State Energy Efficiency Action Plan

Bihar

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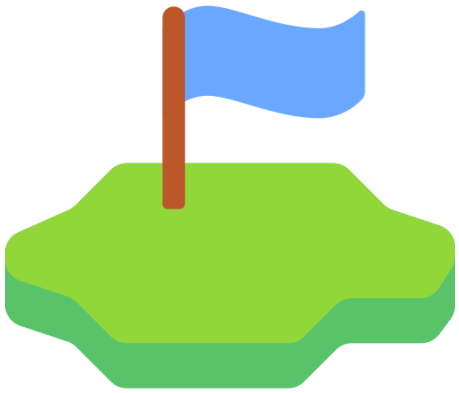
Introduction & State Profile

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 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

Overview

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 Bihar.

As a part of the assignment, there has been identification of stakeholders from various sectors, identification of focus sector in the state of Bihar, 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.

State Profile

Located in the eastern part of India, Bihar is bordered by Nepal in the north, West Bengal in the northeast and Uttar Pradesh in the west. The economy of Bihar is one of the fastest growing in the country with a significant share of agricultural and its allied sectors. Around 74% of the state's population is engaged in agriculture and its allied sectors. It is noted that Bihar is one of the top producers of fruits and vegetables in the country. Additionally, Bihar's economy is primarily service driven with a significant share of two main sectors i.e., agriculture and industrial.

As per the data on Gross State Domestic Product (GSDP), the growth rate of Bihar's economy during the year 2018-19 was 10.5% (at constant prices) and 15.0% (at current prices), which is higher than the growth rate of the Indian economy.

It shall be noted that between 2011-12 to 2018-19, the sectoral composition of the Bihar economy has changed significantly. This change is primarily driven due to the shift in the sectoral share from Primary to Tertiary. The share of primary sector has dropped from 26% in 2011-12 to 20% in 2018-19 whereas the share of tertiary sector has increased from 56% to 61% in the same period.

Key Economic Areas in Bihar

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

Food Processing and Dairy 01

Being an agrarian economy primarily, the food processing and dairy industry is one of the major leading sectors in Bihar. The Bihar state government offers several incentives to the food processing industries such as fruits, vegetables, food grain, milk, meat & honey processing units.

IT & Electronics 02

The IT, ITeS and Electronics System Design & Manufacturing (ESDM) industries are emerging to be one of the major focus sectors in the state of Bihar.

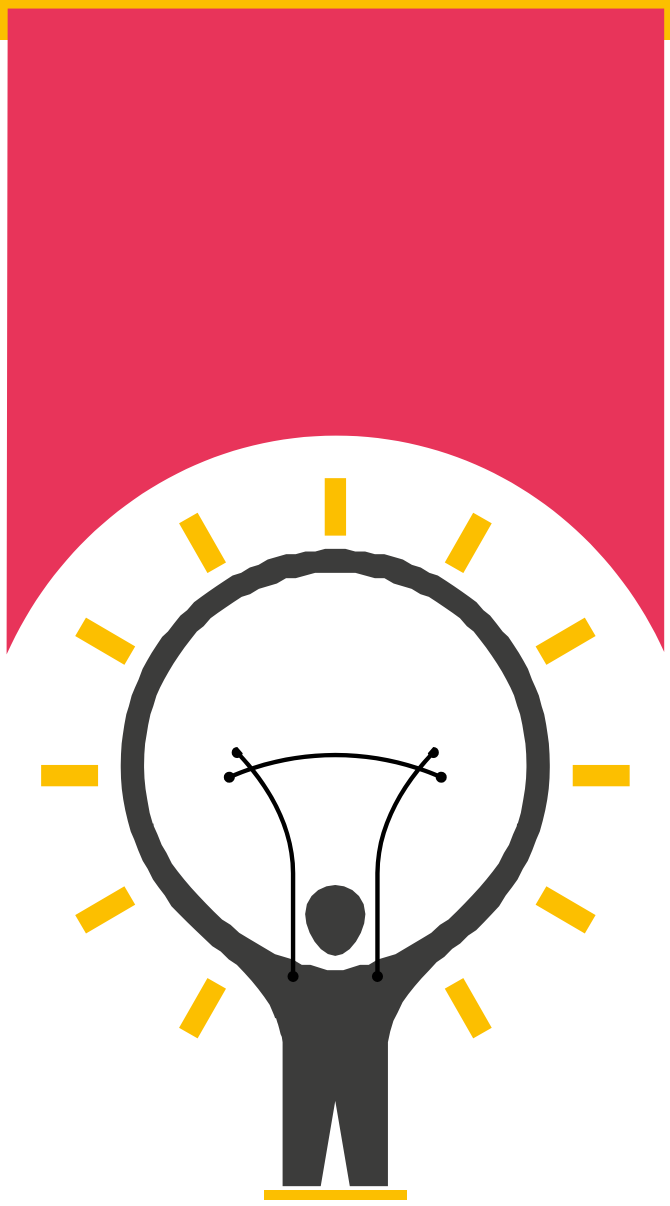
Tourism 03

Bihar's ancient antiques and artefacts attract tourists in huge numbers each year making it a key contributor to the state's economy.

Textiles & Leather 04

Being a highly labor-intensive industry, Bihar is home to around 100,000 weavers. Within the textile industry, the focus products in the state of Bihar are silk and jute.

Need of the Assignment & Scope



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.

