State Energy Efficiency Action Plan - Bihar

MARCH 2023

विद्युत मंत्रालय
MINISTRY OF
POWER

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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.

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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
BSEB	Bihar State electricity board
BSPHCL	Bihar State Power (Holding) Company Limited
BSPGCL	Bihar State Power Generation Company Limited
BSPTCL	Bihar State Power Transmission Company Limited
NBPDCL	North Bihar Power Distribution Company Limited
SBPDCL	South Bihar Power Distribution Company Limited
INR	Indian Rupee
CAGR	Compound annual growth rate
FY	Financial Year
BIADA	Bihar Industrial Area Development Authority
BIA	Bihar Industries Association
BMUS	Bihar Mahila Udyog Sangh
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
BUIDCO	Bihar Urban Infrastructure Development Corporation Ltd
DSM	Demand side management
ECBC	Energy Conservation Building Codes
ULB	Urban Local Bodies
SDA	State Designated Agencies

PWD	Public Works Department
EV	Electric Vehicle
BAIPP	Bihar Agriculture Investment Promotion Policy
PM	Prime Minister
ESCO	Energy Services Company
GCV	Gross Calorofic Value
TOE	Tonnes of oil equivalent
MTOE	Million tonnes of oil equivalent
SAIL	Steel Authority of India Limited
DMA	Directorate of Municipal Administration

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:-

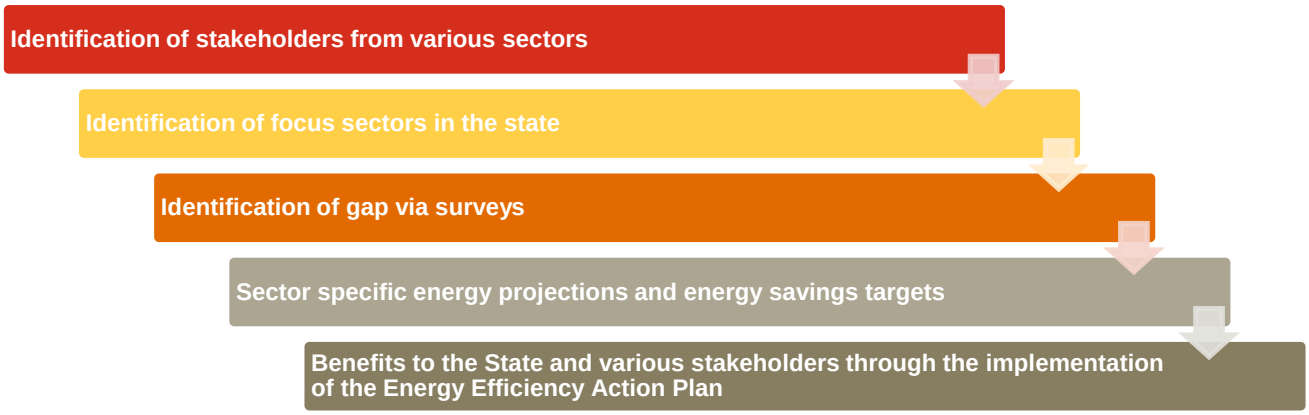


Figure 1: Broad scope of work

State context

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:-

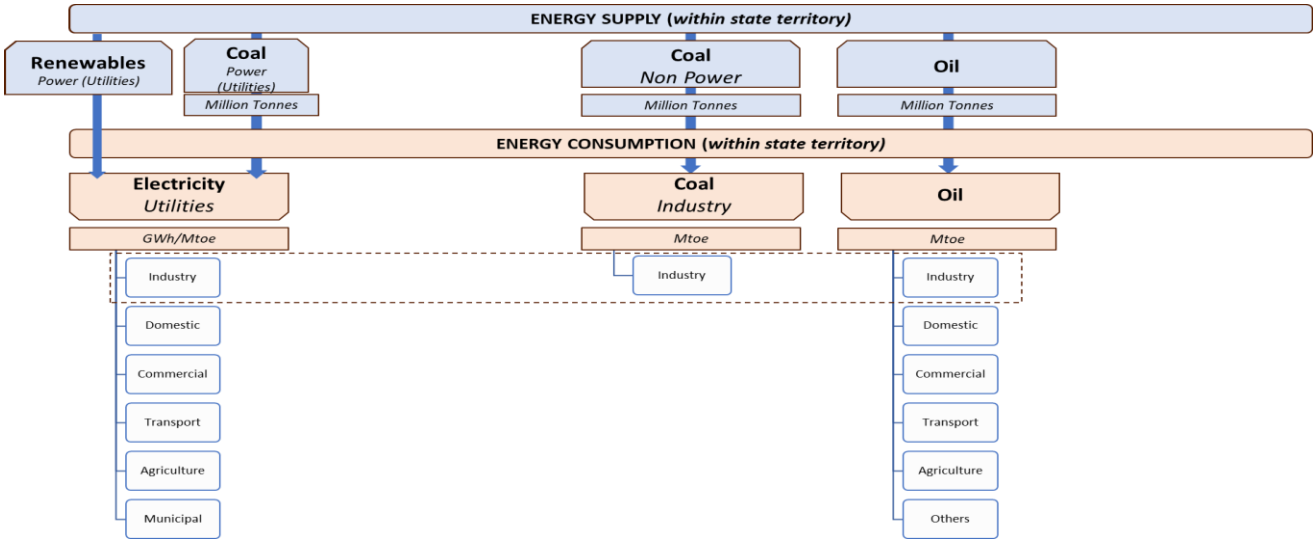


Figure 2: Energy flow in the state (supply and consumption)

From a consumption standpoint - the total energy consumption of Bihar for the year has been estimated to be approximately 10.19 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 1.95 Mtoe. Following figure illustrates the same: -

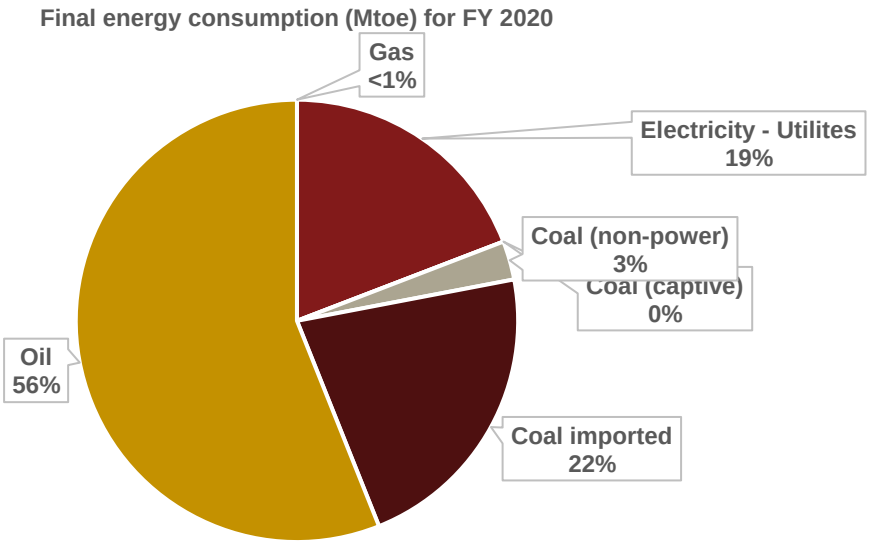


Figure 3: Fuel-wise split of total final energy consumption in Bihar

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

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 Bihar's GSDP and its energy consumption from 2015 to 2030:-

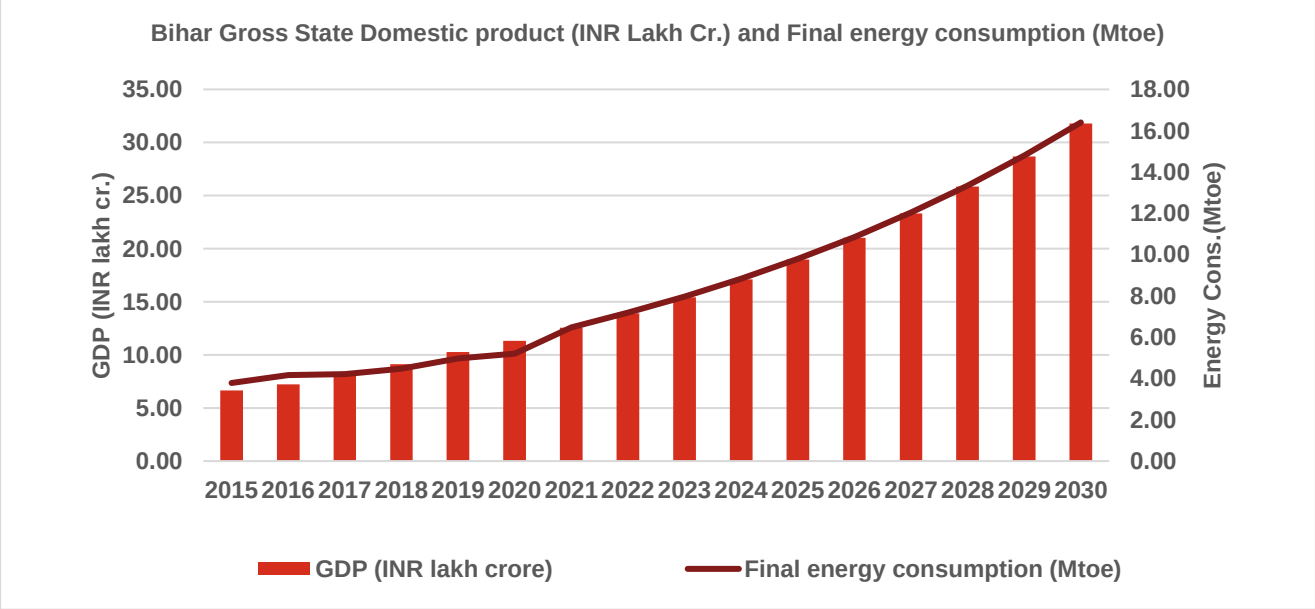


Figure 5: Energy consumption and GDP forecasting of Bihar

The baseline energy consumption intensity for FY2020 was calculated (1.95) and multiplied with forecasted GSDP to obtain final energy consumption trend till 2030.

