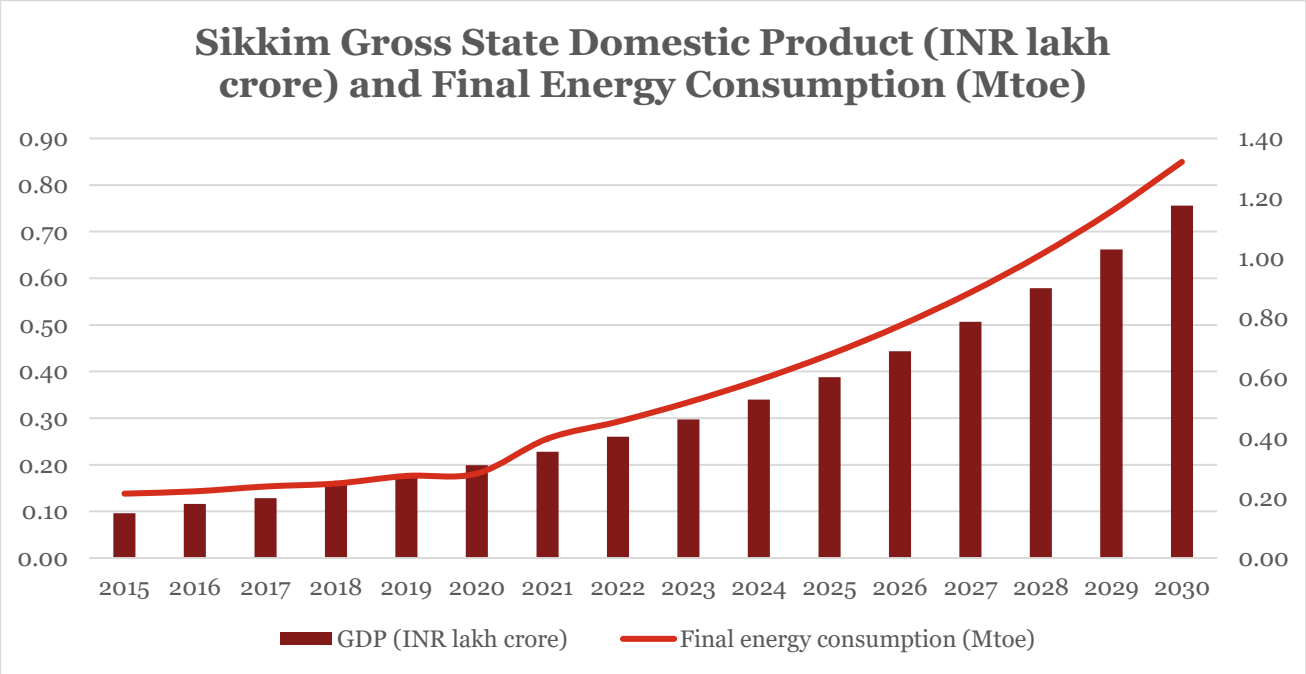


Figure 5:Energy consumption and GDP forecasting of Sikkim

The baseline energy consumption intensity for FY2020 was calculated (0.72) and multiplied with forecasted GSDP to obtain final energy consumption trend till 2030.

Focus sector 1 – Commercial and domestic buildings

Current scenario

The buildings sector in encompasses different types of buildings present in Sikkim i.e, domestic (households) and commercial (health facilities, commercial complexes, public buildings etc.). From an energy perspective – the buildings sector is one of the major consumers at 0.04 Mtoe.

Energy efficiency potential in the sector

The estimated energy efficiency potential projected for the year 2030 in the industrial sector in Sikkim is as follows: -

Table 1: EE potential in Building Sector

EE Strategy	Energy Savings in 2030 under moderate scenario (Mtoe)	Energy Savings in 2030 under ambitious scenario (Mtoe)
Strategy 1	**0.001741604**	**0.003033043**
Strategy 2	**0.00000014**	**0.00000019**
Strategy 3	**0.000056**	**0.000112**

Energy efficiency strategies in the sector

1. Action plan 1 – Replacement Programme for inefficient appliances: Replacement of inefficient appliances with their efficient counterparts can be considered as a low hanging fruit from and energy efficiency implementation standpoint. This strategy can be implemented in both domestic as well as commercial buildings. As part of the strategy, following appliances have been identified that can be in the contention for replacement:-

Following table encapsulates the energy efficiency potential in the year 2030 as per this strategy appliance replacement Programme:-

Table 2: EE Potential from replaing inefficient appliances

Appliance	Inefficient stock in FY2020	Energy saving in moderate scenario (Mtoe)	Energy saving in ambitious scenario (Mtoe)
Fan	150750	**.000526**	**.000877**
Air conditioner	23450	**.000182**	**.000304**
Refrigerator	75375	**.00056**	**.000933**
Washing Machine	61975	**.0000576**	**.0000959**
Television	87100	**.0000243**	**.0000404**
LPG cookstove	155775	**.000391**	**.000782**

(Note: In moderate scenario, it is assumed that 30% of appliances will be replaced with efficient appliances and 10% switch to electric cookstove. In ambitious scenario, it is assumed 50% appliance replacement with efficient appliance and there will be a 20% switch to electric cook stove)

2. Action Plan 2 - it is recommended that the new and upcoming commercial and domestic buildings (having a connected load of minimum 100 kW) may be mandated as per the energy conservation buildings code (ECBC) in the state. Following table illustrates the energy efficiency that can be achieved via this strategy:-

   Following table encapsulates the energy efficiency potential in 2030 as per this strategy of mandating the compliance of ECBC for new buildings:-

2030 energy consumption in new commercial building more than 100 kW (Mtoe)	Energy saving in moderate scenario (Mtoe)	Energy saving in ambitious scenario (Mtoe)
0.00001092	**0.00000014**	**0.00000019**

   (Note: In moderate scenario, it is assumed ECBC will be implemented in new commercial buildings more than 100 kW connected load and lead to 25% savings. In ambitious scenario, ECBC is assumed to be implemented in new commercial buildings more than 100 kW and lead to 35% savings)

3. Action plan 3 - Under this strategy, it is recommended that periodic energy audits may be carried out at public/commercial buildings on load basis. Directives may be issued to government departments to carry out detailed energy audits at their respective building facilities. Following table illustrates the energy efficiency that can be achieved via this strategy: -

2030 energy consumption in commercial and public buildings sector (Mtoe)	Energy saving in moderate scenario (Mtoe)	Energy saving in ambitious scenario (Mtoe)
0.004	**0.000056**	**0.000112**

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

Focus sector 3 – Transport

Current scenario

The transport sector is a major consumer of energy in Sikkim and contributes to approximately 62% of the total energy consumption in the state. Therefore, there needs to be a strong emphasis on electric vehicles to decarbonize this sector.

Energy efficiency potential in the sector

Following table estimates the energy efficiency potential projected for the year 2030 in the transport sector in Sikkim:

Table 3: EE Potential in Transport Sector

Strategy	Energy Savings in 2030 under moderate scenario (Mtoe)	Energy Savings in 2030 under ambitious scenario (Mtoe)
Strategy 1	0.00008	0.000332
Strategy 2		0.0331

Energy efficiency strategies in the sector

1. Action Plan 1: **Transition of existing fleet to electric vehicles:** Under this strategy, it is recommended to transition the existing ICE (Internal combustion Engine) fleet (two wheelers, three wheelers, four wheelers, bus and heavy vehicles) to electric vehicles. Following table encapsulates both the aforementioned scenarios and demonstrates the energy efficiency potential in the year 2030 as per this strategy of transition from ICE to electric vehicles :-

Energy saving in moderate scenario (Mtoe)	Energy saving in ambitious scenario (Mtoe)
0.00008	**0.000332**

(Note: As per NITI Aayog projections, 80% EV penetration in two-wheelers, 80% EV penetration in three-wheelers, 30% EV penetration in four-wheelers, 40% EV penetration in buses and 20% EV penetration in HDV in moderate scenario. 100% EV penetration in two-wheelers, 100% EV penetration in three-wheelers, 60% EV penetration in four-wheelers, 80% EV penetration in buses and 40% EV penetration in HDV in ambitious scenario)

2. Action plan 2: **Ethanol blending Programme:** Under this strategy - it is recommended that, as per the national target, ethanol blending in conventional fuels may be executed. The target already set in this segment is 20%. Following table encapsulates both the aforementioned scenarios and demonstrates the energy efficiency potential in 2030 as per this strategy: -

2025 energy consumption in transport (Mtoe)	Energy saving as per policy (Mtoe)
0.166	**0.0331**

Introduction

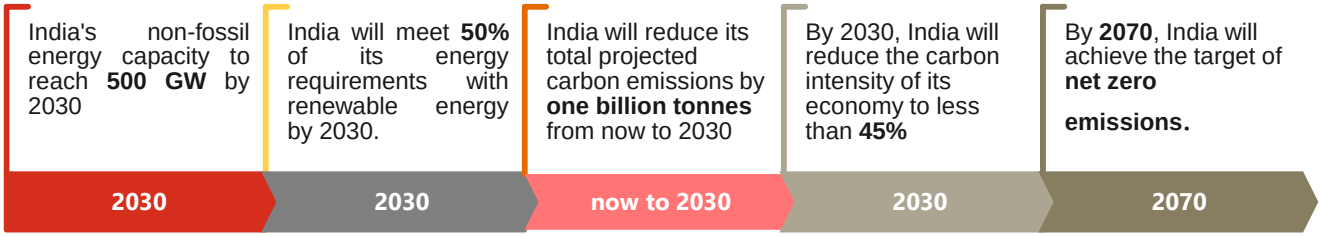
Background and about State Energy Efficiency Action Plan

The objective of the **State Energy Efficiency Action Plan (SEEAP)** is to ensure that the allocation of resources is as per the requirement of the state and to estimate the potential of energy conservation in sectors that are predominant in the region. The current assignment envisions the following:

- Identification of stakeholders from various sectors,
- Identification of focus sectors in a state,
- Identification of gaps through surveys,
- Sector-specific energy projections and energy savings targets
- Benefits to the State and various stakeholders through the implementation of the Energy Efficiency Action Plan

India's Nationally Determined Contributions

India's first NDC in **Paris Agreement on Climate Change - 2016** called for **33-35%** reduction of emissions intensity of GDP by 2030 compared to 2005. However, this target has been increased to **45%** in the recent COP26. The five ambitions, also known as **Panchamrit,** that India announced in the recent Conference of Parties (COP-26) at Glasgow, UK, are as follows:



With the energy efficiency agenda gaining traction and momentum in India, there is a need to continuously evaluate institutional capacity, policies, programs, and markets at the state level to identify best practices and promote cross learning. Developing State Specific Energy Efficiency Action Plan through identification of **focus sector**, **undertaking gap analysis**, **adopting best practices** followed in peer group with **implementation plan strategy**; that can act as platform for developing State's Energy Policy and Programs. This assignment aims to develop State Specific Energy Efficiency Action Plans for the state of Sikkim.