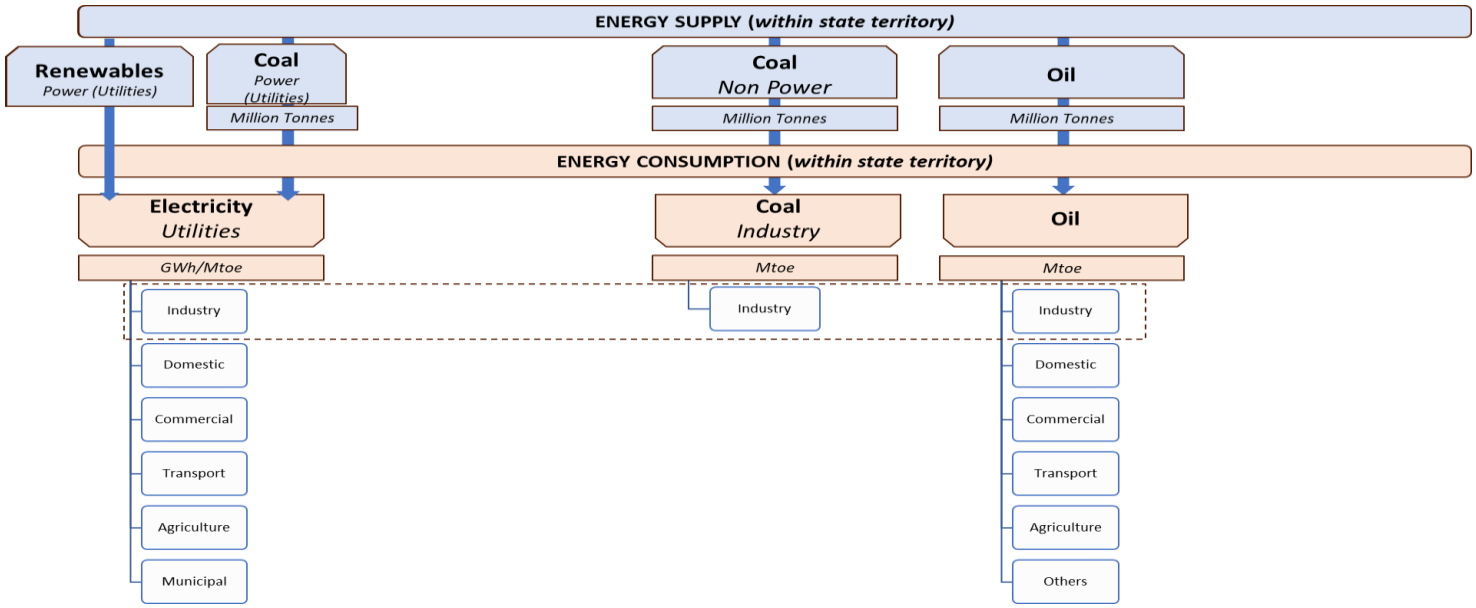
Therefore, there is a dire need for a focused sector-based energy efficiency approach by states/UTs. In view of this, the Bureau of energy efficiency has taken on this endeavor to state specific Energy Efficiency Action Plan through identification of focus sector, undertaking gap analysis, adopting best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

Broad scope of work

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

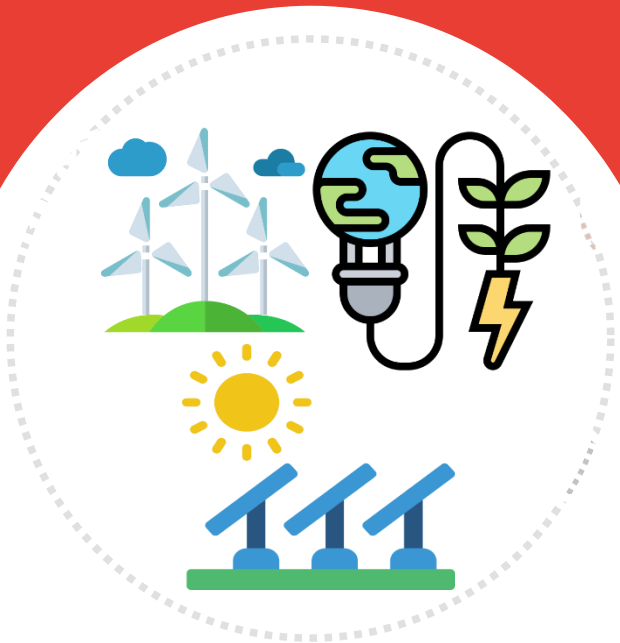
- **Identification of stakeholders from various sectors**
- **Identification of focus sectors in the state**
- **Identification of gap via surveys**
- **Sector specific energy projections and energy savings targets**
- **Benefits to the State and various stakeholders through the implementation of the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

Bihar, with a population of approximately 11 Cr, is located in the eastern part of the country and is an entirely land locked state and is surrounded by West Bengal in the east, Uttar Pradesh in the West and the State of Jharkhand in the South. The economy of Bihar is one of the fastest growing in the country with a significant share of agricultural and its allied sectors. Around 74% of the state's population is engaged in agriculture and its allied sectors. Bihar's economy is primarily service driven with a significant share of two main sectors i.e., agriculture and industrial. From an energy standpoint - oil in the form of LPG, Petrol, Kerosene, HSD, LDO & FO is the most prominent source of energy followed by coal (coal for thermal power plant and non-power activities). Following figure illustrates the energy supply and consumption flow in the state:-