Focus sector 1 - Industries

Current scenario

Industrial 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 From an energy perspective – industrial sector in Bihar is one of the highest consumer in the state.

Energy efficiency potential in the sector

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

Action Plan	Energy Savings in 2030 under moderate scenario (Mtoe)	Energy Savings in 2030 under ambitious scenario (Mtoe)
Action plan 1	0.116	0.41
Action plan 2	0.49	1.38

The afore-mentioned moderate and ambitious scenarios have been discussed in detail in section 4.2 of the report.

Energy efficiency strategies in the sector

1. Action plan 1 - Deepening of PAT scheme: It is recommended that the threshold for the PAT criteria in terms of energy consumption may be lowered so as to accommodate more cement and sponge iron units present within the state. Following table illustrates the energy efficiency that can be achieved via this strategy:-

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)
Cement	0.0708	0.0676	2260000	**998**	**6990**
Sponge iron	0.55	0.4	2100000	**115958**	**405948**

(Note: For the moderate and Ambitious SEC assigned to cement and sponge iron non-PAT units - It is assumed that all the existing units will achieve the moderate SEC target in 50% units and achieve ambitious SEC target in 70% units.)

2. Action plan 2 – EE in SME**:** Manufacturing MSME may be looked at more carefully from the lens of energy efficiency. A number of MSME industry clusters are there in Bihar 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. Following table illustrates the energy efficiency that can be achieved via this strategy:-

Baseline SEC (toe/tonne)	Moderate SEC (toe/tonne)	Ambitious SEC (toe/tonne)	Production in 2030 [1] (tonnes)	Energy saving in moderate scenario (toe)	Energy saving in ambitious scenario (toe)
Clay fired Brick	0.026	0.012	59100000	475537	1331504
Brick	0.036	0.032	219000	12587	25243
Coke Oven	0.209	0.198	945000	5974	16728

(Note: For the moderate scenario it is assumed that 50% penetration of zig-zag in brick sector, coke dry quenching in coke oven units will take place. For the ambitious scenario it is assumed that 70% penetration of zig-zag in brick sector and coke dry quenching in coke oven units will take place)

Focus sector 2 – Commercial and domestic buildings

Current scenario

[1] https://ibm.gov.in/IBMPortal/

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.). From an energy perspective – the buildings sector is one of the major consumers at 3.05 Mtoe.

Energy efficiency potential in the sector

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

EE Strategy	Energy Savings in 2030 under moderate scenario (Mtoe)	Energy Savings in 2030 under ambitious scenario (Mtoe)
Strategy 1	0.315	0.549
Strategy 2	0.0020	0.0027
Strategy 3	0.015	0.030

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 illustrates the energy efficiency that can be achieved via this strategy:-

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:-

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 3 – Transport

Current scenario

The transport sector is a major consumer of energy in Bihar and contributes to approximately 36% of the total energy consumption in the state. From an energy perspective – it is one of the major consumers in the state.

Energy efficiency potential in the sector

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

Strategy	Energy Savings in 2030 under moderate scenario (Mtoe)	Energy Savings in 2030 under ambitious scenario (Mtoe)
Strategy 1	0.1200	0.2248
Strategy 2		1.0321

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)
0.1200	**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 4 – Agriculture

Current scenario

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. From an energy perspective – it is one of the major consumers in the state.

Energy efficiency potential in the sector

Following table estimates the energy efficiency potential projected for the year 2030 in the agriculture sector in Bihar:

Strategy	Energy Savings in 2030 under moderate scenario (Mtoe)	Energy Savings in 2030 under ambitious scenario (Mtoe)
Strategy 1	0.09	0.12
Strategy 2	0.019	0.033

Energy efficiency strategies in the 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	**0.1200**	**0.2248**

(Note: By 2025, moderate scenario assumes 75% replacement of diesel pumps with solar pumps. 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**

Introduction

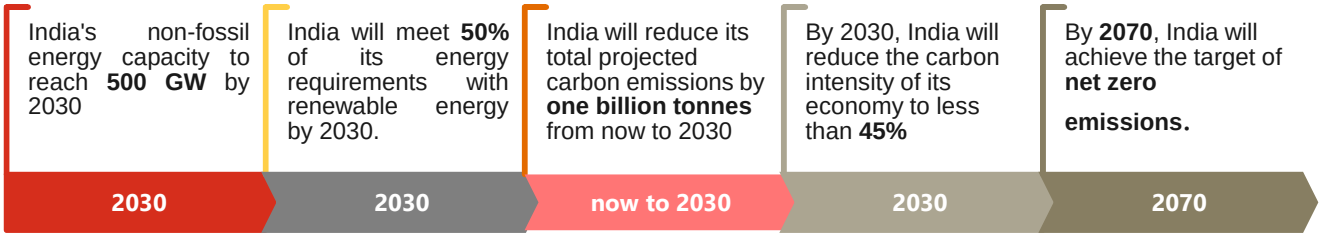
Background and about State Energy Efficiency Action Plan

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 and Mission LiFE

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:



What is Mission LiFE?

Mission LiFE is an India-led global mass movement to nudge individual and community action to protect and preserve the environment. At the 26th session of the Conference of the Parties (COP26) to the United Nations Framework Convention on Climate Change (UNFCCC) held in Glasgow, United Kingdom, India shared the mantra of LiFE - Lifestyle for Environment - to combat climate change. India is the first country to include LiFE in its Nationally Determined Contributions (NDCs).

Need for this assignment

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.

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 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.

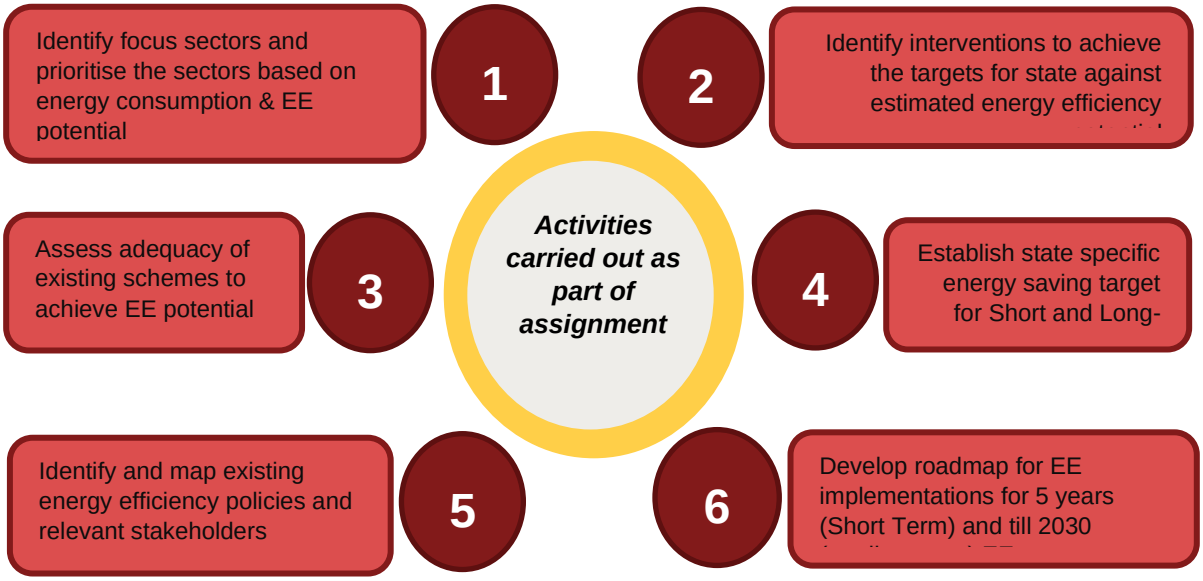


Figure 6: Key activities of the project

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. The major contributors within the primary, secondary and tertiary sectors in the state of Bihar are as follows:

Table 1: Breakdown of primary, secondary and tertiary sectors in Bihar

Primary	Secondary	Tertiary
Agriculture, forestry, fishing	Construction	Trade and repair services
Crops	Manufacturing	Real estate
Livestock	Electricity, gas, water supply & other utility services	Ownership of dwelling and Professional Services
Fishing and aquaculture		Air, Water & Road Transport