India is a diverse country with diverse energy consumption patterns in different states/UTs. Broadly, the energy consumption is divided in five major sectors i.e., **Industries, Buildings, Transportation, Agriculture, Municipalities and DISCOMs.**

Though energy efficiency is a multi-dimensional subject, defining key focus areas to bridge gaps is the need of the hour. For instance, there may be states with lesser urbanized areas and therefore lesser number of high energy consumption buildings. Such a state may need more focus on energy efficiency in sectors such as Transportation, Agriculture, or others.

As a part of the assignment, there has identification of stakeholders from various sectors, identification of focus sector in the state of Sikkim, identification of gaps in the sector, providing best practices and identification of designated agency to carry out efficiency activity in the sector in consultation with state for preparation of a short-term plan till the year 2025 and a medium-term plan till the year 2030. The plan also highlights the benefits derived from these initiatives to the state.

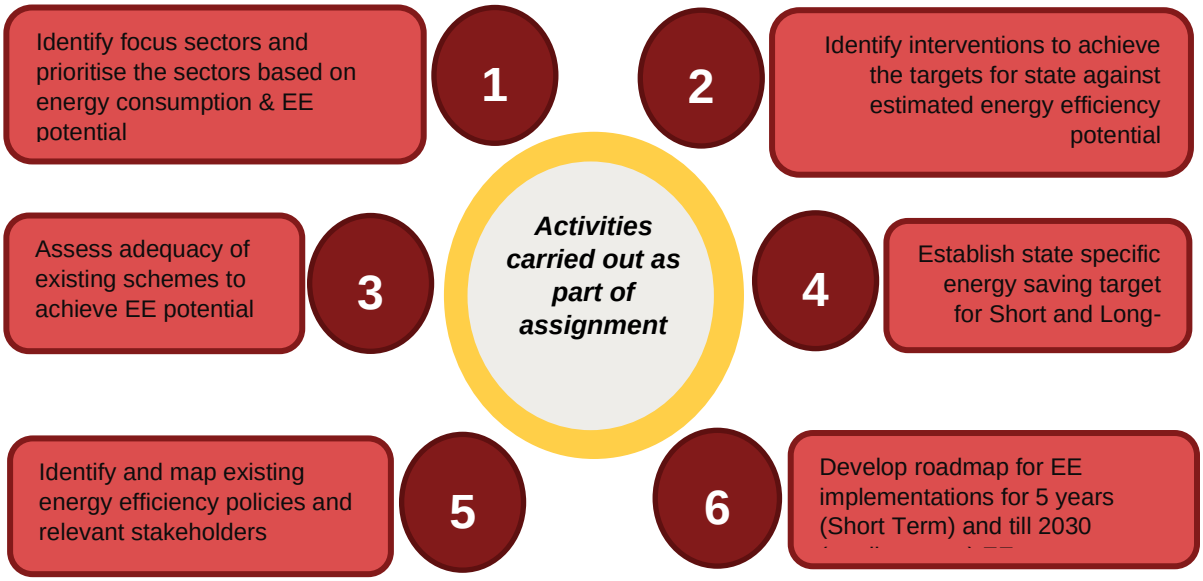


Figure 6: Key activities of the project

State profile

Located in the North-eastern part of India, Sikkim encompasses Lesser Himalaya, Central Himalaya, and the Tethys Himalaya. The area is like a stairway leading from the western border of the Tibetan plateau down to the plains of West Bengal. The habitable areas exist only up to the altitude of 2,100 m constituting only 20% of the total area of the state. Spanning Sikkim's western borders are the Khangchendzonga and the Singalila Range, a north- south spur of the Great Himalaya. The northern limits reaching out to the Tibetan Plateau is straddled by the Donkia Range while the eastern flank is bounded by the Chola Range. More than 64% of the population of Sikkim depends on agriculture for their livelihoods, directly or indirectly cultivating 1,09,963 hectares which is only 15% of the total land area of Sikkim. The hill slopes have been converted into farmlands using terrace-farming techniques and is used for cultivation. Cardamom is the main cash crop in the district, which makes a premier part of economy.

The Gross State Domestic Product (GSDP) of Sikkim expanded at a high CAGR of 12.66% between 2015-16 and 2020-21. In 2020-21, the secondary sector contributed 55.19% to the state's GSVA at current prices. It was followed by the tertiary sector at 34.16% and the primary sector at 10.64%. At a CAGR of 15.45%, the primary sector witnessed the fastest growth among the three sectors between 2011-12 and 2020-21.

As per the state profile of Sikkim developed by Invest India, the following are the key sectors that have emerged as major contributors t o the growth of Sikkim:

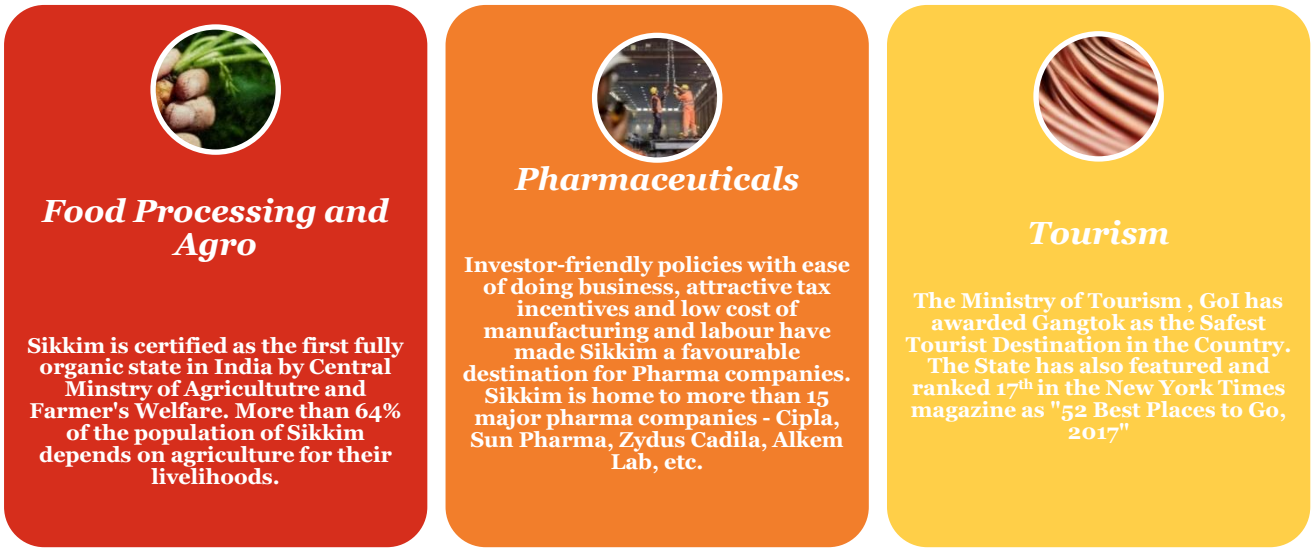


Figure 7: Key economic areas in Sikkim

Table 4: Key profile of Sikkim[1]

S.No.	Parameter	Sikkim
1	Population (2022-23)	6.7 lakhs
2	Land Area (km^2)	7096
3	Number of Districts (2022)	4
4	Gross State Domestic Product (2019-20) at constant prices (2011-12)	₹1,763 Crore
5	Per Capita Income (2019-20) at constant prices (2011-12)	₹2,32,968
6	Installed Power Generation Capacity (2022)	95.7 MW
7	Per capita electricity consumption (2014-15)	317.73 kWh

Energy supply and consumption scenario

Energy supply

From an energy supply standpoint – oil in the form of LPG, Petrol, Kerosene, HSD, LDO & FO and hydro-electric powerplant is the most prominent source of energy. Following flowchart illustrates energy supply and consumption scenario in Sikkim:-

