Assam Energy Action Plan

Action items for Government of Assam to secure a clean, efficient, affordable and self-reliant energy future

Table of Contents

List of Figures

List of tables

Abbreviations

AEDA	Assam Energy Development Agency
AEEDC	Assam Energy Efficiency Development Corporation
AERC	Assam Electricity Regulatory Commission
AIDC	Assam Industrial Development Corporation
APDCL	Assam Power Distribution Company Ltd.
APFC	Average Power Factor Correction
APGCL	Assam Power Generation Company Ltd.
ASDA	Assam State Designated Agency
ASTC	Assam State Transport Corporation
AT&C	Aggregate Technical and Commercial
BAU	Business-as-Usual
BEE	Bureau of Energy Efficiency
BESS	Battery Energy Storage System
BIPV	Building Integrated Photovoltaic
CEA	Central Electricity Authority
CEIA	Chief Electrical Inspector-Cum-Adviser
CFA	Central Finance Assistance
CGD	City Gas Distribution
CII	Chamber of Indian Industry
CNG	Compressed Natural Gas
DPR	Detailed Project Report
DR	Demand Response
DSM	Demand Side Management
DT	Distribution Transformer
ECBC	Energy Conservation Buildings Code
EE	Energy Efficiency
EESL	Energy Efficiency Services Ltd.
ESCO	Energy Service Company
FICCI	Federation of Indian Chambers of Commerce and Industry
FINER	Federation of Industry and Commerce of North Eastern Region
FiT	Feed in Tariff
GDD	Guwahati Development Department
GIS	Geographic Information System
GW	Gigawatt
HVDS	High Voltage Distribution System
INR	Indian national Rupee
IRP	Integrate Resource Planning
ITI	Industrial Training Institute
kWh	kilowatt hour

LED	Light Emitting Diode
LPG	Liquified Petroleum Gas
M&V	Monitoring and Verification
MNRE	Ministry of New and Renewable Energy
MSME	Micro, Small and Medium Enterprises
MW	Megawatt
NEDFi	North Eastern Development Finance Corporation Ltd.
NESSIA	North Eastern Small Scale Industries Association
NITI Aayog	National Institution for Transforming India
NPTI	National Power Training Institute
NTPC	National Thermal Power Corporation
O&M	Operation and Maintenance
PNG	Piped Natural Gas
PPP	Public Private Partnership
PWD	Public Works Department
RE	Renewable Energy
RFP	Request for Proposal
SDA	State Designated Agency
SDG	Sustainable Development Goals
SEC	Specific Energy Consumption
SECC	Socio-Economic Caste Census
SITA	State Innovation and Transformation Aayog
SNA	State Nodal Agency
T&D	Transmission and Distribution
ToD	Time of Day
UDD	Urban Development Department
ULB	Urban Local Body
WHR	Waste Heat Recovery
WTE	Waste to Electricity

About the project

Assam by adopting the Assam 2030: Our Dream, Our Commitment (vision and strategic architecture document) in 2016 became the first Indian state to formally adopt Sustainable Development Goals (SDGs) for its development path. The document highlights state government's commitment to improve the quality of life for its residents through economic growth and sustainable development. Since energy is essential for all economic activities, it is prudent for Assam to secure its energy future.

Realizing the need for an energy plan supported by a clear vision, the state's Power Department has signed a cooperation agreement with IGEN-ACCESS Programme of GIZ to prepare 'Assam Energy Action Plan'. To achieve desired outcomes from this agreement a Project Management Unit (PMU) and a Project Implementation Unit (PIU) have been constituted by the state government. The PMU is hosted by the Power Department and has representation from departments like Transport, Agriculture and Industry. A team of consultants from ICF Consulting India Pvt. Ltd., IIT Guwahati, and IORA Ecological Solutions support these units with technical and knowledge support.

The development of Assam Energy Action Plan was scheduled in the form of six sequential Work Packages as illustrated in Figure 1.