Mining and quarrying	Financial services
	Hotels & restaurants

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:

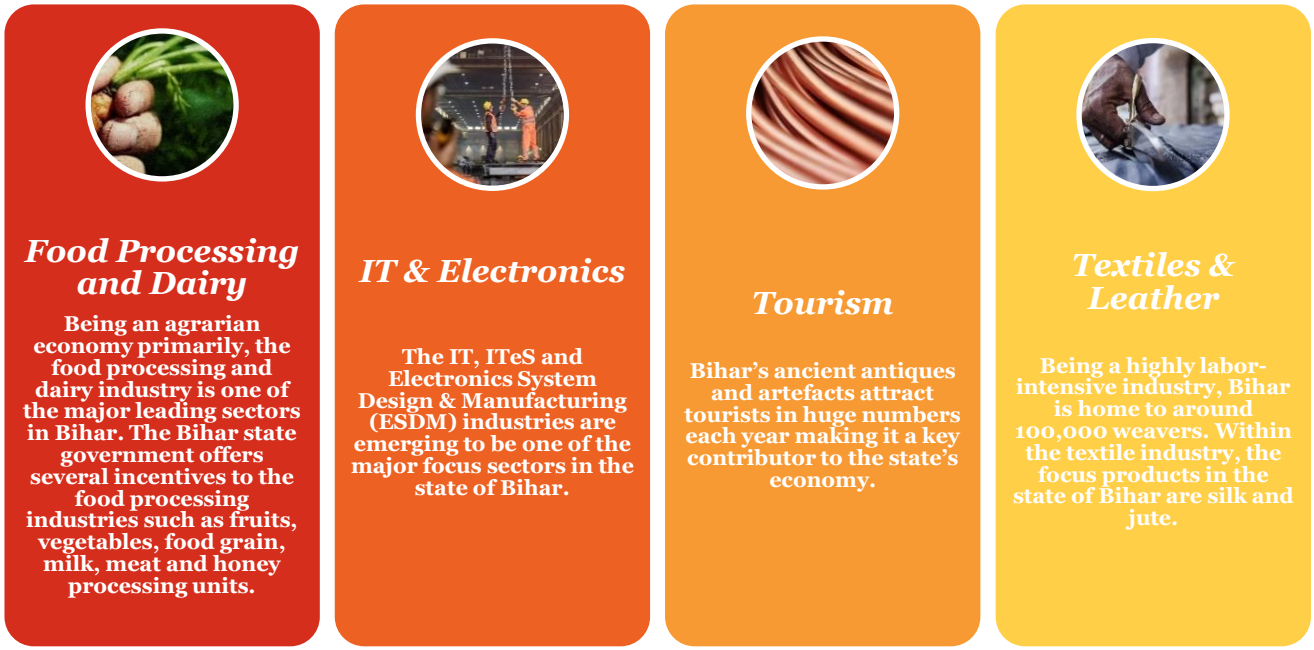


Figure 7: Key economic areas in Bihar

Table 2: Key profile of Bihar[2]

S.No.	Parameter	Bihar
1	Population (2019-20)	11 Crores
2	Land Area (km^2)	94,613
3	Number of Districts (2022)	38
4	Gross State Domestic Product (2019-20) at constant prices (2011-12)	₹4,14,977 Crore
5	Per Capita Income (2019-20) at constant prices (2011-12)	₹34,413
6	Primary sector share in GSDP	20%
7	Secondary sector share in GSDP	20%
8	Tertiary sector share in GSDP	60%
9	Installed Power Generation Capacity (2022)	7,323 MW
10	Per capita electricity consumption (2018-19)	311 kWh

[2] Bihar Economic Survey 2020-21

Energy supply and consumption scenario

Energy supply

From an energy supply 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 flowchart illustrates energy supply and consumption scenario in Bihar:-

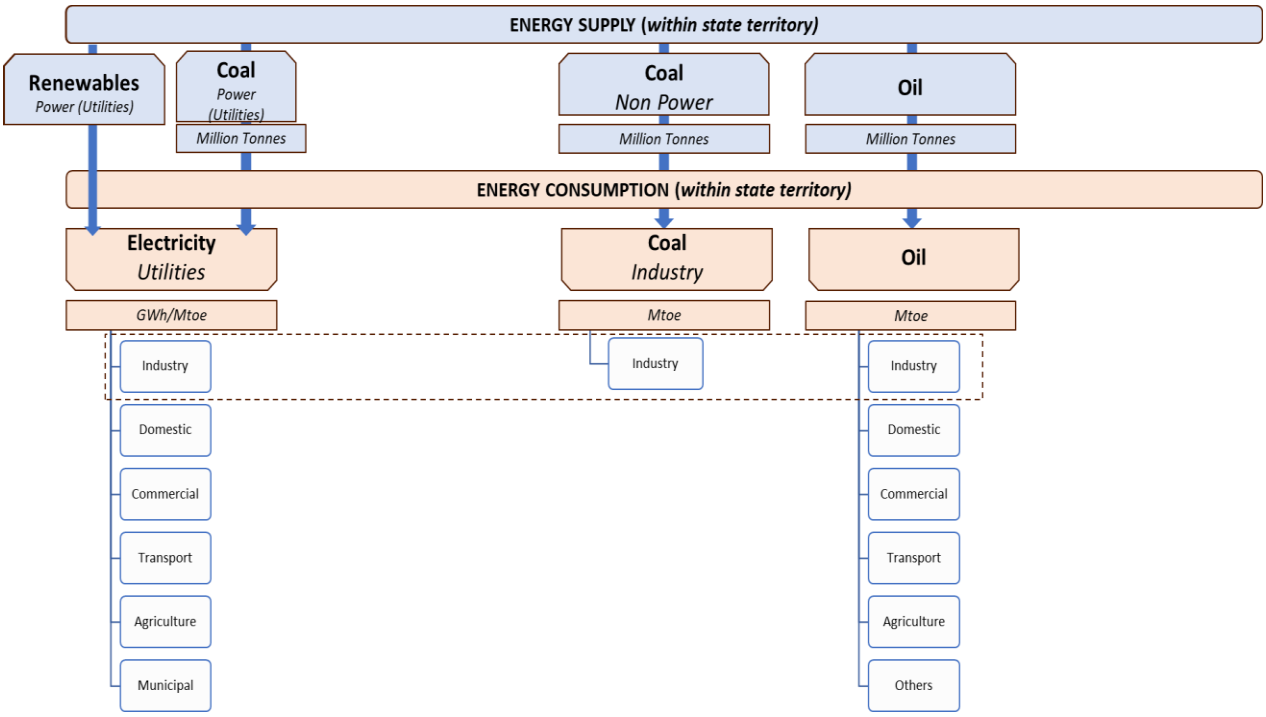


Figure 8: Bihar's energy supply and consumption characteristics

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.). While the non-power coal is only used in the industrial sector.

Energy Consumption

From a consumption standpoint - the total energy consumption of Bihar for the year has been estimated to be approximately 10.19 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 1.95 Mtoe. Following figure illustrates the same: -

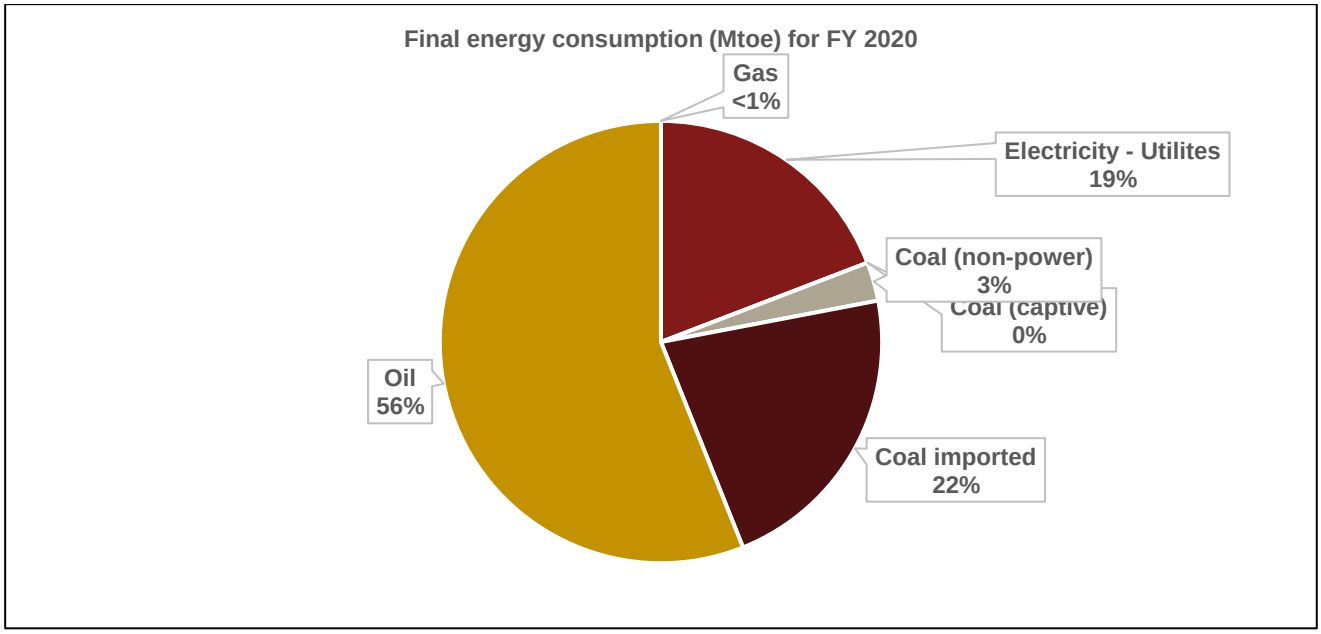


Figure 9: Bihar's final energy consumption (fuel wise)

As specified above, the energy consumption in the state is composed of primary energy and electricity. It is pertinent to mention here that Bihar has seen a gradual increase in energy consumption ranging from 7.35 Mtoe in 2015 to 10.11 Mtoe in 2020. This consumption encapsulates electricity, oil and coal (non power).