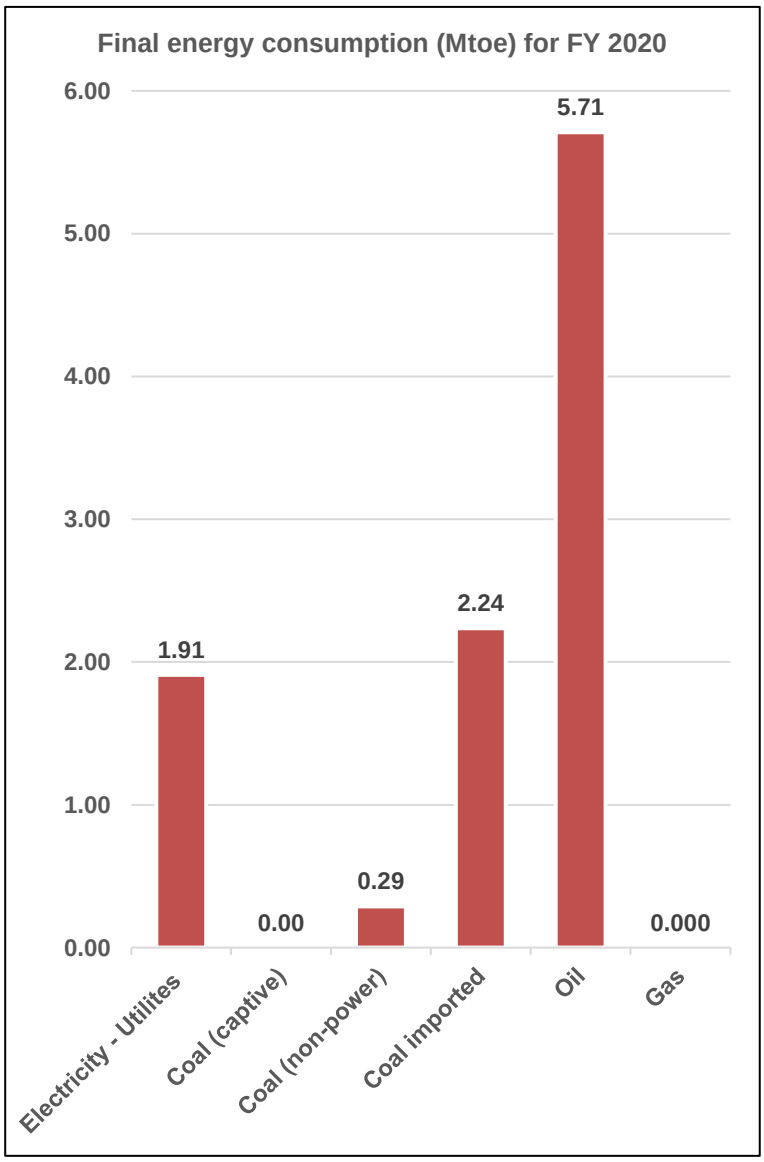
The Energy Consumption Scenario

From a consumption standpoint - the total energy consumption of Bihar has been estimated to be approximately 10.15 Mtoe for the year 2019-20.



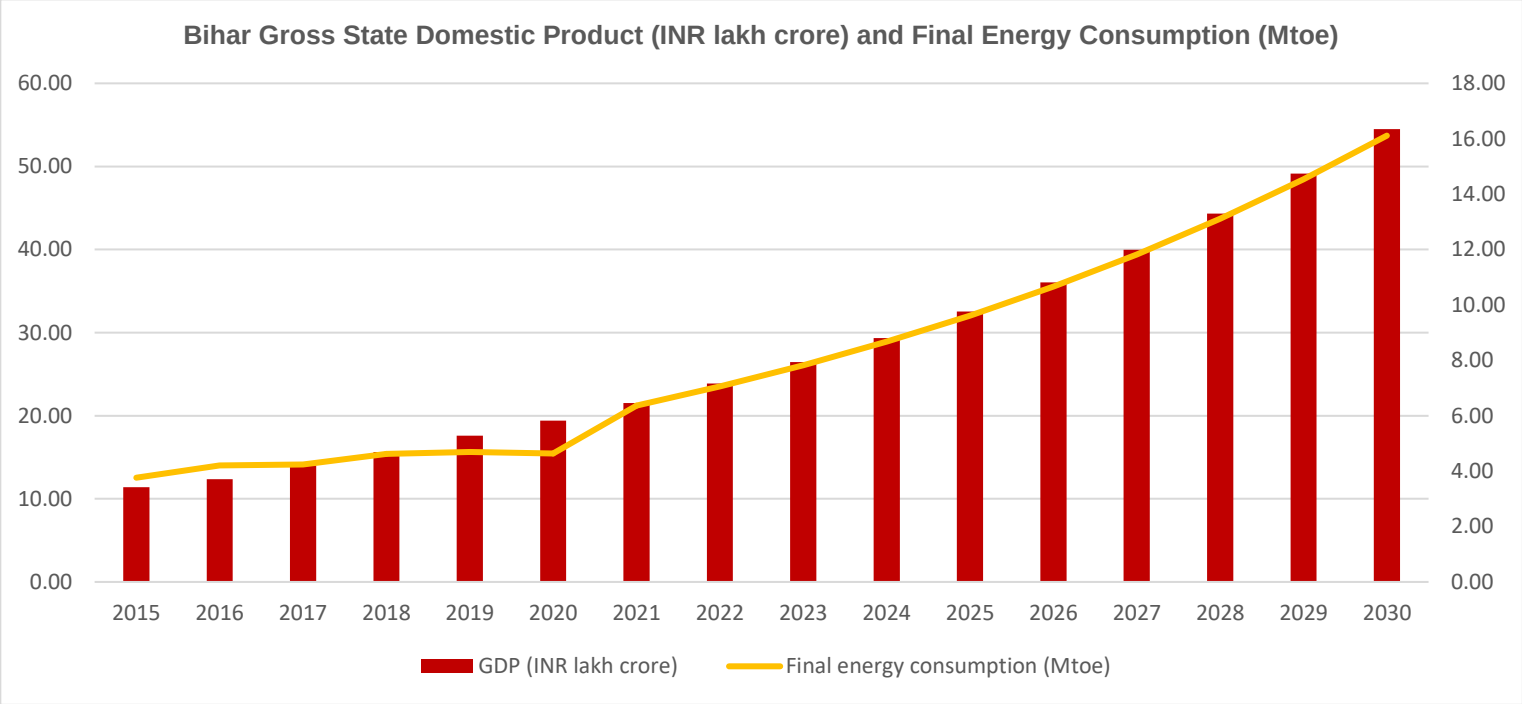
The total energy consumption for the State of Bihar has been estimated to be approximately 10.15 Mtoe for the year 2019-20. It is pertinent to mention here that oil consumption is the major contributor to this estimate at 5.71 Mtoe followed by coal (domestic and imported) at 2.53 Mtoe and electricity at 1.91 Mtoe. Following figure illustrates the same: -