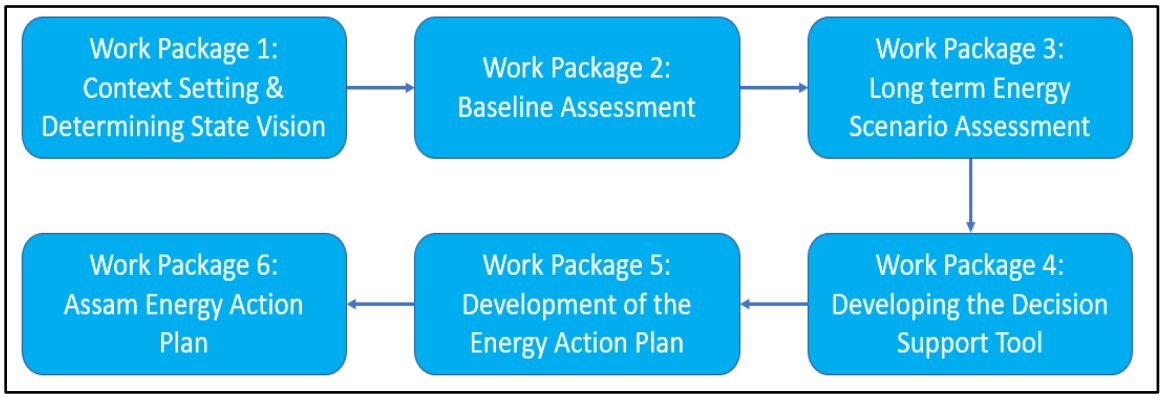


Figure 1: Work packages in Assam Energy Action Plan project

The six work packages (WPs) have been catalogued into three broad categories: 1. Vision, 2. Energy Plan, and 3. Energy Action Plan as shown in Figure 2. The approach of action plan development follows a top-down approach wherein Vision for Energy Plan (that includes goals, objectives, strategic areas) was determined at the outset and further detailing with respect to energy plan (baseline and scenarios assessment) was carried out subsequently.

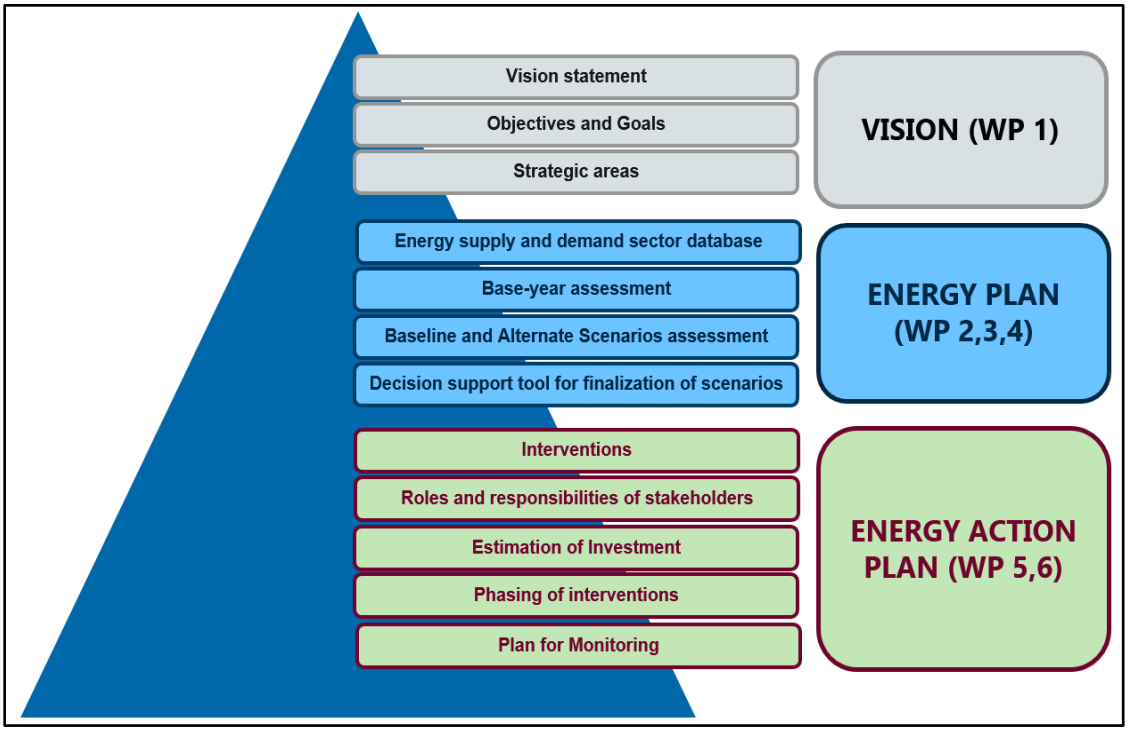


Figure 2: Structuring of Assam Energy Action Plan project

The Assam Energy Action Plan was prepared over nine months and Figure 3 illustrates the timeline of key events.