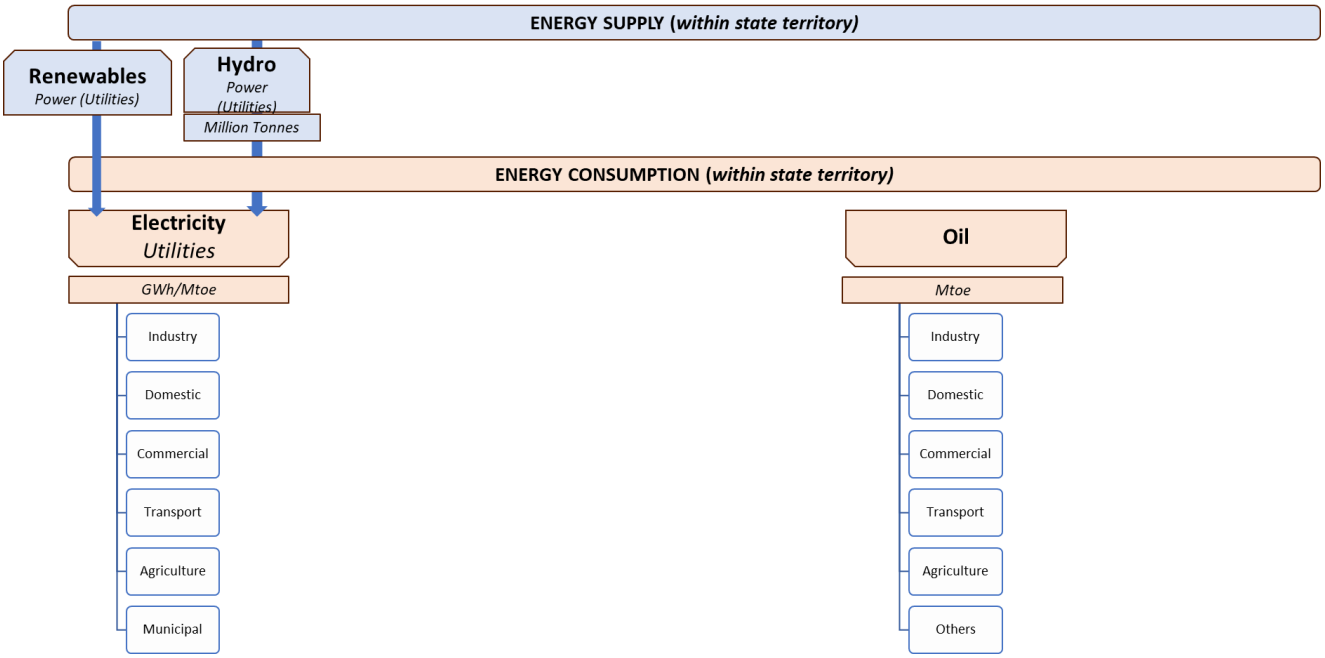


Figure 8: Sikkim's energy supply and consumption characteristics

As illustrated in the above figure – along with oil, electricity (generated from the thermal power plants and renewable sources) is utilized across critical sectors such as Industries, Domestic, Commercial, Transport, Agriculture and Municipal (public lighting, water treatment plants, municipal water pumps etc.).

Energy Consumption

From a consumption standpoint - the total energy consumption of Sikkim for the year has been estimated to be approximately 0.18 Mtoe for the year 2019-20. It is pertinent to mention here that oil consumption is the major

[1] DIRECTORATE OF ECONOMICS, STATISTICS, MONITORING & EVALUATION, Govt of Sikkim | Energy and Power Department, Government of Sikkim

contributor to this estimate at 0.15 Mtoe followed by electricity at 0.035 Mtoe. Following figure illustrates the same: -

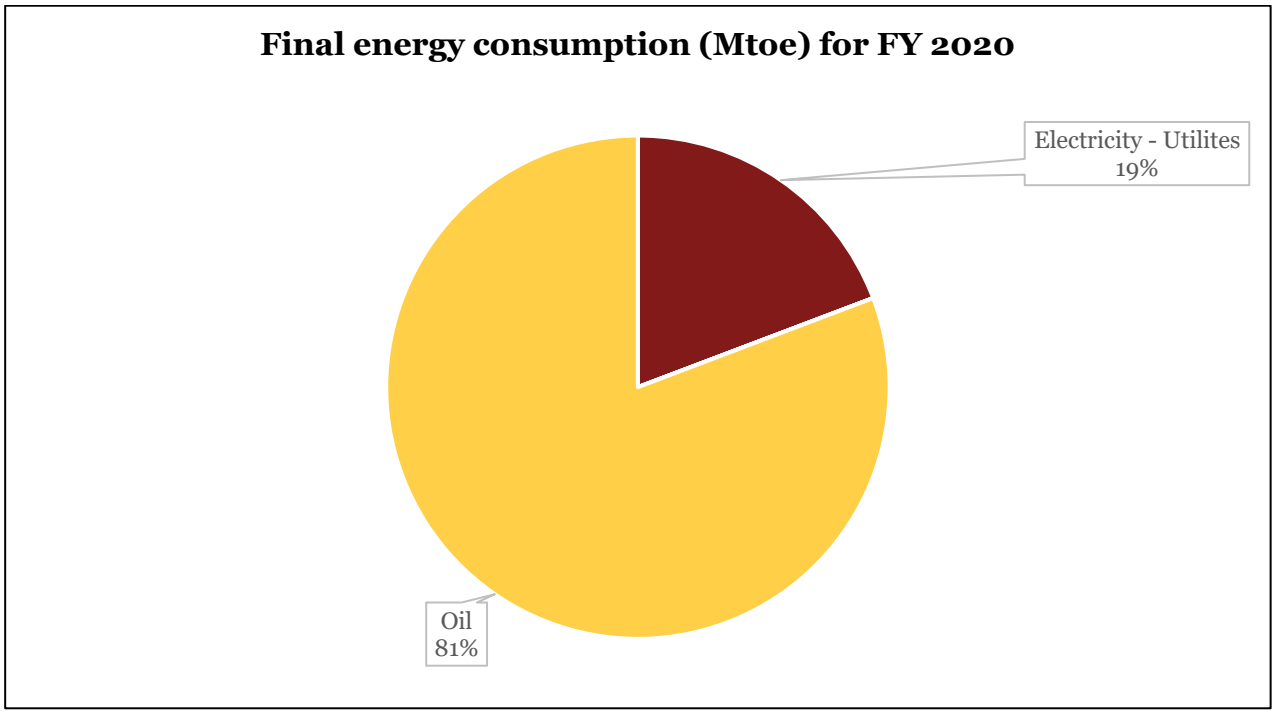


Figure 9: Sikkim's final energy consumption (fuel wise)

As specified above, the energy consumption in the state is composed of primary energy and electricity. It is pertinent to mention here that Sikkim has seen a gradual increase in energy consumption ranging from 0.14 Mtoe in 2015 to 0.18 Mtoe in 2020. This consumption encapsulates electricity and Oil.

Following figure illustrates the final energy consumption of Sikkim (in Mtoe) between 2015 and 2020:-

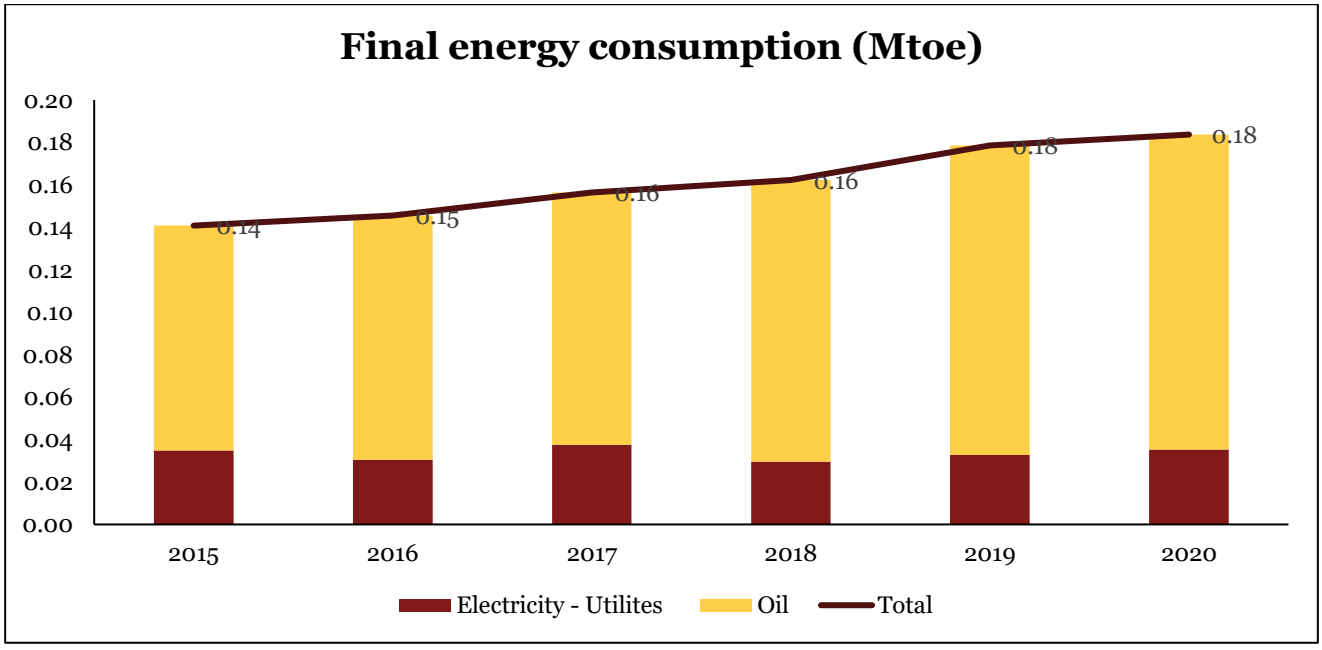


Figure 10: Final energy consumption

Electricity Scenario

Installed capacity

The Sikkim Energy & Power Department is responsible for the production of electricity, its transmission to various load centres, and its final consumption by all types of consumers. To meet the state's constantly expanding demand and generate income, the Department as a whole is in charge of developing electricity projects. Sikkim

may look forward to generating and utilising its enormous hydropower potential, which has been estimated to reach 8000 MW Peak with a firm base of 3000 MW, with the opening of this sector for private developers. The state now has 95.70 MW of installed capacity overall. There is currently 5352.7 MW of total hydropower potential in the state, and it is spread out over different stages of implementation.