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

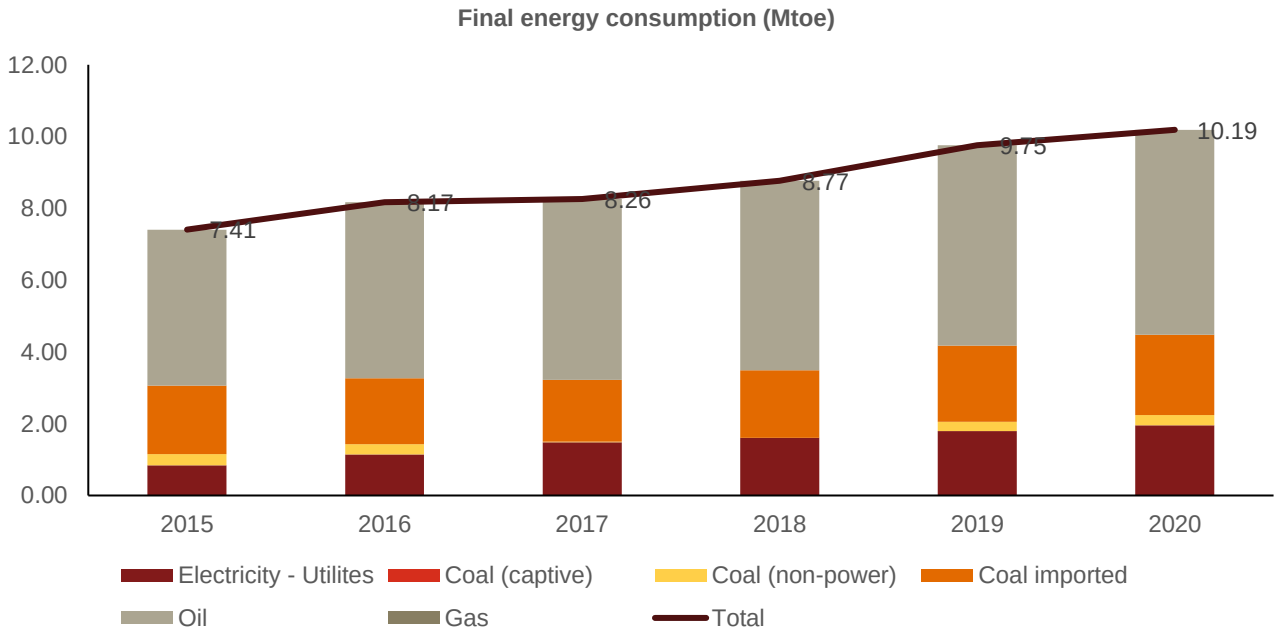


Figure 10: Final energy consumption

Electricity Scenario

Installed capacity

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%.

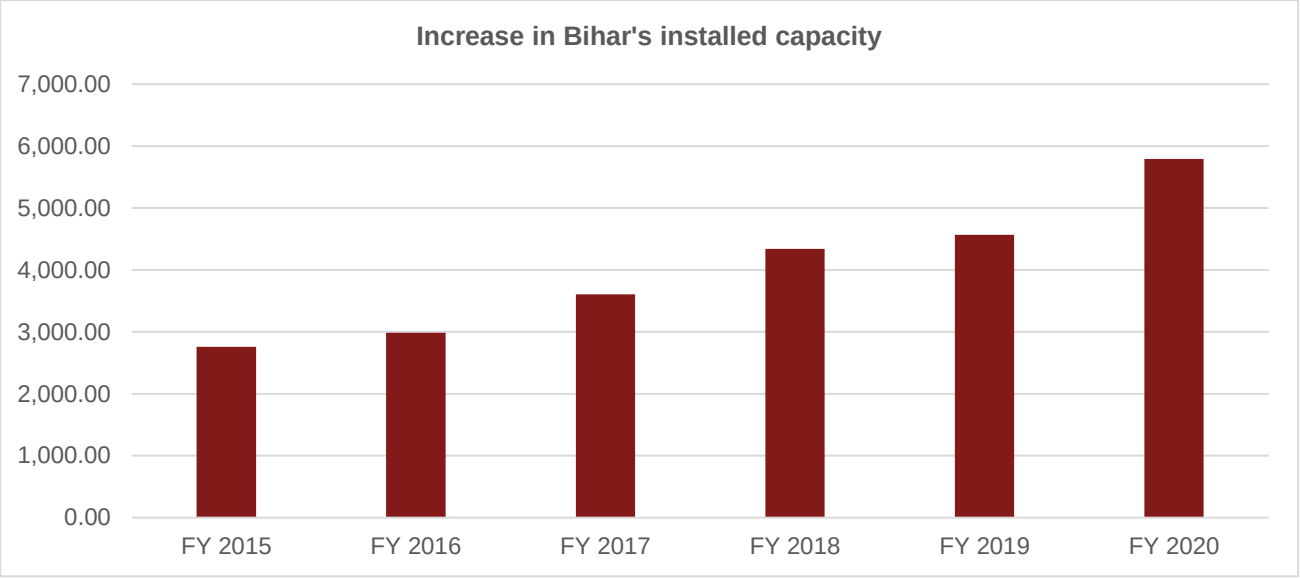


Figure 11: Increase in Bihar's installed capacity for electricity generation over the years

Electricity peak demand in the state

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

Table 3: Bihar's peak demand trend

	Peak Demand Projection (MW)	Peak Demand Met (MW)
2012-13	2650	1802
2013-14	3150	2335
2014-15	3500	2831
2015-16	4112	3459
2016-17	4405	3769
2017-18	4965	4535
2018-19	5300	5139

There has been a significant jump in power demand over the years, this may be attributed to increase in agricultural connections, wider use of electrical appliances and increase in the quality and the hours of power

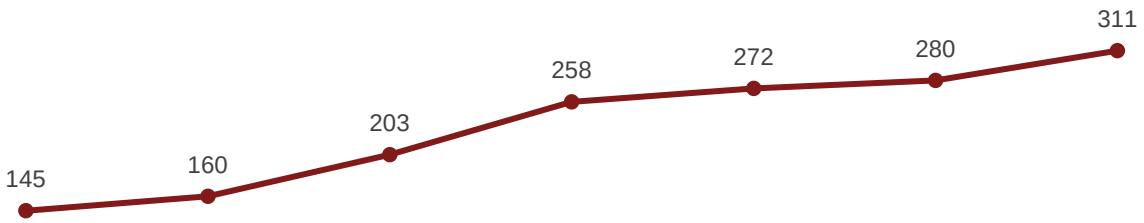


Figure 12: Per capita electricity consumption in Bihar

supply. Coincidentally, the increase in per capita power consumption has risen at a similar rate as the state's installed capacity for electricity. Following graph depicts rise in Bihar's per capita power consumption: -

Renewable energy scenario

As on 31 March 2020, the total estimated potential of renewable power in the state of Bihar is around 12,719 MW. This can be broken down as:

Table 4: Total estimated renewable energy potential in Bihar[3]

Source	Estimated Potential (in MW)
Solar Energy	11,200
Biomass Power	619
Small-hydro Power	527
Bagasse-based cogeneration in sugar mills	300
Waste to energy	73
Total	**12,719**

Further, the monthly renewable energy generation in the state between April 2019 to February 2020 (in MU) can be broken down as:

Table 5: Renewable energy generation in Bihar in 2019-20

(in MU)	Solar	Biomass	Bagasse	Small Hydel	Total
Apr-19	18	2	27	-	**47**
May-19	3	1	2	-	**6**
Jun-19	17	2	2	-	**21**
Jul-19	14	1	-	4	**20**
Aug-19	14	1	-	4	**20**
Sep-19	14	1	-	1	**16**
Oct-19	14	1	-	1	**16**
Nov-19	15	1	11	0	**27**
Dec-19	11	2	32	1	**46**
Jan-20	11	2	32	1	**46**
Feb-20	11	2	32	1	**46**