Final energy consumption (Mtoe) for FY 2020



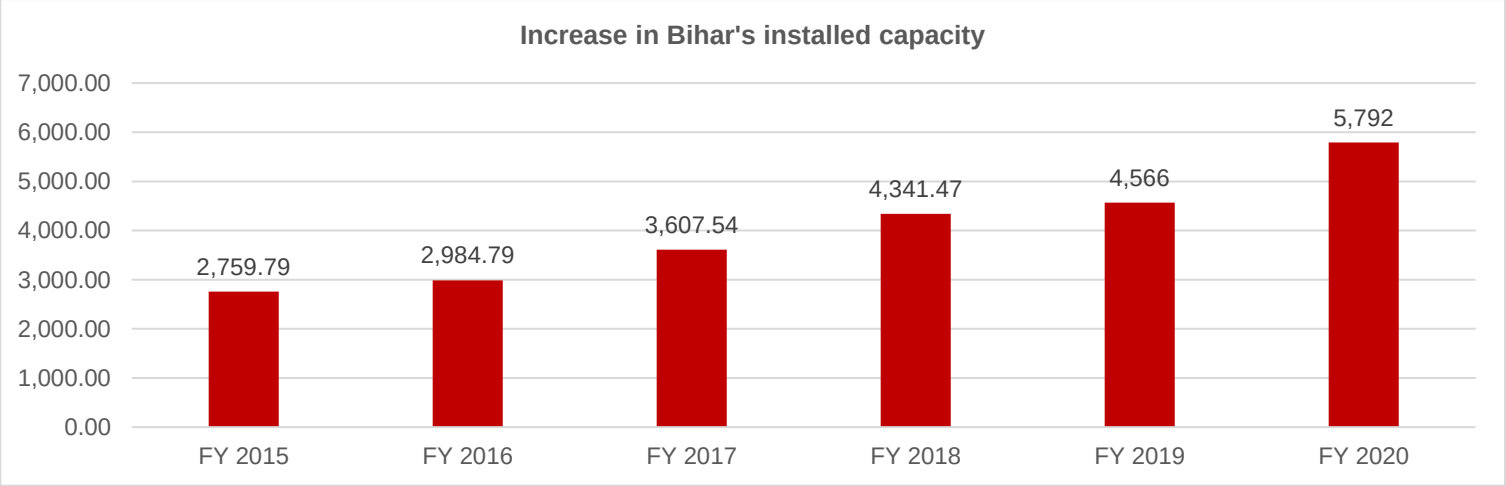
Projection and forecasting of GDP and Energy Consumption

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 figure captures Bihar's GDP over the years (between 2014/15 to 2019/20). Bihar's GDP varies from INR 3.42 Lakh Cr in 2015 to 5.83 Lakh Cr in 2020 at a CAGR OF 11.2%. 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 11.2% and 20% weightage to the forecast of 10.9% as per the latest Bihar Economic Survey.



Installed Capacity in Bihar

Bihar's total installed capacity at the end of 2019-20 FY was 5792 MW. It is pertinent to mention here that the power availability in the state has increased from 3,500 MW in 2014-15 to 5792 MW in 2019-20 with the growth being by 71%.