Electricity peak demand in the state

In the context of power availability, over the years Sikkim has undertaken several measures related to energy capacity addition, improvement of transmission and distribution network as well as energy conservation. As a result, Sikkim's peak demand has increased over the years:

Table 5: Sikkim's peak demand trend

Year	Peak Demand Met (MW)
2018	90
2019	105
2020	115
2021	120
2022	132

Renewable energy scenario

As on 31 March 2020, the total estimated potential of renewable power in the state of Sikkim is around 5,209 MW. This can be broken down as:

Table 6: Sikkim Renewable Energy Scenario

Source	Estimated Potential (in MW)
Solar Energy	4,940
Biomass Power	2.3
Small-hydro Power	266.64
Total	**5,209**

Total estimated renewable energy potential in Sikkim[2]

Overview of Institutional framework and stakeholder mapping

The below figure shows the organizational structure of the Power Department of Sikkim:

[2] Energy Statistics India 2021

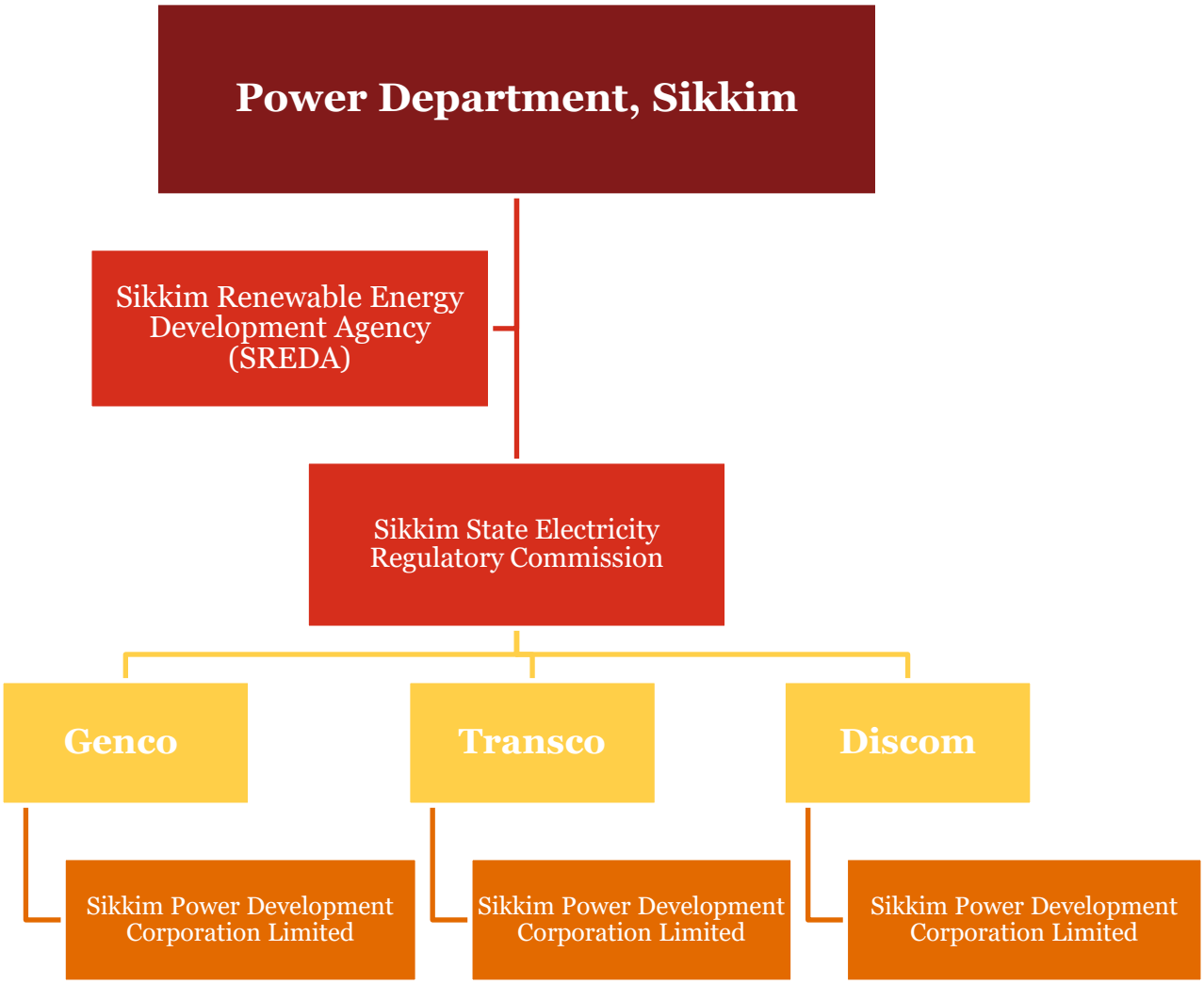


Figure 11: Overview of institutional framework

- **Power Department Sikkim**: The Energy & Power Department, Government of Sikkim is responsible for generation, distribution and transmission of electricity in the State of Sikkim. The Department is a deemed licensee under the provisions of the electricity Act, 2003 in the State.
- **Sikkim Renewable Energy Development Agency (SREDA)**: The department is fully geared up towards development of green energy. With the recent transfer of mandate, SREDA is now under the administrative control of Energy & Power Department. SREDA is working towards promoting Roof-Top based solar power generation to meet the Renewable Purchase Obligation (RPO) of 13 MWp Solar Power generations by 2022 and to contribute towards national endeavor.
- **Sikkim State Electricity Regulatory Commission**: Sikkim State Electricity Regulatory Commission (SSERC) has been set up as per the Section 82 of the Electricity act, 2003. Presently SSERC has only a tiny Organisation structure to discharge the various activities and functions. The structure of the Commission has been framed in line with the guidelines issued by the Central Electricity Regulatory Commission with the aim to provide the best possible services to the consumers as well as the power generators, distributors and suppliers.
- **Sikkim Power Development Corporation Limited**: Sikkim Power Development Corporation , a Government of Sikkim Enterprise, is engaged in the business of development of Hydro Power Projects

in Sikkim. The Corporation is developing hydro power project of capacity up to 25 MW. The Corporation has selected M/s Athena Power Projects Pvt Limited as its strategic partner to bring in more efficiency and resources for development of the Corporation.

Moreover, from an end consumer perspective – a number of other departments were also consulted as part of this study. Following figure illustrates the various departments were involved as a part of the study: -

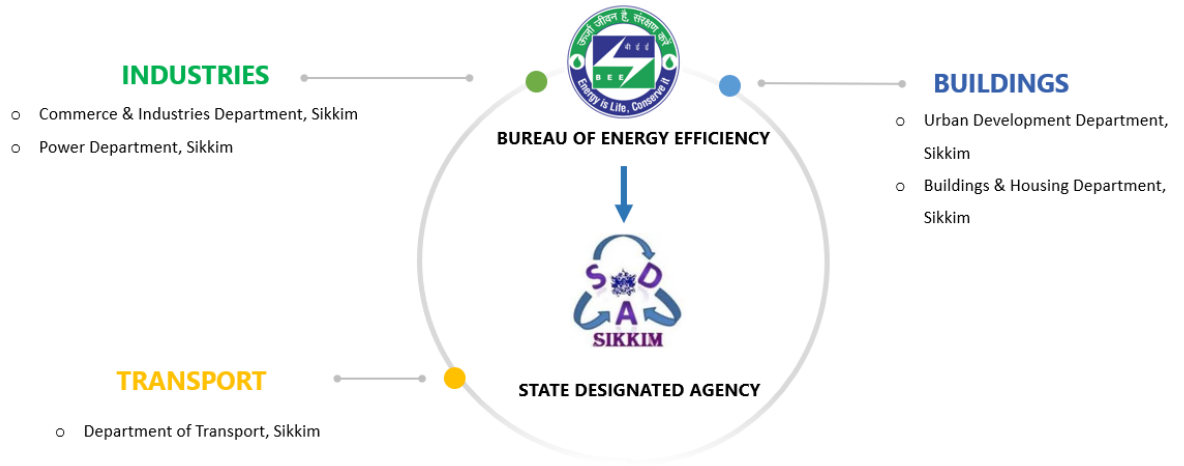


Figure 12: Departments representing Industries, buildings, and transport

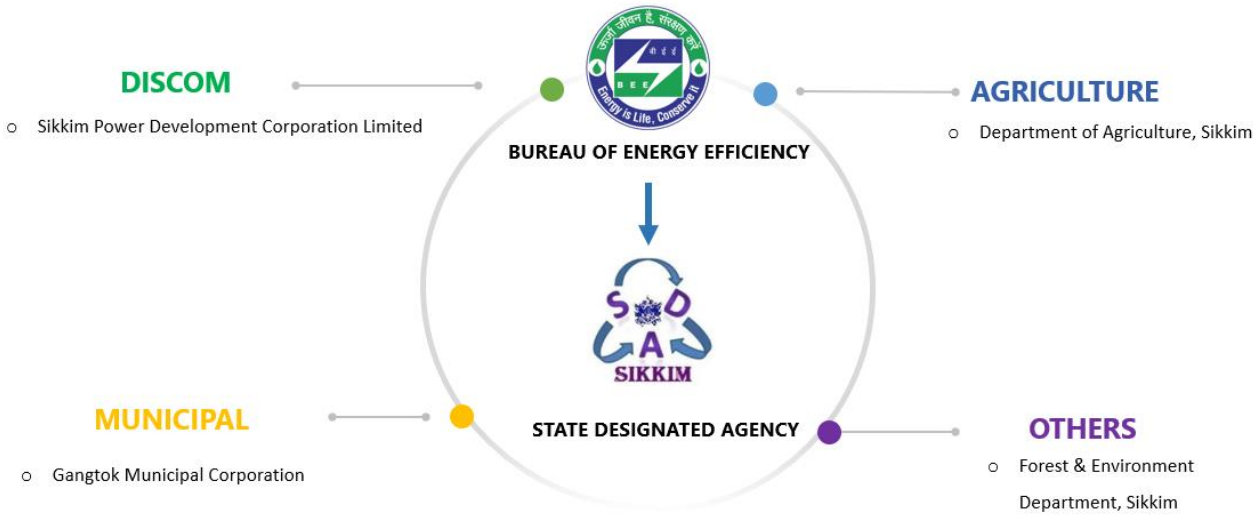


Figure 13: Departments representing DISCOMs, agriculture, municipal and others.