[3] Energy Statistics India 2021

Overview of Institutional framework and stakeholder mapping

The below figure shows the organizational structure of the Department of Energy (Bihar):

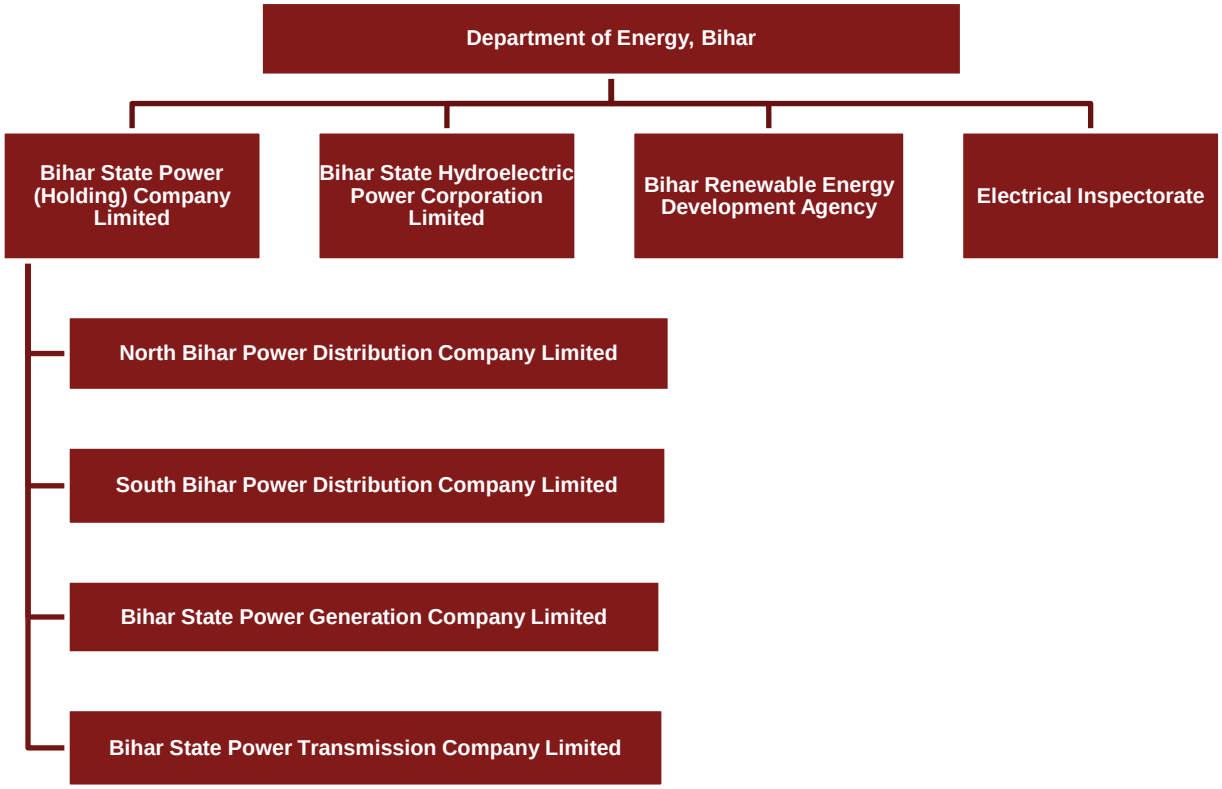


Figure 13: Organizational structure of Bihar's Department of energy

In 2012, the Bihar State Electricity Board (BSEB) which was originally formed to manage all electricity-related activities in Bihar was segregated into 5 separate entities:

i. Bihar State Power (Holding) Company Limited (“BSPHCL”)
ii. Bihar State Power Generation Company Limited (“BSPGCL”)
iii. Bihar State Power Transmission Company Limited (“BSPTCL”)
iv. North Bihar Power Distribution Company Limited (“NBPDCL”)
v. South Bihar Power Distribution Company Limited (“SBPDCL”).

BSPHCL holds shares of the other four reorganized companies as listed above. This is mainly an investment company responsible for coordinating the activities of other supporting entities. BSPGCL and BSPTCL are engaged in the generation and transmission of electricity respectively. NBPDCL and SBPDCL undertake activities related to distribution of electricity to consumers, trading of electricity, and implementation of rural electrification schemes.

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: -

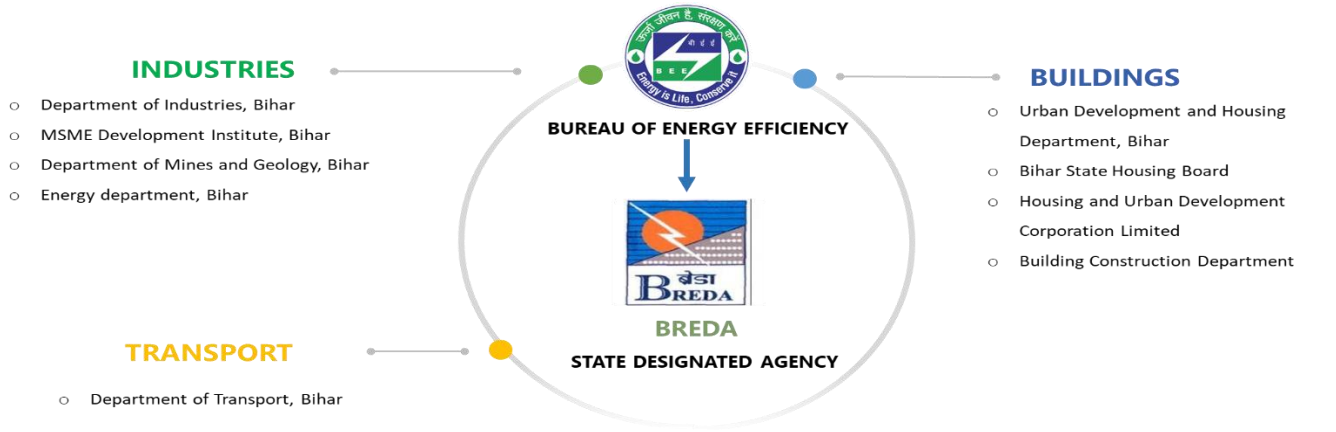


Figure 14: Departments representing Industries, buildings and transport

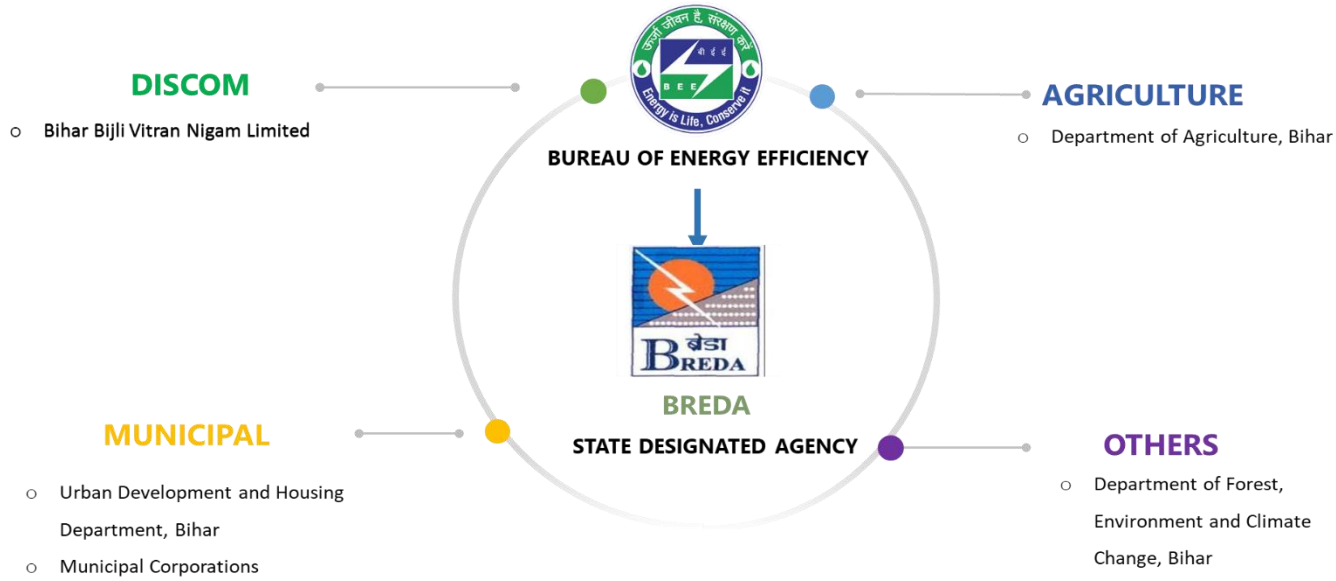


Figure 15: Departments representing DISCOMs, agriculture, municipal and others.

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 Bihar.