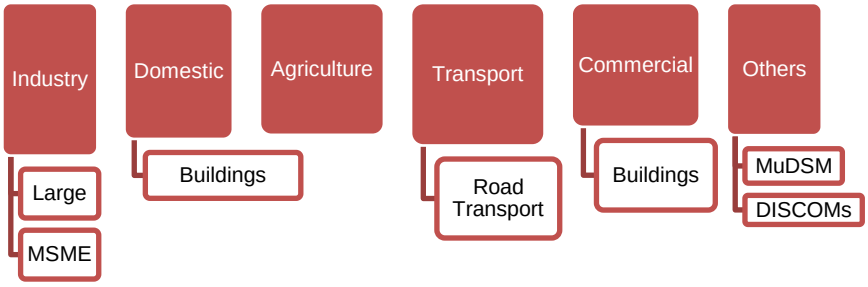
Identifying Focus Sectors

Industry, Transport & Building Sector Contribute to ~97% Energy consumption in Bihar in FY 2020

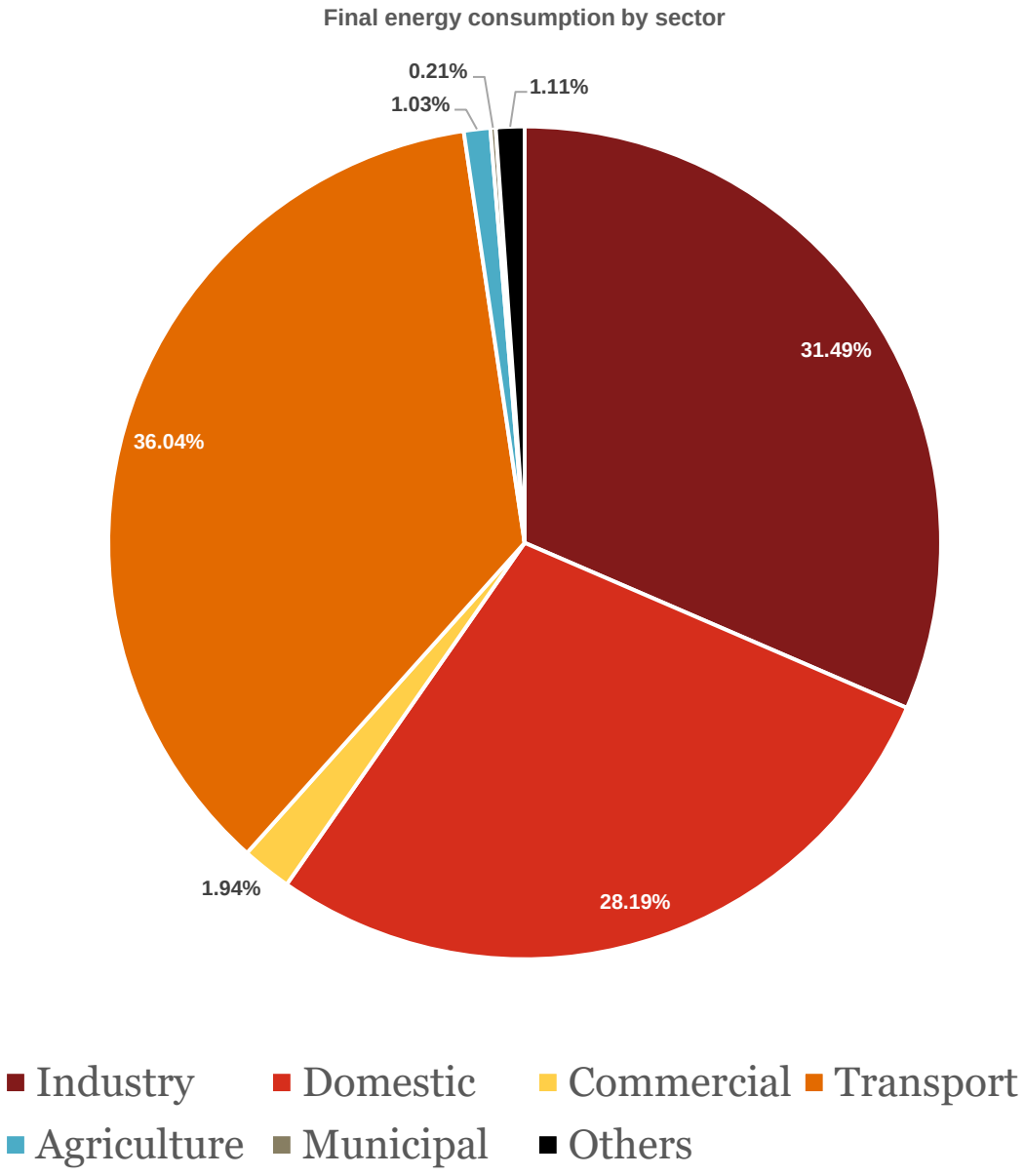
For identifying the major energy guzzling sectors in the state, energy consumption data of a number of sectors was researched and analyzed. This data was gathered via primary consultations with the various stakeholders and through secondary domain research.

Identified Focus Sectors

In the year 2019 - the transport sector of Bihar consumed 36% of the total final energy consumption at 3.64 Mtoe followed by the industrial sector at 31% (3.18 Mtoe), domestic sector at 28% (2.85 Mtoe) and the remaining by the commercial, agriculture, municipal and others. Upon analyzing the energy consumption data gathered via primary exercise and secondary research the following focus sectors have been identified:



Energy Consumption Sector wise Split



PwC Insights

Focus Sector: Buildings

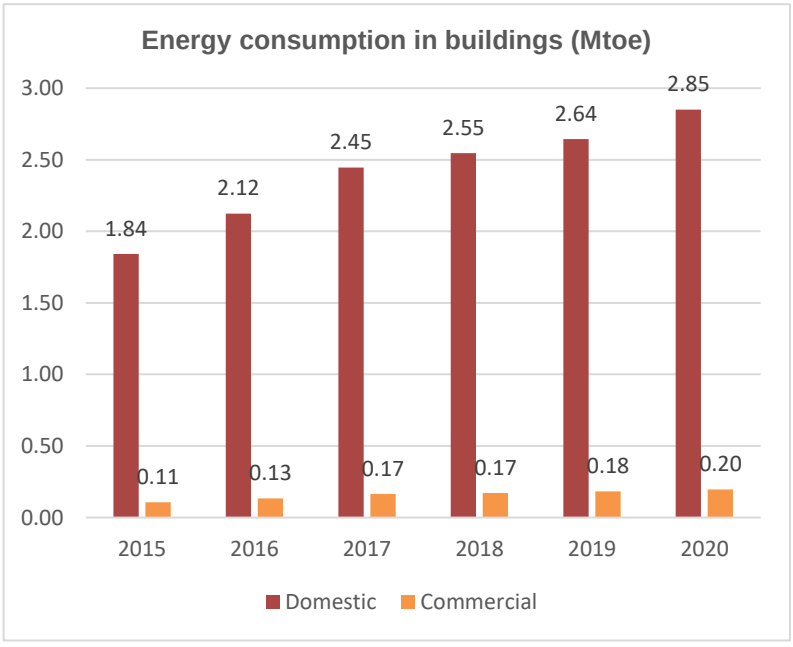
The Building Sector contributes to ~30% of the total energy consumption in the State of Bihar in FY 2020.

The buildings sector in encompasses different types of buildings present in Bihar 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.

Key highlights for the building sector in Bihar

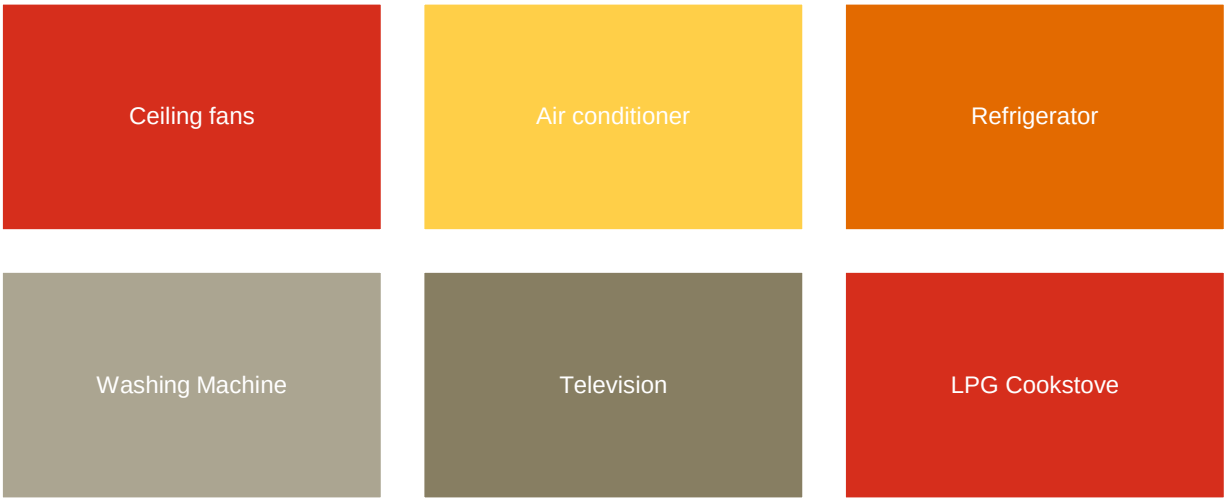
The total energy consumption in Bihar related to Building Sector in FY 2020 is 0.04 Mtoe. It constitutes to around 22% of the total energy consumption in the State.

From an energy perspective – the buildings sector is one of the major consumers at 3.05 Mtoe. Following figure illustrates the sector's energy consumption over the years:-



Strategies in Building 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:-

Appliance	Inefficient stock in FY2020	Energy saving in moderate scenario (Mtoe)	Energy saving in ambitious scenario (Mtoe)
Fan	27292950	**0.10**	**0.16**
Air conditioner	4245570	**0.033**	**0.055**
Refrigerator	13646475	**0.101**	**0.169**
Washing Machine	11220435	**0.010**	**0.017**
Television	15769260	**0.004**	**0.007**
LPG cookstove	28202715	**0.071**	**0.142**

(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)
0.008	**0.0020**	**0.0027**

(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)
1.010	**0.015**	**0.030**

(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: Transport

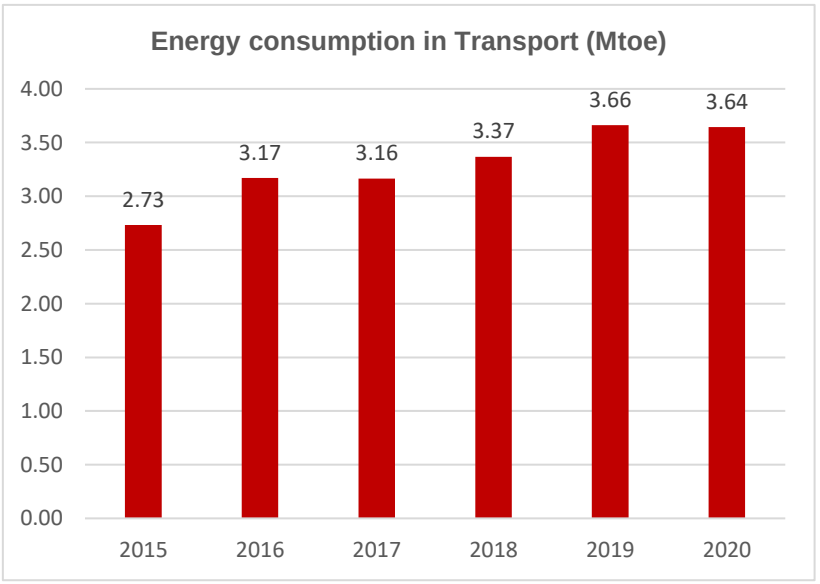
The transport sector is a major consumer of energy in Bihar and contributes to approximately 36% of the total energy consumption in the state. Therefore, there needs to be a strong emphasis on electric vehicles to decarbonize this sector. The below table shows the key highlights of the transport sector in Bihar.