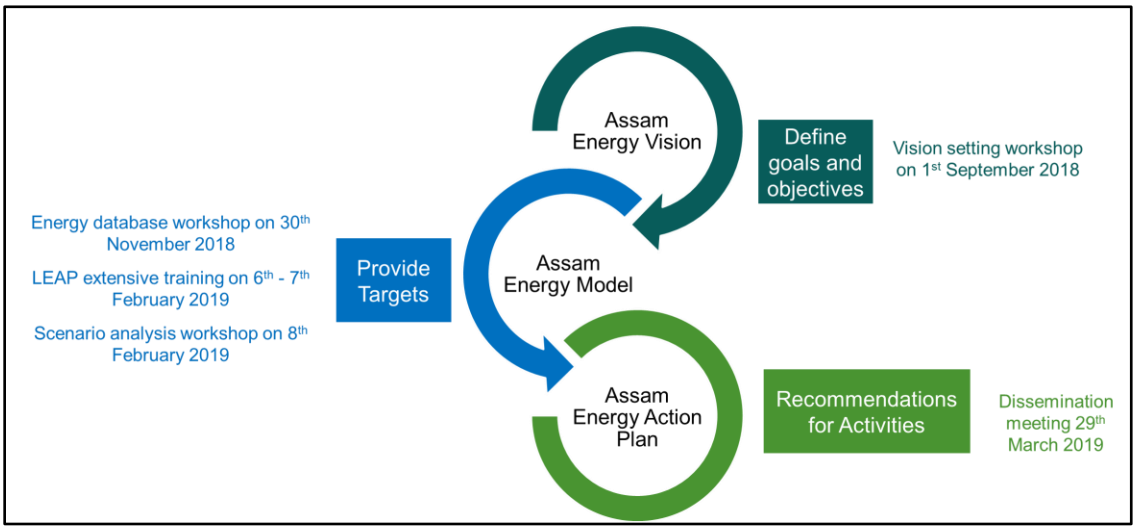


Figure 3: Timeline of key events

The Assam Energy Action Plan employs the approach illustrated in Figure 4. The energy vision which was prepared by the stakeholders provides a sense of direction in which actions need to be oriented. For example, the objective 'Assam is to achieve 50% share of modern and commercial cooking by 2030', gives a sense for interventions in modern fuels like LPG, PNG and electricity for cooking. However, objective does not quantify the number of households that should transition to LPG, PNG or electricity for cooking. For this, Assam

Energy Model is developed which provides magnitude to the actions. The recommendations of the action plan are thus directed by both the energy vision and model.