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:-

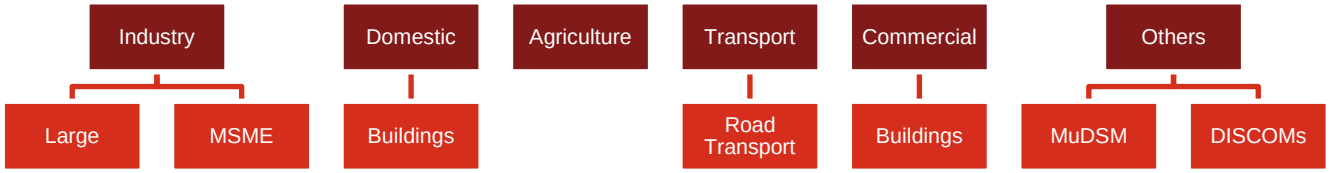


Figure 16: Areas assessed as part of focus sector identification

Identified focus sectors

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

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.

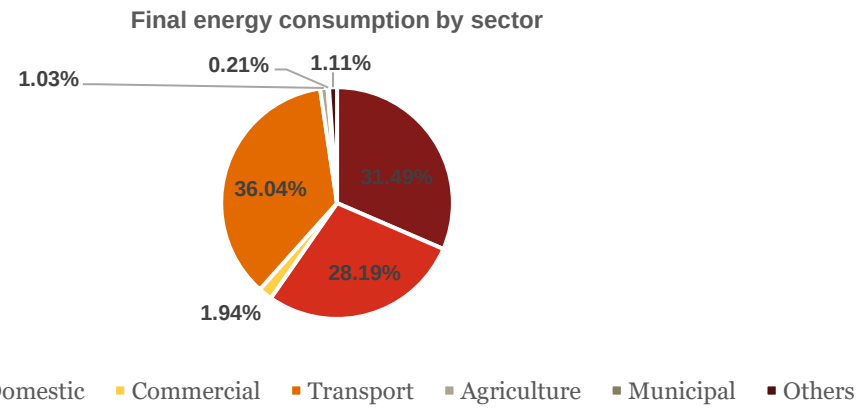


Figure 17: Final energy consumption by sector

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 Bihar'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 Bihar's GDP

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.

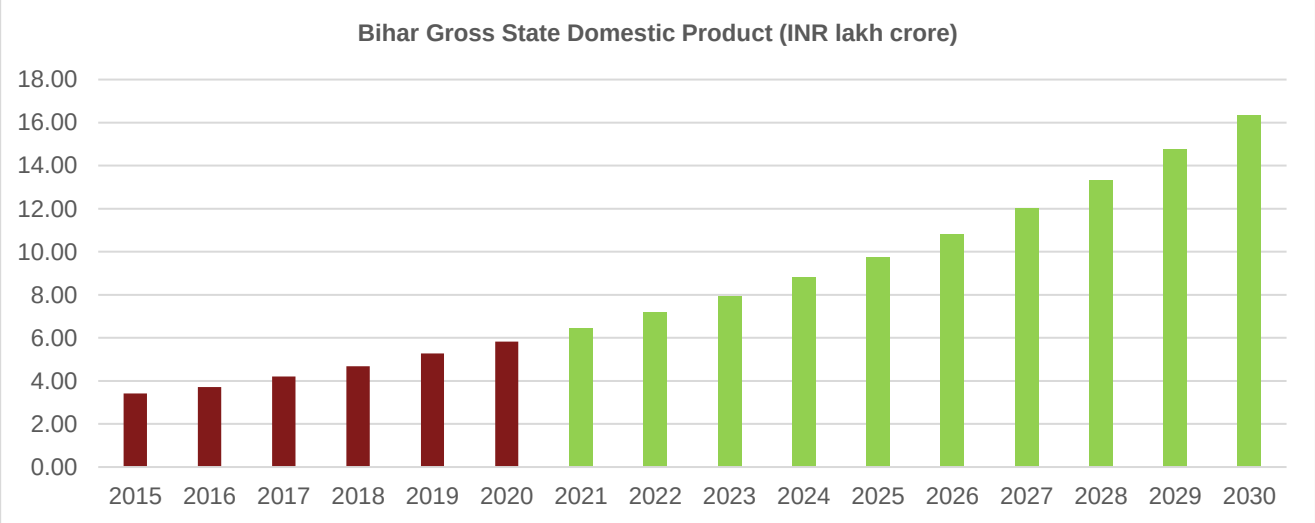


Figure 18: Bihar's GDP projection

Forecasting of final energy Consumption

The final energy consumption in Bihar varies from 7.35 Mtoe in 2014-15 to 10.11 Mtoe in 2020. This indicates a 38% rise in energy consumption over a period of five years. The baseline energy consumption intensity for FY2020 was calculated (1.95) and multiplied with forecasted GSDP to obtain final energy consumption trend till 2030. Following figure illustrates this information:

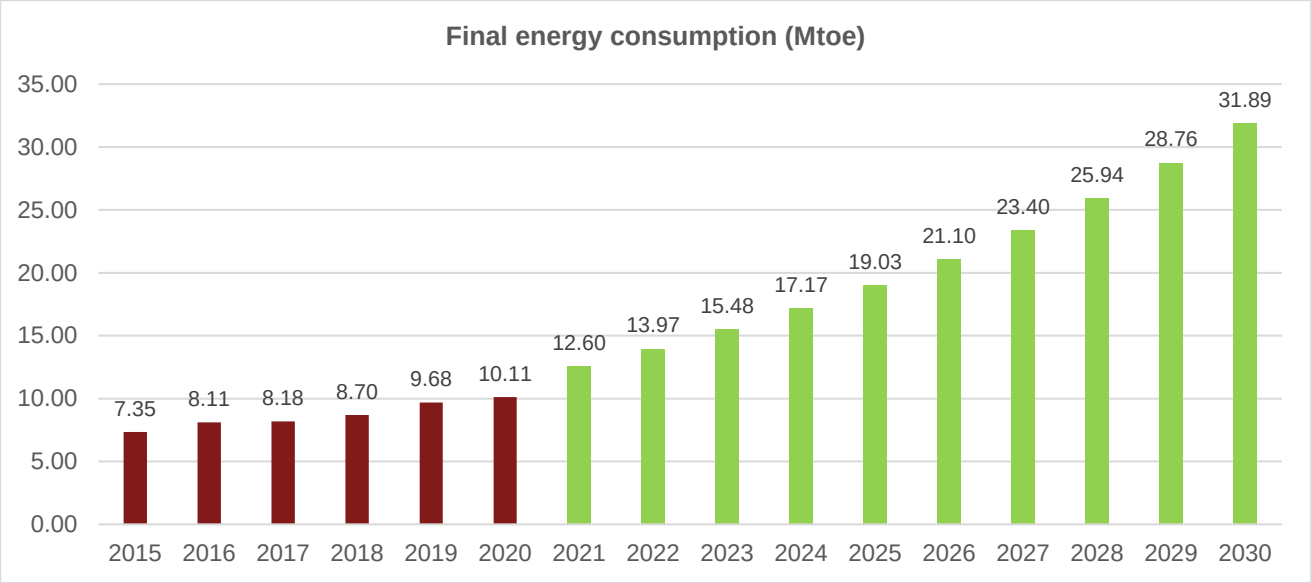


Figure 19: Year-wise projection of final energy consumption

Focus sector 1 – Industry

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

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. Following table encapsulates the key highlights of the industrial sector in Bihar[4] [5] [6]:-

Table 6: Key highlights of the industrial sector in Bihar

Key highlights	
Share in overall energy consumption	31%
Major sectors in Bihar	Cement, Thermal power plant, refinery, secondary steel, coke oven, brick among others
Major mineral reserves	Limestone, mica, quartz / silica, quartzite, talc/soapstone/ steatite
Major companies operating in Bihar	Hindustan Coca Cola Beverage, JMD Steel, Bharat Wagon and Engineering etc.
Designated Consumers for PAT scheme	4
Main industrial areas	Patna Industrial Area, Darbhanga Industrial Area, Muzaffarpur Industrial Area, Bhagalpur Industrial Area
Other key highlights	Since the introduction of the Industrial Investment Promotion Policy, the food processing sector has continued to attract the highest number of proposals followed by manufacturing and energy sector.
Stakeholders	Department of Industries, Bihar Bihar Industrial Area Development Authority (BIADA) Bihar Industries Association (BIA) Bihar Mahila Udyog Sangh (BMUS) Bihar Chamber of Commerce & Industries Patliputra Industries Association Eastern Bihar Industries Association Eastern Bihar Chamber of Commerce & Industries Mines & Geology Department, Bihar

4 Unlocking National Energy Efficiency Potential, Bureau of Energy Efficiency

5 All India Electricity Statistics 2021, Central Electricity Authority

6 Department of Industries, Bihar

It is pertinent to mention here that the industrial sector in Bihar has traditionally been suffering from low investment, low capital and low return on investment. However, over the last few years with the right intervention from the government, there has been a lot of significant improvement. The state has a large base of cost-effective industrial labor, making it an ideal destination for a wide range of industries.

According to the Department for Promotion of Industry and Internal Trade (DPIIT), cumulative FDI inflows in Bihar were valued at US$ 168.08 million between October 2019-June 2022.Total merchandise exports from the state stood at US$ 2,308.60 million in 2021-22, and US$ 1,258.97 in 2022-23 (till August 2022).