Identification of focus sectors

India has remained progressive and one of the front runners to achieve its Energy Efficiency (EE) potential, through innovative programmes such as the PAT scheme, Standards & Labelling, UJALA scheme, Energy Conservation Building Code, Electric Vehicle mission and Smart metering etc. However, at the country level, there is still an immense potential to be realized from large-scale implementation of EE interventions at state level in various demand sectors- industries, MSMEs, agriculture, transport, municipal, domestic & commercial buildings.

These states are also at different stages of progressiveness towards adoption of EE interventions in various demand sectors, which necessitates the need to identify focus sectors, evaluate existing policies and institutional capacities. This section identifies the key energy consuming sectors in Sikkim.

Methodology of focus sector identification

For identifying the major energy guzzling sectors in the state, energy consumption data of a number of sectors was researched and analyzed. This data was gathered via primary consultations with the various stakeholders and through secondary domain research. In this regard, following sectors were analyzed:-

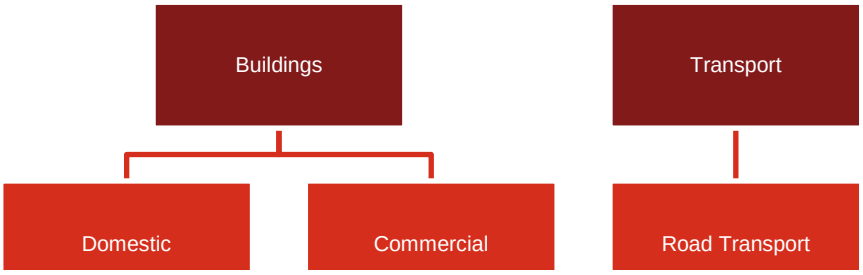


Figure 14: Areas assessed as part of focus sector identification

Identified focus sectors

Upon analyzing the energy consumption data gathered via primary exercise and secondary research, following focus sectors have been identified:

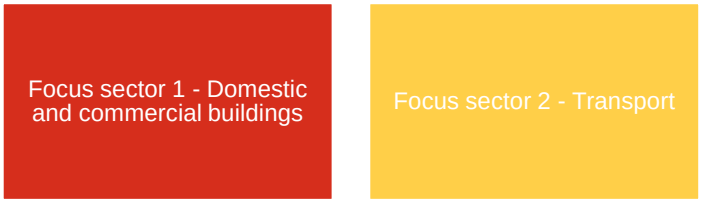


Figure 15: Focus Sectors

In the year 2019 - the transport sector of Sikkim consumed **62%** of the total final energy consumption at **0.112 Mtoe** followed by the domestic sector at **20% (0.036 Mtoe)**, Industrial sector at **15% (0.027 Mtoe)** and the remaining by the commercial, agriculture, municipal and others.

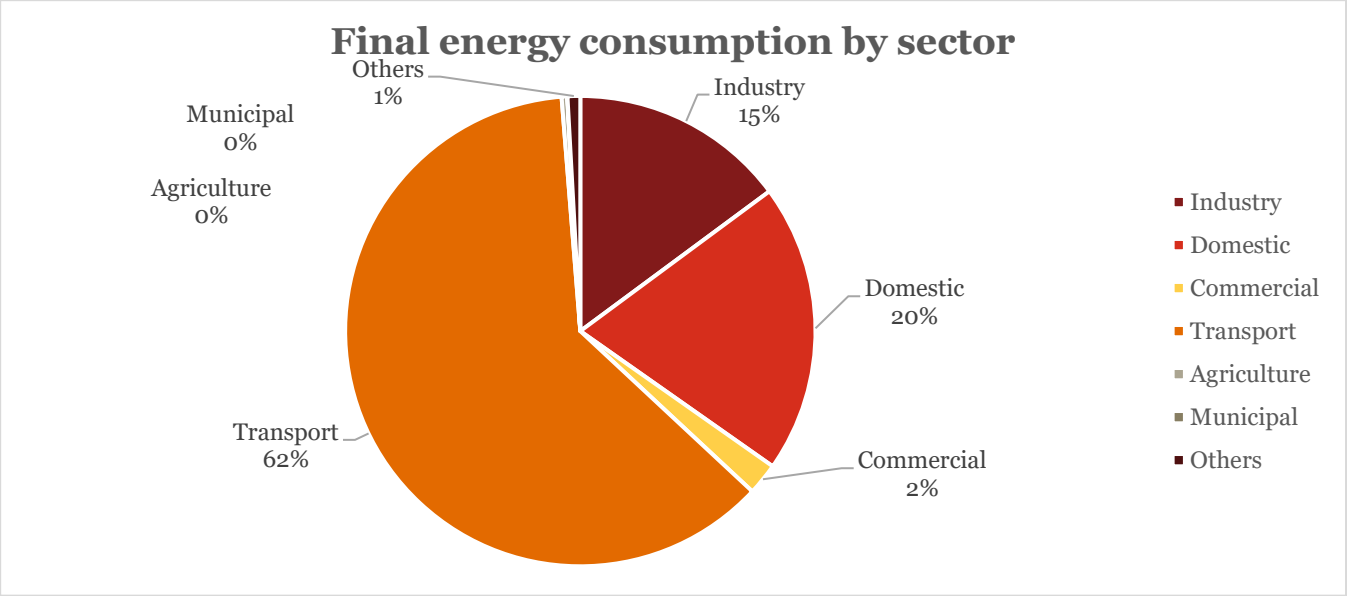


Figure 16: Final energy consumption by sector

In this regard, the afore-mentioned sectors have been selected based on their total final energy consumption in 2019-20.

Projections and forecasting

It has long been axiomatic that economic growth and energy demand are linked. As an economy grows – its energy demand increases; if energy is constrained, GDP growth pulls back in turn.

In view of the above, this section explores the past trends related to Sikkim's **energy consumption** and its GDP and at the same time projects future trajectory of the aforementioned critical elements and explores their correlation i.e., energy intensity.

Forecasting of Sikkim's GDP

Following figure captures Sikkim's GDP over the years (between 2014/15 to 2019/20). Sikkim's GDP varies from **INR 0.15 Lakh Cr** in 2015 to **0.31 Lakh Cr** in 2020 at a CAGR OF 15.6%. This figure also projects the increase in GDP from 2020 to 2030. This has been projected till 2030 using 80% weightage to historic trend of 15.6% and 20% weightage to the forecast of 14.3% as per the latest Sikkim Economic Survey.

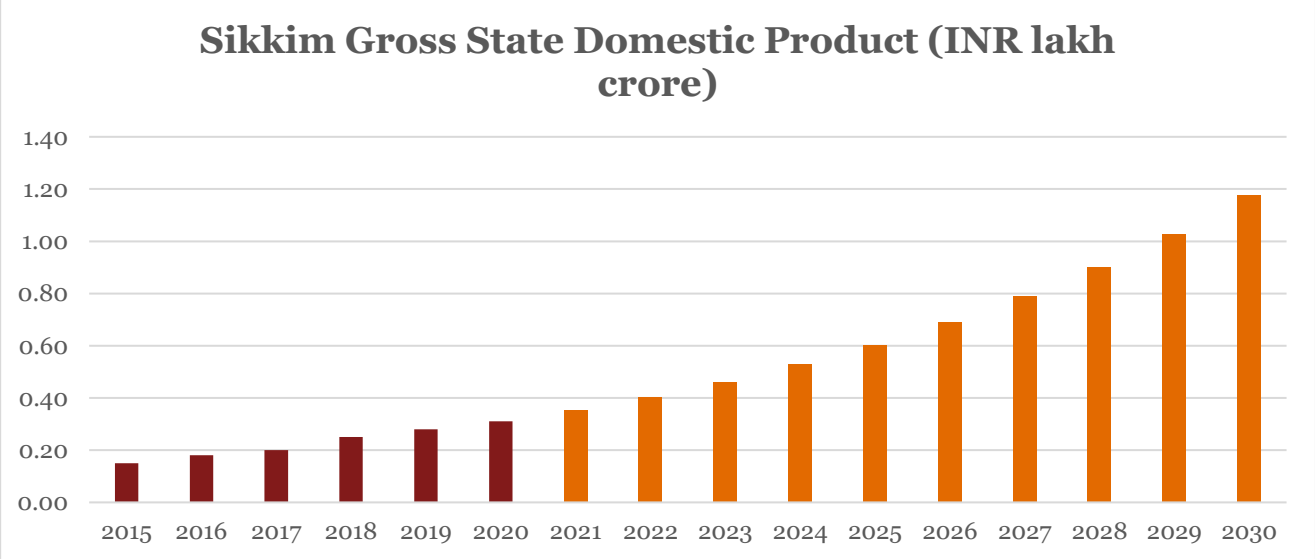


Figure 17: Sikkim Gross State Domestic Product

Forecasting of final energy Consumption

The final energy consumption in Sikkim varies from 0.14 Mtoe in 2014-15 to 0.18 Mtoe in 2020. This indicates a 31.3% rise in energy consumption over a period of five years. The baseline energy consumption intensity for FY2020 was calculated and multiplied with forecasted GSDP to obtain final energy consumption trend till 2030.