The Transport Sector contributes to 36% of the total energy consumption in the State of Bihar in FY 2020.

Key highlights for the Transport sector in Bihar

The total energy consumption in Bihar related to Transport Sector in FY 2020 is 3.64 Mtoe. It constitutes to around 36% of the total energy consumption in the State.

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



Strategies in Transport 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)
0.1200	**0.2248**

(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)
5.161	**1.0321**

Focus Sector: Industry

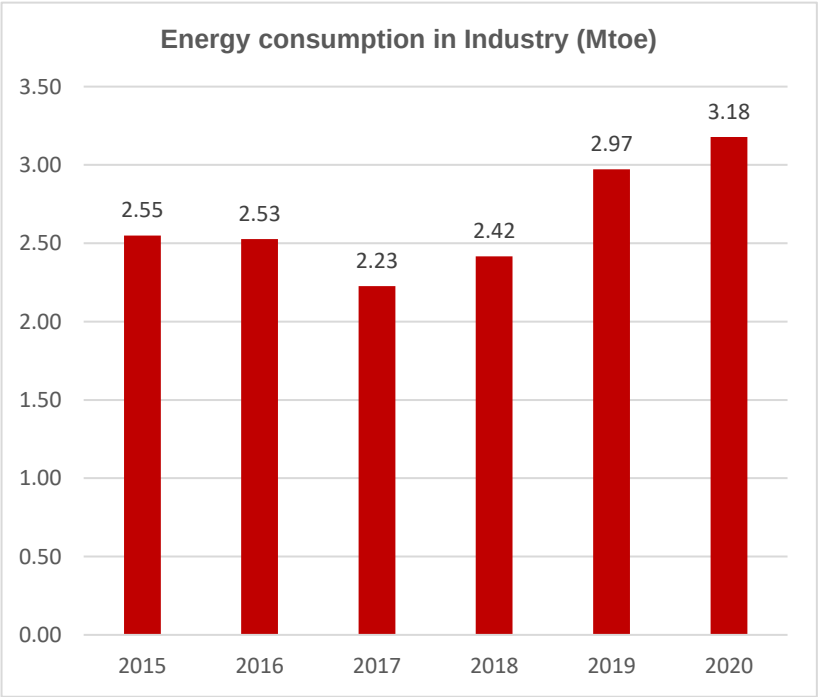
The Industries sector refers to various sizes of manufacturing industries including designated consumers from sectors like iron & steel and cement which are significant consumers of energy and have high potential for energy efficiency measures along with MSME industries belonging to sectors like brick manufacturing, sponge iron, coke oven to name a few.

The Industry Sector contributes to 31.5% of the total energy consumption in the State of Bihar in FY 2020.

Key highlights for the Industry sector in Bihar

The total energy consumption in Bihar related to Industry Sector in FY 2020 is 3.18 Mtoe. It constitutes to around 31% of the total energy consumption in the State.

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



Strategies in Industry Sector

1. **Action plan 1 – Deepening of PAT scheme:** It is pertinent to comprehend that some of the existing manufacturing units of the already notified sectors (cement and iron & steel) does not fall under the purview of the PAT scheme. In this regard, it is recommended that the threshold for the PAT criteria may be lowered so that some of the existing cement and sponge iron units like ECO cement, Kanodia infra and Bihar sponge ltd. may be added to the PAT scheme.

   Following table encapsulates both the aforementioned scenarios and demonstrates the energy efficiency potential in the year 2030 as per this strategy of deepening the PAT scheme:-

Baseline SEC (toe/tonne)	Moderate SEC (toe/tonne)	Ambitious SEC (toe/tonne)	Production in 2030 (tonnes)	Energy saving in moderate scenario (Mtoe)	Energy saving in ambitious scenario (Mtoe)
Cement	0.0708	0.0676	2260000	**0.000998**	**0.006990**
Sponge iron	0.55	0.4	2100000	**0.115958**	**0.405948**

(Note: The baseline, moderate and ambitious specific energy consumption has been assumed based on various studies on the secondary domain along with the consultant's previous experience in the industrial sector. For moderate scenario - It is assumed that all the existing units will achieve the moderate SEC target in 50% units. For the ambitious scenario - it is assumed that all existing units will achieve ambitious SEC target in 70% unit)

2. **Action plan 2 - Energy efficiency in the Non-PAT sector:** Manufacturing MSME industries form the backbone of the Indian economy – so it is only justified that this sector may be looked at more carefully from the lens of energy efficiency. From secondary research – it was discovered that there are a number of MSME industry clusters that are energy intensive. It is recommended that clay fired brick, brick and coke oven sectors may be incentivized or prompted to adopt energy efficient technologies. In view of this, following scenarios are proposed:-