Energy efficiency potential in the sector

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

Energy Savings in 2030 under moderate scenario (Mtoe)	Energy Savings in 2030 under ambitious scenario (Mtoe)
0.116	0.41
0.49	1.38

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 the various type of industries. This will be discussed in detail in the next section.

Energy Efficiency Strategies in the Industrial sector

To realize the energy efficiency potential in the industrial sector in Bihar, 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 Bihar by segregating the total energy saving potential for each sector. The energy saving target for industrial sector is 0.713 Mtoe by 2031.[7]

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

Present schemes/policies in place pertaining to energy efficiency

From an industries sector perspective – Bihar has two main national level schemes which are being administered through the Bureau of Energy Efficiency. This is detailed as below:

- **Perform Achieve and Trade (PAT) scheme:** Under this scheme, acceleration of energy efficiency is targeted in energy intensive industries through the issuance of tradable instruments which are known as "Energy Saving Certificates" or "ESCerts". As part of this scheme, the notified energy intensive industrial units (which are also known as designated consumers) are required to reduce their energy consumption by undertaking energy efficiency measures. The PAT scheme is presently looking after the energy consumption of 14 sectors. These include: Cement, Aluminum, Chlor and alkali, Pulp and paper, Iron & steel, Fertilizer, Thermal power plants, Petroleum refinery, Railways, Petrochemicals, DISCOM, Railways, Textile, Commercial buildings.

  Bihar has the following designated consumers (DC):

7 UNNATEE report, Bureau of Energy Efficiency 2019

Designated Consumers
North Bihar Power Distribution Company Ltd. (NBPDCL) - DISCOM
South Bihar Power Distribution Company Ltd. (SBPDCL) - DISCOM
NTPC Ltd- Kahalgaon – Thermal Power Plant
Indian Oil Corporation Limited – Petroleum Refinery

- **BEE-SME programme:** The BEE SME Programme has been initiated to carry out energy efficiency-specific activities in the SME sector in India including conducting an extensive study for specific sectors as well as generating energy-related data for the SME sector which is believed to be highly unorganised and fragmented. As part of this programme, 25 clusters have been selected from 35 clusters across the country where the adoption of energy efficiency practices will be undertaken through several steps like capacity building, development of financing mechanisms and knowledge sharing.

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

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. The savings have been calculated using the moderate and ambitious scenario which is defined in this case as follows:-

Moderate scenario

- For moderate scenario - It is assumed that all the existing units will achieve the moderate SEC target in 50% units.

Ambitious scenario

- For the ambitious scenario - it is assumed that all existing units will achieve ambitious SEC target in 70% units.

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 [8](tonnes)	Energy saving in moderate scenario (toe)	Energy saving in ambitious scenario (toe)
Cement	0.0708	0.0676	2260000	**998**	**6990**
Sponge iron	0.55	0.4	2100000	**115958**	**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)

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 7: Action points for deepening of PAT scheme

S. No.	Action Plans for Bihar state to achieve energy efficiency potential
1	Mandatory Standardized Energy Audits in every three years for all units that have energy consumption below PAT threshold, in all notified PAT sectors, excluding MSEs.
2	Creating enabling environment through B2B forums with global technology suppliers

[8] https://ibm.gov.in/IBMPortal/

3	State-level energy efficiency roadmap for key sectors to be prepared
4	Channelizing green/climate finance and leverage financing instruments including but not limited to risk guarantee programs
5	Encouraging demonstration and pilot projects through technical institutions like IIT, IISc

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:-

Moderate scenario

- For moderate scenario - 50% penetration of zig-zag in brick sector, coke dry quenching in coke oven units.

Ambitious scenario

- For the ambitious scenario - 70% penetration of zig-zag in brick sector and coke dry quenching in coke oven units

Following table encapsulates both the aforementioned scenarios and demonstrates the energy efficiency potential in 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 [9] (tonnes)	Energy saving in moderate scenario (toe)	Energy saving in ambitious scenario (toe)
Clay fired Brick	0.026	0.012	59100000	475537	1331504
Brick	0.036	0.032	219000	12587	25243
Coke Oven	0.209	0.198	945000	5974	16728

(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)

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 8: Action points to promotion of EE in non PAT sector

S. No.	Action Plans
1	Awareness on Energy conservations in brick, refractory and coke oven clusters
2	Periodic standardized energy audits for MSMEs on load basis and reimbursement of energy audit cost to include key units such as petrol pumps, goods carriers, restaurants, mining activity, brick units
3	Sector-specific policy development for financial assistance on implementation of ECMs suggested in energy audit.
4	Demonstration projects on latest Energy Efficiency Technologies in SME clusters

[9] https://ibm.gov.in/IBMPortal/

5	Technical and financial assistance for transition from Bull Trench Kiln to Zig-Zag Kilns, tunnel kiln in refractory and coke dry quenching in coke oven units
6	Encouragement of biomass blending in coal-fired brick kilns by strengthening the supply chain

Energy savings targets and monitoring mechanism

Energy savings targets

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

Action Plan	Energy Savings in 2030 under moderate scenario (Mtoe)	Energy Savings in 2030 under ambitious scenario (Mtoe)
Deepening and Widening of PAT scheme	0.116	0.41
Energy efficiency in non-PAT	0.49	1.38

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, industries can set specific, measurable, and time-bound targets for reducing energy consumption.
- **Monitoring and measuring progress**: Once targets have been set, industries 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 – 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 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. Following table depicts the key highlights for the building sector in Bihar: -

Table 9: Key highlights for the building sector in Bihar

Key highlights	
Share in energy consumption	30%
Number of Buildings under Building Energy Efficiency Program (BEEP)	974
Stakeholders	• Planning and Development Department, Bihar • Public Health Engineering Deptt. • Building Construction Department, Bihar • Bihar Urban Infrastructure Development Corporation Ltd (BUIDCO) • Urban Development & Housing Department, Bihar

Energy efficiency potential in the sector

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

EE Strategy	Energy Savings in 2030 under moderate scenario (Mtoe)	Energy Savings in 2030 under ambitious scenario (Mtoe)
Strategy 1	0.315	0.549
Strategy 2	0.0020	0.0027
Strategy 3	0.015	0.030

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 Bihar, 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 Bihar by segregating the total energy saving potential for each sector. The energy saving target for buildings sector is 0.337 Mtoe by 2031.[10]

Keeping the above in hindsight, this section explores the present policies/strategies pertaining to energy efficiency in Bihar 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:-

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**

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

10 UNNATEE report, Bureau of Energy Efficiency 2019

Table 10: Action points for promoting appliance replacement EE programme

S. No.	Action Plans for Bihar 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)
0.008	**0.0020**	**0.0027**

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 points for promoting ECBC for energy efficiency in buildings

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 2: 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)
1.010	**0.015**	**0.030**

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 points to promote energy audit in buildings

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 recommended for the industrial sector, following table illustrates the overall energy savings targets envisaged for the buildings in Bihar in the year 2030:-

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	0.315	0.549
Effective implementation of Bihar ECBC 2022	0.0020	0.0027

Energy audit for commercial and public buildings	0.015	0.030

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 3 – Transport

Current scenario

Brief description of the sector

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.[11] [12]

Key highlights	
Share in final energy consumption	36%
Type of vehicles	ICE (2W, 3W, 3W, Buses, HDV) and electric vehicles
Stakeholders	• Department of Transport, Bihar • Bihar State Road Development Corporation Limited

The Department of Transport under the Government of Bihar is the nodal agency for the regulation of road transport, passenger as well as freight movement. Within the state of Bihar, road transport is responsible for carrying more than 80% of the total goods and passenger traffic. The construction and maintenance related to road infrastructure also generates employment opportunities within the state. The public investment in the road sector particularly has grown at around 16% between 2013 to 2019 from INR 5,988 Cr to INR 17,585 Cr.

Energy efficiency potential in the sector

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

Strategy	Energy Savings in 2030 under moderate scenario (Mtoe)	Energy Savings in 2030 under ambitious scenario (Mtoe)
Strategy 1	0.1200	0.2248
Strategy 2		1.0321

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 electr 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 Bihar is 0.551 Mtoe by 2031.[13]

11 Unlocking National Energy Efficiency Potential, Bureau of Energy Efficiency

12 Department of Transport, Bihar

13 UNNATEE report, Bureau of Energy Efficiency 2019

Keeping the above in hindsight, this section explores the present policies/strategies pertaining to energy efficiency in Bihar 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 of 2019-20, there are approximately 93 Lakh ICE [14]registered vehicles in the state. Out of this - 22.5 % are buses, 9.25 % are two wheelers, 8.53% are 4 wheelers, 8.24% are three wheelers and the remaining 1% of heavy-duty 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)
0.1200	**0.2248**

   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 13: Action points to promote transition to EVs in Bihar

S. No.	Action Plans for Bihar 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

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:-

14 MORTH

2025 energy consumption in transport (Mtoe)	Energy saving as per policy (Mtoe)
5.161	**1.0321**

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 14: Action points to promote 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 industrial sector, following table illustrates the overall energy savings targets envisaged for the buildings in Bihar in the year 2030:-

Action Plan	Energy Savings in 2030 under moderate scenario (Mtoe)	Energy Savings in 2030 under ambitious scenario (Mtoe)
Transition to electric vehicles	0.1200	0.2248
Ethanol blending	1.0321 (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.