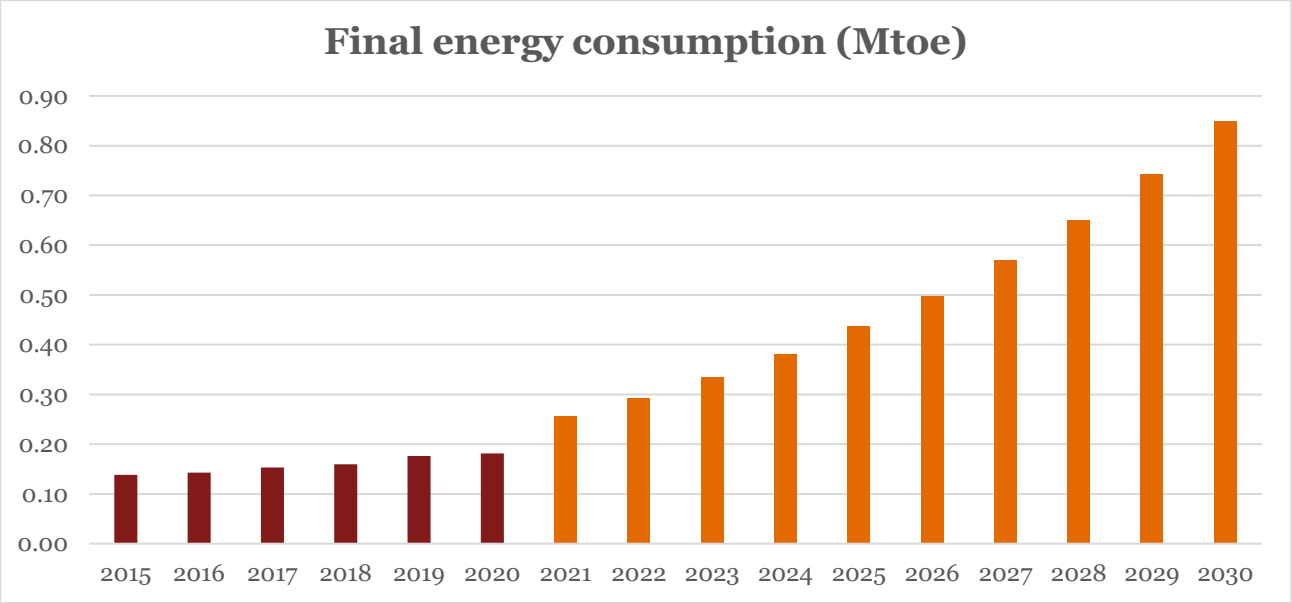


Figure 18: Year-wise projection of final energy consumption

Focus sector 1 – Buildings

This section assesses the present scenario of this sector, energy efficiency potential, EE strategies in the sector (existing and proposed) along with setting of energy savings targets and its monitoring mechanism.

Current scenario

Brief description of the sector

The buildings sector in encompasses different types of buildings present in Sikkim i.e, domestic (households) and commercial (health facilities, commercial complexes, public buildings etc.). This sector can be considered as a low hanging fruit from the perspective of EE implementation as such programmes in this sector are relatively less complex as compared to industries. Following table depicts the key highlights for the building sector in Sikkim: -

Table 7: Key highlights for the building sector in Sikkim

Key highlights	
Share in energy consumption	22%
Stakeholders	• Urban Development Department, Sikkim • Buildings & Housing Department, Sikkim

Energy efficiency potential in the sector

The estimated energy efficiency potential projected for the year 2030 in the buildings sector in Sikkim is as follows: -

Table 8: EE Potential in Building Sector

EE Strategy	Energy Savings in 2030 under moderate scenario (Mtoe)	Energy Savings in 2030 under ambitious scenario (Mtoe)
Strategy 1	**0.001741604**	**0.003033043**
Strategy 2	**0.00000014**	**0.00000019**
Strategy 3	**0.000056**	**0.000112**

The energy savings potential has been estimated based on the following two scenarios: -

- Moderate scenario
- Ambitious scenario

The afore-mentioned two scenarios have been devised across both domestic and commercial type of buildings based on different type of strategies. This will be discussed in detail in the next section.

Energy Efficiency strategies in the buildings sector

To realize the energy efficiency potential in the buildings sector in Sikkim, as set out in the previous section, a number of strategies and polices have to fall in place. Moreover, apart from the estimated EE potential in the state, the Unlocking National Energy Efficiency Potential (UNNATEE) report published by the Bureau of Energy Efficiency has laid out the energy saving target of Sikkim by segregating the total energy saving potential for each sector. The energy saving target for buildings sector is 0.01 Mtoe by 2031.[3]

3 UNNATEE report, Bureau of Energy Efficiency 2019

Keeping the above in hindsight, this section explores the present policies/strategies pertaining to energy efficiency in Sikkim as well as recommend various energy efficiency strategies (policy as well as technological) in order to realize the state's energy savings potential.

Recommended schemes/policies to achieve the state's energy efficiency potential

4. **Action plan 1 – Replacement Programme for inefficient appliances:** Replacement of inefficient appliances with their efficient counterparts can be considered as a low hanging fruit from and energy efficiency implementation standpoint. This strategy can be implemented in both domestic as well as commercial buildings. As part of the strategy, following appliances have been identified that can be in the contention for replacement:-

The savings estimated from the appliance replacement Programme have been calculated using the moderate and ambitious scenario which is defined in this case as follows:-

Moderate scenario

- In moderate scenario, it is assumed that 30% of appliances will be replaced with efficient appliances. For LPG cookstove, a 10% switch to electric cookstove in moderate scenario

Ambitious scenario

- In ambitious scenario, it is assumed 50% appliance replacement with efficient appliance. For LPG cookstove, a 20% switch to electric cookstove in ambitious scenario

Following table encapsulates both the aforementioned scenarios and demonstrates the energy efficiency potential in the year 2030 as per this strategy appliance replacement Programme:-

Table 9: EE Potential from replacing inefficient appliances

Appliance	Inefficient stock in FY2020	Energy saving in moderate scenario (Mtoe)	Energy saving in ambitious scenario (Mtoe)
Fan	150750	**.000526**	**.000877**
Air conditioner	23450	**.000182**	**.000304**
Refrigerator	75375	**.00056**	**.000933**
Washing Machine	61975	**.0000576**	**.0000959**
Television	87100	**.0000243**	**.0000404**
LPG cookstove	155775	**.000391**	**.000782**

To achieve this potential, it is critical that this strategy is put into play. For this following are some of the recommended action points:-

Table 10: Action Plans for Sikkim state to achieve energy efficiency potential in Domestic Building Sector

S. No.	Action Plans for Sikkim state to achieve energy efficiency potential

1	Development of state-specific implementation models and identification of relevant agencies for replacing all existing inefficient appliances in government offices and buildings with BEE Star Rated appliances
2	Phase-wise plan for replacement of existing inefficient appliances with BEE Star rated appliances in all buildings, through DSM schemes

5. **Action plan 2: Implementing ECBC:** Under this strategy, it is recommended that the new and upcoming commercial and domestic buildings (having a connected load of minimum 100 kW) may be mandated as per the energy conservation buildings code (ECBC) in the state. In view of this, following scenarios are proposed:-

Moderate scenario

- In moderate scenario, it is assumed ECBC will be implemented in new commercial buildings more than 100 kW connected load and lead to 25% savings.