Baseline SEC (toe/tonne)	Moderate SEC (toe/tonne)	Ambitious SEC (toe/tonne)	Production in 2030 (tonnes)	Energy saving in moderate scenario (toe)	Energy saving in ambitious scenario (toe)
Clay fired Brick	0.026	0.012	59100000	0.475537	1.331504
Brick	0.036	0.032	219000	0.012587	0.025243
Coke Oven	0.209	0.198	945000	0.005974	0.016728

(Note: The baseline, moderate and ambitious specific energy consumption has been assumed based on various studies on the secondary domain along with the consultant's previous experience in the industrial sector. For moderate scenario - 50% penetration of zig-zag in brick sector, coke dry quenching in coke oven units. For the ambitious scenario - 70% penetration of zig-zag in brick sector and coke dry quenching in coke oven units)

* There are approximately 1100+ rice mills in Bihar, however only 115 of them have the capability of producing parboiled rice. This is critical as production of parboiled rice requires more energy (electricity and thermal) as compared to mills producing raw rice that only uses electricity and the consumption is negligible.

Focus Sector: Agriculture

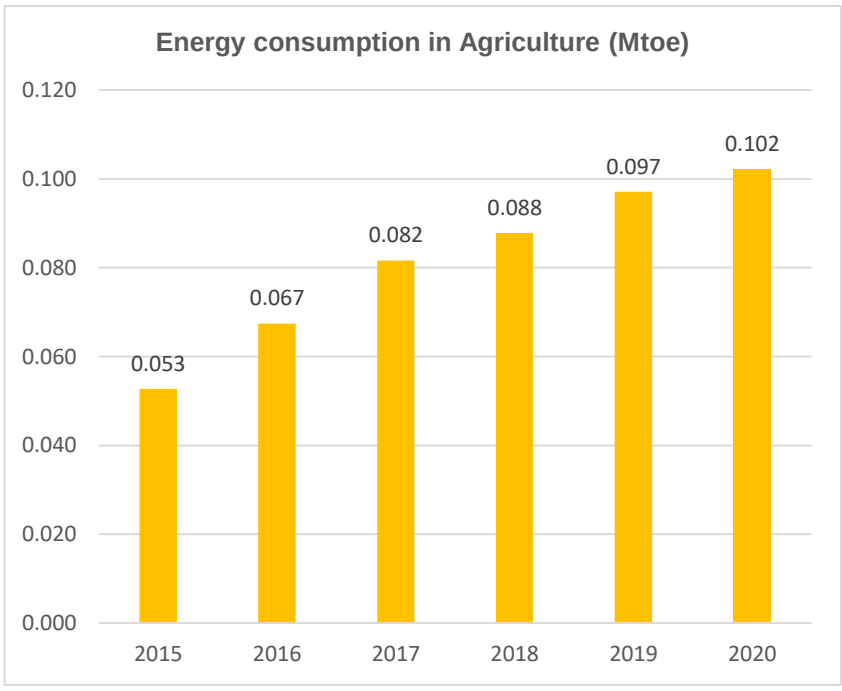
Bihar state is located in the Indo-Gangetic plains in central-north India, and its naturally fertile soil is one of the key assets of the State, and conducive to agriculture However, agriculture and its allied sectors in Bihar are beset by many challenges, and climate change and its impacts are only likely to deepen these challenges. Therefore, the overall strategy of the state energy efficiency action plan (SEEAP) is to transform agriculture and its allied sectors into energy efficient, climate resilient and efficient production system.

The Agriculture Sector contributes to 1.03% of the total energy consumption in the State of Bihar in FY 2020.

Key highlights for the Agriculture sector in Bihar

The total energy consumption in Bihar related to Agriculture Sector in FY 2020 is 0.10 Mtoe. It constitutes to around 1.03% of the total energy consumption in the State.

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



Strategies in Agriculture Sector

1. **Action plan 1 – Transition of existing diesel pumps to solar based pumps:** Under this strategy, it is recommended that the existing stock of diesel-based pumps may be replaced by solar based pumps by 2025.

   Following table encapsulates both the aforementioned scenarios and demonstrates the energy efficiency potential in the year 2030 as per this strategy of transition from diesel pumps to solar based pumps :-

Diesel pumps estimated inventory by 2025	Energy saving in moderate scenario (Mtoe)	Energy saving in ambitious scenario (Mtoe)
439575	0.09	0.12

   (For moderate scenario - By 2025, moderate scenario assumes 75% replacement of diesel pumps with solar pumps. For the ambitious scenario By 2025, ambitious scenario assumes 100% replacement with solar pumps)

2. **Action plan 2 - Replacement of inefficient electric pumps with efficient electric pumps:** Under this strategy, it is recommended that the existing stock of inefficient electric pumps may be replaced by solar based pumps by 2025.

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

Inefficient pumps estimated inventory by 2030	Inefficient pumps replaced by Star-Rated pumps in ambitious scenario by 2030	Energy saving in moderate scenario (Mtoe)	Energy saving in ambitious scenario (Mtoe)
263825	439709	0.019	0.033

   (For moderate scenario - assumes 30% replacement with efficient Star-Rated pumps. For the ambitious scenario - assumes 50% replacement with efficient Star-Rated pumps)