Focus sector 4 – Agriculture

Current scenario

Brief description of the sector

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.

Almost 80% of the population of Bihar is engaged in agriculture and its allied sectors. Since 2008-09, several policies and roadmaps have been implemented in the state with a continued focus on increasing the productivity growth as well as improving the income of farmers. The major commercial crops in Bihar are as follows:

- Rice
- Wheat
- Lentils
- Maize (Corn)
- Sugar cane
- Fruits such as mangoes, bananas, jackfruit, litchis

Further in 2020, the Bihar Agriculture Investment Promotion Policy (BAIPP) was formulated to encourage the growth of agribusiness sector in the state. As per the policy, the seven focus sub-sectors are makhana, honey, fruits & vegetables, maize, seeds, medicinal & aromatics plants and tea. From an energy consumption perspective, following table illustrates the key highlights of the agriculture sector in Bihar:-

Table 15: Key highlights of agriculture sector in Bihar

Key highlighs	
Share in final energy consumption	1.03%
Major crops produced	Paddy, wheat, maize, pulses, sugarcane, potato, tobacco, oilseeds, onion, chillies, jute
Cultivable area	7.946 million hectare
Net sown area	5.638 million hectare
Rainfall	1,205 mm
Irrigated area	3.43 million hectare
Cropping intensity	142%
Stakeholders	Department of Agriculture, Bihar Animal and Fisheries Resource Department, Bihar Water Resource Department / Minor Water Resource Department Directorate of Horticulture, Bihar Sugarcane Industries Department IARI Regional Station, Pusa (Bihar) Agro-Economic Research Centre for Bihar & Jharkhand Directorate of Rice Development

Energy efficiency potential in the sector

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

Strategy	Energy Savings in 2030 under moderate scenario (Mtoe)	Energy Savings in 2030 under ambitious scenario (Mtoe)
Strategy 1	0.09	0.12
Strategy 2	0.019	0.033

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 the agriculture sector. This will be discussed in detail in the next section.

Proposed energy efficiency strategies in the agriculture sector

As per the Unlocking National Energy Efficiency Potential of Bureau of Energy Efficiency, the energy saving target for a state has been calculated by segregating the total energy saving potential for each sector. The energy saving target for agriculture sector is 0.020 Mtoe by 2031[15]. From an energy consumption standpoint, it is estimated that presently there are more than 4 lakh diesel pumps in Bihar[16] along with 2 Lakh electric pumps

Keeping the above in hindsight, this section explores the present policies/strategies pertaining to energy efficiency in Bihar 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 agriculture sector

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

3. **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.

   As per this strategy – following scenarios have been adopted for the replacement of existing stock of diesel pumps with solar based pumps:-

   Moderate scenario

   - By 2025, moderate scenario assumes 75% replacement of diesel pumps with solar pumps

   Ambitious scenario

   - By 2025, ambitious scenario assumes 100% replacement with solar pumps

   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 :-

15 UNNATEE Report, Bureau of Energy Efficiency 2019

16 https://static1.squarespace.com/static/5ad6d42a7e3c3a444757cf50/t/5d67b319e683a900014529ca/1567077151489/Electrifying+Agriculture+in+Bihar_postreview_Final.pdf

Diesel pumps estimated inventory by 2025	Energy saving in moderate scenario (Mtoe)	Energy saving in ambitious scenario (Mtoe)
439575	0.1200	0.2248

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 points to promote replacement of diesel pumps with solar based pumps

S. No.	Action Plans for Bihar state to achieve energy efficiency potential
1	Effective implementation of PM KUSUM Yojana

4. **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. As per this strategy – following scenarios have been adopted for the replacement of inefficient electric pumps with energy efficient electric pumps: -

Moderate scenario

- Moderate scenario assumes 30% replacement with efficient Star-Rated pumps

Ambitious scenario

- Ambitious scenario assumes 50% replacement with efficient Star-Rated pumps

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

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 points to promote replacement of ineffcient electric pumps with efficient 5 star pumps

S. No.	Action Plans
1	Phase wise plan to implement DSM scheme for replacement of existing inefficient pumps through ESCOs

Energy savings targets & Monitoring mechanism

Energy savings targets

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

Strategy	Energy Savings in 2030 under moderate scenario (Mtoe)	Energy Savings in 2030 under ambitious scenario (Mtoe)
Replacement of diesel pumps with solar based pumps	0.09	0.12
Replacement of inefficient electric pumps with energy efficient electric pumps	0.019	0.033

Monitoring mechanism

Implementing an energy savings monitoring mechanism is an important step for the agriculture 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 energy bills, conducting an energy audit to identify areas of high energy use, or using energy monitoring tools to track energy consumption. Identifying energy-saving opportunities: Once a baseline has been established, farmers and agricultural businesses can identify areas where energy savings can be made. This may involve implementing energy-efficient technologies, optimizing irrigation systems, or changing behaviors.
- **Setting energy-saving targets**: Based on the energy-saving opportunities identified, farmers and agricultural businesses can set specific, measurable, and time-bound targets for reducing energy consumption. Monitoring and measuring progress: Once targets have been set, farmers and agricultural businesses 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, farmers and agricultural businesses can make significant progress in reducing energy consumption, lowering costs, and improving sustainability performance. Additionally, it can lead to improved crop yields, reduced water usage, and increased profitability.

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: -

Sector	Energy saving in moderate (Mtoe)	Energy saving in ambitious (Mtoe)	Emission Saving (MtCO2)	Emission Saving (MtCO2)	Investment Potential (INR crore)
Industry	0.61	1.80	1.91	5.62	2468.8
Buildings	0.06	0.10	0.19	0.32	162.1
Transport	0.48	1.02	1.51	3.20	2313.1
Agriculture	0.11	0.49	0.35	0.49	2313.1
Total	**1.61**	**3.41**	**3.96**	**9.63**	**7257.0**

(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:-

Focus Sector	EE strategies	Action Points	Implementing agencies
Industries	Strategy 1: Deepening of PAT	1. Mandatory Standardized Energy Audits in every three years for all units that have energy consumption below PAT threshold, in all notified PAT sectors 2. Creating enabling environment through B2B forums with global technology suppliers 3. State-level energy efficiency roadmap for key sectors to be prepared 4. Channelizing green/climate finance and leverage financing instruments including but not limited to risk guarantee programs 5. Encouraging demonstration and pilot projects through technical institutions like IIT, IISc	Bureau of Energy Efficiency (BEE); BREDA
	Strategy 2: EE in non-PAT sectors	1. Awareness on Energy conservations in brick, refractory and coke oven clusters 2. Periodic standardized energy audits for MSMEs on load basis and reimbursement of energy audit cost to include key units such as petrol pumps, goods carriers, restaurants, mining activity, brick units 3. Sector-specific policy development for financial assistance on implementation of ECMs suggested in energy audit. 4. Demonstration projects on latest Energy Efficiency Technologies in SME clusters 5. Technical and financial assistance for transition from Bull Trench Kiln to Zig-Zag Kilns, tunnel kiln in refractory and coke dry quenching in coke oven units 6. Encouragement of biomass blending in coal-fired brick kilns by strengthening the supply chain.	Bureau of Energy Efficiency (BEE); BREDA
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); BREDA
	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	Bureau of Energy Efficiency; BREDA Urban Development and Housing Department

		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	
	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; BREDA 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

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

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

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

Annexures

List of sources

Primary Source	Secondary Source
Department of Agriculture, Bihar	Central Electricity Authority
Department of Transport, Bihar	Bihar Economic Survey
Department of Energy, Bihar	Ministry of Statistics and Programme Implementation
Department of Industries, Bihar	*Bihar Renewable Energy Development Agency*
Bihar Bijli Vitran Nigam Limited	Ministry of Road Transport and Highways
MSME Development Institute Patna	Bureau of Energy Efficiency
Bihar State Housing Board	Energy Efficiency Services Limited
Housing and Urban Development Corporation Limited	NITI Aayog (Energy Dashboard)
Urban Development and Housing Department, Bihar	Ministry of Micro, Small and Medium Enterprises
Bihar State Building Construction Corporation Limited	Ministry of Steel
Building Construction Department	Ministry of Power
Municipal Corporations (ULB)	Ministry of New and Renewable Energy
Damodar Valley Corporation	India Brand Equity Foundation
Steel Authority of India (SAIL)	World Bank / Asian Development Bank
Directorate of Municipal Administration (DMA)	Indian Bureau of Mines, Ministry of Mines

List of stakeholders

Stakeholder
Department of Agriculture, Bihar
Department of Transport, Bihar
Department of Energy, Bihar

Department of Industries, Bihar
MSME Development Institute Patna
Bihar State Housing Board
Housing and Urban Development Corporation Limited
Urban Development and Housing Department, Bihar
Bihar State Building Construction Corporation Limited
Building Construction Department
Municipal Corporations (ULB)