Ambitious scenario

- In ambitious scenario, ECBC+ is assumed to be implemented in new commercial buildings more than 100 kW and lead to 35% savings

Following table encapsulates both the aforementioned scenarios and demonstrates the energy efficiency potential in 2030 as per this strategy of mandating the compliance of ECBC for new buildings:-

2030 energy consumption in new commercial building more than 100 kW (Mtoe)	Energy saving in moderate scenario (Mtoe)	Energy saving in ambitious scenario (Mtoe)
0.00001092	**0.00000014**	**0.00000019**

To achieve this potential, it is critical that this strategy is put into play. For this following are some of the recommended action points:-

Table 11: Action Plans for Sikkim state to achieve energy efficiency potential through ECBC

S. No.	Action Plans
1	Integrate ECBC in new building approval process
2	Setting-up of effective enforcement plan with ULBs and SDA as monitoring agencies
3	Development and maintenance of ECBC compliance portal, directory of energy efficient materials/technologies
4	Empanelment of building experts at the state level
5	Market Outreach for ECBC compliant Products, Radio Jingles, Social Media Awareness
6	Pilot project investment for Super ECBC as case studies (initial 20 Buildings)
7	Periodic upgradation of PWD Schedule of Rates (SoR) to incorporate latest energy efficient materials and technologies
8	Inclusion of curriculum on energy efficiency in buildings, in state universities and education boards

6. **Action plan 3: Energy audit for commercial and public buildings:** Under this strategy, it is recommended that periodic energy audits may be carried out at public/commercial buildings on load basis. Directives may be issued to government departments to carry out detailed energy audits at heir respective building facilities. In view of this, following scenarios are proposed:-

Moderate scenario

- In moderate scenario, it is assumed 5% buildings will have energy audit and in ambitious scenario, it is assumed 10% of buildings will get energy audit

Ambitious scenario

- It is assumed that energy audit recommendations implementation will lead to 30% savings

Following table encapsulates both the aforementioned scenarios and demonstrates the energy efficiency potential in 2030 as per this strategy of mandating the compliance of ECBC for new buildings: -

2030 energy consumption in commercial and public buildings sector (Mtoe)	Energy saving in moderate scenario (Mtoe)	Energy saving in ambitious scenario (Mtoe)
0.004	**0.000056**	**0.000112**

To achieve this potential, it is critical that this strategy is put into play. For this following are some of the recommended action points:-

Table 12: Action Plans for Sikkim state to achieve energy efficiency potential in Commercial Buildings through audits

S. No.	Action Plans
1	Issue directives to all government departments to conduct energy audits and target to achieve BEE Star Rating for public buildings more than 100kW connected load
2	Periodic energy audits for commercial buildings on load basis and incentives on achieving star rating for buildings
3	Capacity Building of Architects & Building Professionals and Developers
4	Market Outreach for Star & Shunya Rating by Radio Jingles, Social Media Awareness
5	Transformation of iconic government buildings to Net-Zero (10 nos)
6	Mandatory minimum set point of 24 degree for air conditioners in all government buildings

Energy Efficiency targets and Monitoring mechanism

Energy savings targets

Taking into account the savings estimated based on strategy 1, 2 & 3 recommended for the building sector, following table illustrates the overall energy savings targets envisaged for the buildings in Sikkim in the year 2030:-

Table 13: Energy Efficiency Targets - Building

Action Plan	Energy Savings in 2030 under moderate scenario (Mtoe)	Energy Savings in 2030 under ambitious scenario (Mtoe)
Deepening of S&L in domestic buildings	**0.001741604**	**0.003033043**

Effective implementation of Sikkim ECBC 2022	**0.00000014**	**0.00000019**
Energy audit for commercial and public buildings	**0.000056**	**0.000112**

Monitoring mechanism

Monitoring Mechanism

Implementing an energy savings monitoring mechanism is an important step for industries to track and measure their progress in reducing energy consumption and associated costs. This can involve a number of different steps, including:

- **Establishing a baseline**: The first step in monitoring energy savings is to establish a baseline of energy consumption. This can involve reviewing energy bills or conducting an energy audit to identify areas of high energy use. Identifying energy-saving opportunities: Once a baseline has been established, industries can identify areas where energy savings can be made. This may involve implementing energy-efficient technologies, optimizing processes or equipment, or changing behaviors.
- **Setting energy-saving targets**: Based on the energy-saving opportunities identified, buildings can set specific, measurable, and time-bound targets for reducing energy consumption.
- **Monitoring and measuring progress**: Once targets have been set, buildings can monitor and measure progress towards meeting these targets. This can involve tracking energy consumption and costs over time, analyzing data to identify trends, and comparing actual performance against targets.
- **Reporting and communicating results**: Regular reporting and communication of energy savings results can help to build momentum and engagement within an organization. This can involve sharing results with key stakeholders, such as management, employees, and customers, and celebrating successes along the way. In addition to these steps, it is also important to establish a culture of continuous improvement around energy management. This can involve training and awareness-raising programs, setting up energy teams or champions within an organization, and ensuring that energy-saving initiatives are integrated into wider business strategies. By implementing an energy savings monitoring mechanism and establishing a culture of continuous improvement around energy management, industries can make significant progress in reducing energy consumption, lowering costs, and improving sustainability performance.

Focus sector 2 – Transport

Current scenario

Brief description of the sector

The transport sector is a major consumer of energy in Sikkim and contributes to approximately 62% of the total energy consumption in the state. Therefore, there needs to be a strong emphasis on electric vehicles to decarbonize this sector. The below table shows the key highlights of the transport sector in Sikkim.

Table 14: Key Highlights Transport Sector

Key highlights	
Total energy consumption (2019-20)	0.112 Mtoe
Share in final energy consumption	62%
Stakeholders	• Department of Transport, Sikkim

Unlike other state where the transport sector is looked after by road transportation corporations, in Sikkim, this is directly taken care of by the government department i.e. Transport Department.

Energy consumption in the sector

Following graph illustrates the final energy consumption in Sikkim (in Mtoe) in the industrial sector in Sikkim from 2015 to 2020:

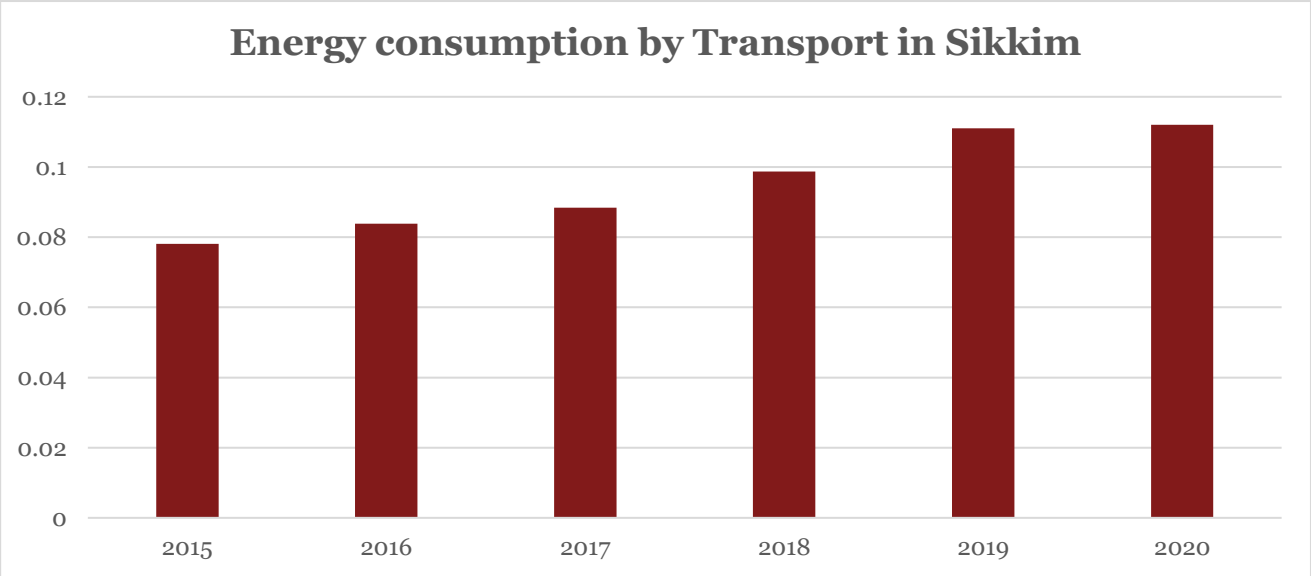


Figure 19: Energy consumption by Transport in Sikkim

Energy efficiency potential in the sector

Following table estimates the energy efficiency potential projected for the year 2030 in the transport sector in Sikkim:

Table 15: EE Potential in Transport Sector

Strategy	Energy Savings in 2030 under moderate scenario (Mtoe)	Energy Savings in 2030 under ambitious scenario (Mtoe)
Strategy 1	0.00008	0.000332
Strategy 2	0.0331	

The energy savings potential has been estimated based on the following two scenarios: -

- Moderate scenario
- Ambitious scenario

The afore-mentioned two scenarios have been devised keeping in hindsight strategies like transition to electric vehicles and ethanol blending. This will be discussed in detail in the next section.

Strategies in the Transport sector

The rapid growth of vehicles numbers in the State has been accompanied by related problems including congestion and traffic snarls, lack of adequate parking spaces, high accident rates, environmental vehicular pollution rise, and inadequacy of road space for efficient public transportation. In this regard, there is dire need for the state government to decarbonize the sector in order to align with India's NDC and Net Zero commitments. Moreover, as per the Unlocking National Energy Efficiency Potential published by the Bureau of Energy Efficiency, the energy saving target for the state has been calculated by segregating the total energy saving potential for each sector. The energy saving target for transport sector in Sikkim is 0.11 Mtoe by 2031.[4]

Keeping the above in hindsight, this section explores the present policies/strategies pertaining to energy efficiency in Sikkim as well as recommend various energy efficiency strategies (policy as well as technological) in order to realize the state's energy savings potential in the transport sector

Recommended schemes/policies to achieve the state's energy efficiency potential

1. **Action plan 1 – Transition of existing fleet to electric vehicles:** Under this strategy, it is recommended to transition the existing ICE (Internal combustion Engine) fleet (two wheelers, three wheelers, four wheelers, bus and heavy vehicles) to electric vehicles.

   As per this strategy – following scenarios have been adopted for the replacement of ICE fleet by electric vehicles:-

   Moderate scenario

   - As per NITI Aayog projections, 80% EV penetration in two-wheelers, 80% EV penetration in three-wheelers, 30% EV penetration in four-wheelers, 40% EV penetration in buses and 20% EV penetration in HDV in moderate scenario

   Ambitious scenario

   - 100% EV penetration in two-wheelers, 100% EV penetration in three-wheelers, 60% EV penetration in four-wheelers, 80% EV penetration in buses and 40% EV penetration in HDV in ambitious scenario

   Following table encapsulates both the aforementioned scenarios and demonstrates the energy efficiency potential in the year 2030 as per this strategy of transition from ICE to electric vehicles :-

Energy saving in moderate scenario (Mtoe)	Energy saving in ambitious scenario (Mtoe)
0.00008	**0.000332**

   To achieve this potential, it is critical that this strategy is put into play. For this following are some of the recommended action points:-

   Table 16: Action Plans for Sikkim state to achieve energy efficiency potential through EV

S. No.	Action Plans for Sikkim state to achieve energy efficiency potential
1	Establishment of regulatory mechanism to develop EV charging infrastructure
2	Set up Charging stations based on open-access
3	Pilot projects on Battery Swapping stations in 3 model cities
4	Pilot projects on Hydrogen Fuel Cell Vehicles

4 UNNATEE report, Bureau of Energy Efficiency 2019

2. **Action plan 2: Ethanol blending Programme:** Under this strategy - it is recommended that, as per the national target, ethanol blending in conventional fuels may be executed. The target already set in this segment is 20%.
Following table encapsulates both the aforementioned scenarios and demonstrates the energy efficiency potential in 2030 as per this strategy:-

2025 energy consumption in transport (Mtoe)	Energy saving as per policy (Mtoe)
0.166	**0.0331**

To achieve this potential, it is critical that this strategy is put into play. For this following are some of the recommended action points:-

Table 17: Action Plans for Sikkim state to achieve energy efficiency potential through Ethanol Blending

S. No.	Action Plans
1	Encourage establishing biofuel production plants

Energy savings targets and monitoring mechanism

Energy savings target

Taking into account the savings estimated based on strategy 1 & 2 recommended for the transport sector, following table illustrates the overall energy savings targets envisaged for the transport in Sikkim in the year 2030:-

Table 18: Energy Savings Target - Transport Sector

Action Plan	Energy Savings in 2030 under moderate scenario (Mtoe)	Energy Savings in 2030 under ambitious scenario (Mtoe)
Transition to electric vehicles	0.00008	0.000332
Ethanol blending	0.0331 (As per policy)	

Monitoring mechanism

Monitoring Mechanism

Implementing an energy savings monitoring mechanism is an important step for the transport sector to track and measure their progress in reducing energy consumption and associated costs. This can involve a number of different steps, including:

- **Establishing a baseline**: The first step in monitoring energy savings is to establish a baseline of energy consumption. This can involve reviewing fuel consumption data or conducting an energy audit to identify areas of high energy use.
- **Identifying energy-saving opportunities**: Once a baseline has been established, transport companies can identify areas where energy savings can be made. This may involve implementing energy-efficient technologies, optimizing routes, or changing behaviors. Setting energy-saving targets: Based on the energy-saving opportunities identified, transport companies can set specific, measurable, and time-bound targets for reducing energy consumption.

- **Monitoring and measuring progress**: Once targets have been set, transport companies can monitor and measure progress towards meeting these targets. This can involve tracking fuel consumption and costs over time, analyzing data to identify trends, and comparing actual performance against targets.
- **Reporting and communicating results**: Regular reporting and communication of energy savings results can help to build momentum and engagement within an organization. This can involve sharing results with key stakeholders, such as management, employees, and customers, and celebrating successes along the way. In addition to these steps, it is also important to establish a culture of continuous improvement around energy management. This can involve training and awareness-raising programs, setting up energy teams or champions within an organization, and ensuring that energy-saving initiatives are integrated into wider business strategies. By implementing an energy savings monitoring mechanism and establishing a culture of continuous improvement around energy management, transport companies can make significant progress in reducing energy consumption, lowering costs, and improving sustainability performance. Additionally, these improvements can lead to cost savings, improved air quality, and increased energy security.

Investment potential

Taking into hindsight the energy savings potential that has been highlighted for each of the focus sectors – it is also pertinent that this study also takes into account the investment required to realize this potential. This section illustrates the investment required to execute each of the strategies.

Estimated investment potential

Following table depicts the estimated energy & emission savings potential that can be achieved through each of the strategies along with its estimated investment potential: -

Table 19: Estimated Investment Potential

Sector	Energy saving in moderate (Mtoe)	Energy saving in ambitious (Mtoe)	Emission Saving (MtCO2)	Emission Saving (MtCO2)	Investment Potential (INR crore)
Buildings	0.00180	0.00314	0.0056	0.0098	5.8
Transport	0.03323	0.03347	0.1040	0.1048	61.6
Total	**0.1096**	**0.1146**	**0.03503**	**0.03661**	**67.4**

(Note: Market Potential calculated using cost of 1 tonne of oil equivalent as INR 18,402 and assuming a payback of 3 years)

Way forward

Following table summarizes the strategies put forward as part of this SEEAP report along with the action points required to enforce the same. Moreover, this table also points out the relevant departments that may take up the execution of the afore-said action points:-

Table 20: Way forward

Focus Sector	EE strategies	Action Points	Implementing agencies
Buildings	Strategy 1: Appliance replacement programme	1. Development of state-specific implementation models and identification of relevant agencies for replacing all existing inefficient appliances in government offices and buildings with BEE Star Rated appliances 2. Phase-wise plan for replacement of existing inefficient appliances with BEE Star rated appliances in all buildings, through DSM schemes	Bureau of Energy Efficiency (BEE); Sikkim SDA
	Strategy 2: Enforcing ECBC in new and upcoming buildings	1. Integrate ECBC in new building approval process 2. Setting-up of effective enforcement plan with ULBs and SDA as monitoring agencies 3. Development and maintenance of ECBC compliance portal, directory of energy efficient materials/technologies 4. Empanelment of building experts at the state level 5. Market Outreach for ECBC compliant Products, Radio Jingles, Social Media Awareness 6. Pilot project investment for Super ECBC as case studies (initial 20 Buildings) 7. Periodic upgradation of PWD Schedule of Rates (SoR) to incorporate latest energy efficient materials and technologies 8. Inclusion of curriculum on energy efficiency in buildings, in state universities and education boards	Bureau of Energy Efficiency; Sikkim SDA Urban Development and Housing Department
	Strategy 3: Promoting energy audits for commercial and public buildings	1. Issue directives to all government departments to conduct energy audits and target to achieve BEE Star Rating for public buildings more than 100kW connected load 2. Periodic energy audits for commercial buildings on load basis and incentives on achieving star rating for buildings 3. Capacity Building of Architects & Building Professionals and Developers 4. Market Outreach for Star & Shunya Rating by Radio Jingles, Social Media Awareness 5. Transformation of iconic government buildings to Net-Zero (10 nos) 6. Mandatory minimum set point of 24 degree for air conditioners in all government buildings	Bureau of Energy Efficiency; Sikkim SDA Urban Development and Housing Department
Transport	Strategy 1: Transition of existing fleet to electric vehicles	1. Establishment of regulatory mechanism to develop EV charging infrastructure 2. Set up Charging stations based on open-access 3. Pilot projects on Battery Swapping stations in 3 model cities 4. Pilot projects on Hydrogen Fuel Cell Vehicles	Department of Transport

	Strategy 2: Ethanol blending programme	1. Encourage establishing biofuel production plants	State Transport Department & Individual Government Departments

References

Energy Data

Table 21: Energy Data

S.No.	Reference
1	Energy Statistics India 2021, Ministry of Statistics and Programme Implementation (MoSPI)
2	National Accounts Data, Ministry of Statistics and Programme Implementation (MoSPI)
3	Population Projections For India and States 2011-2036, National Commission on Population, Ministry of Health & Family Welfare
4	NITI Aayog: India Energy Dashboards
5	Small and Medium Enterprises: Energy Efficiency Knowledge Sharing A Platform for Promoting Energy Efficiency in SMEs (SAMEEKSHA)
6	Simplified Digital Hands-on Information on Energy Efficiency in MSMEs (SIDHIE), Bureau of Energy Efficiency (BEE), Ministry of Power
7	Impact Assessment of BEE's Standard & Labelling Program in India, Market Xcel Data Matrix Pvt Ltd.

Fuel calorific values

Table 22: Fuel calorific values

Fuel	Gross Calorific Value (GCV)	Unit of GCV
Coal	4,500	kcal/kg
Natural Gas	10,200	kcal/kg
Diesel	10,350	kcal/kg
Electricity	860	kcal/kWh

Units of conversion

Table 23: Units of conversion

Units	
1 tonne of oil equivalent (TOE)	1,00,00,000 kcal
	0.000001 MTOE
	11,630 kWh

Annexures

List of sources

Table 24: List of sources

Primary Source	Secondary Source
Department of Transport, Sikkim	Central Electricity Authority
Energy and Power Department, Sikkim	Sikkim Economic Survey
Sikkim Renewable Energy Development Agency	Ministry of Statistics and Programme Implementation
Sikkim State Electricity Regulatory Commission	Sikkim Renewable Energy Development Agency
Sikkim Power Development Corporation Limited	Ministry of Road Transport and Highways
Urban Development Department, Sikkim	Bureau of Energy Efficiency
Buildings & Housing Department, Sikkim	Energy Efficiency Services Limited
Gangtok Municipal Corporation	NITI Aayog (Energy Dashboard)
	Ministry of Micro, Small and Medium Enterprises
	Ministry of Power
	Ministry of New and Renewable Energy
	India Brand Equity Foundation
	World Bank / Asian Development Bank

List of stakeholders

Table 25: List of stakeholders

Stakeholder
Department of Transport, Sikkim
Energy and Power Department, Sikkim
Sikkim Renewable Energy Development Agency
Sikkim State Electricity Regulatory Commission

Sikkim Power Development Corporation Limited
Urban Development Department, Sikkim
Buildings & Housing Department, Sikkim
Gangtok Municipal Corporation