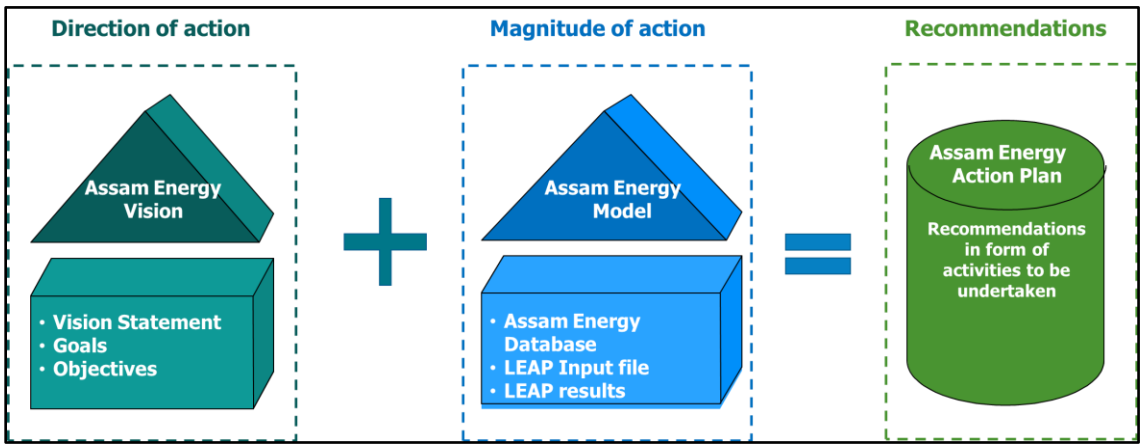


Figure 4: Linkage between Assam energy vision, model and action plan

During the course of this project following documents were prepared:

1. Context Setting Report
2. Assam Energy Vision
   - Vision setting toolkit
   - Assam Energy Vision - 2030 Report
3. Base-year assessment
   - Report on existing policies, programs and regulations
   - Report on sector-wise energy demand estimation methodology
4. Alternate energy scenarios assessment
   - Assam Energy Model
   - User Manual for Assam Energy Model
   - Alternate energy-scenario assessment Report
5. Decision Support Tool (DST) and User Manual
6. Assam Energy Action Plan (this report)

Important Note: This report is a culmination of several activities conducted during the project. This report makes appropriate references to the other reports prepared in the project which are mentioned above. It is recommended to read these reports for a deeper understanding of the prior work and linkage between activities.

Introduction to the report

The Assam Energy Vision - 2030 rightly recognizes the key role of energy to realize state's SDG targets. To assist Assam realize its energy goals and thereby support other development goals, the energy vision has set an ambition for development of affordable, reliable, and modern energy future for Assam.

The long-term scenario analysis for energy sector reveal the economic, social and environment benefits of aggressive energy efficiency and fuel shifting. The analysis also provides a direction to plan for generation capacity addition and power procurement till 2030. However, in order to realize the benefits computed through on-paper analysis, on-ground implementation by different stakeholders is required. The scenario analysis is the basis for formulation of the long term-energy action plan. The action plan proposes activities to meet targets set under the Assam Energy Secured (AES) scenario. The description of the scenarios is presented in Annexure. The action plan will cover different aspects described below:

- ✓ Define sectoral targets.
- ✓ Identify and prioritize strategic areas and interventions.
- ✓ Prepare a roadmap for phase wise implementation of activities.
- ✓ Estimate the resource requirement to mobilize the interventions.
- ✓ Identify geographical areas which can be focused for interventions.

The energy action plan prepared for Assam consists of sector wise activities which can be classified in four major categories:

- ✓ *Category 1: Policy and regulatory*
  The initiatives that may be notified by the state government to create a regulatory push. These initiatives will bear out as long term strategy options to supplement the efforts of clean energy vision.
- ✓ *Category 2: Institutional strengthening and awareness*
  The activities that may be undertaken in order to streamline the processes, establish or strengthen systems.
- ✓ *Category 3: Project development and technology promotion*
  The activities which require design and implementation of projects with the participation of the state agencies, power companies, funding agencies and private players such as developers, manufacturers, suppliers, retailers and dealers of agriculture pumps. These activities also include pilot projects to demonstrate the workability of concept for large scale replication.
- ✓ *Category 4: Financial and fiscal support*
  The activities which involve a direct monetary support in the form of subsidies, incentives or waivers. At present also, there are several interventions by the state to achieve this purpose.

The proposed action plan considers strengthening and expansion of the already existing initiatives in the state. Some of the suggested activities are drawn from practices adopted elsewhere in the country and globally.

The energy action plan is being prepared over a time horizon of 10 years. However, the activities may have to be revisited based on the technological and market development. The progress of the activities

will need to be monitored regularly to verify the success of the activities. The state will benefit from this 10-year plan in multiple ways such as monetary benefits to the consumers due to efficient energy consumption, reduced cost of electricity supply because of optimized sourcing, and ultimately lesser greenhouse gas emissions because of energy conservation and higher renewable in the mix.

The key recommendations under each category is illustrated in Figure 5, while the detailed sector wise action plan is presented in Chapter 5.

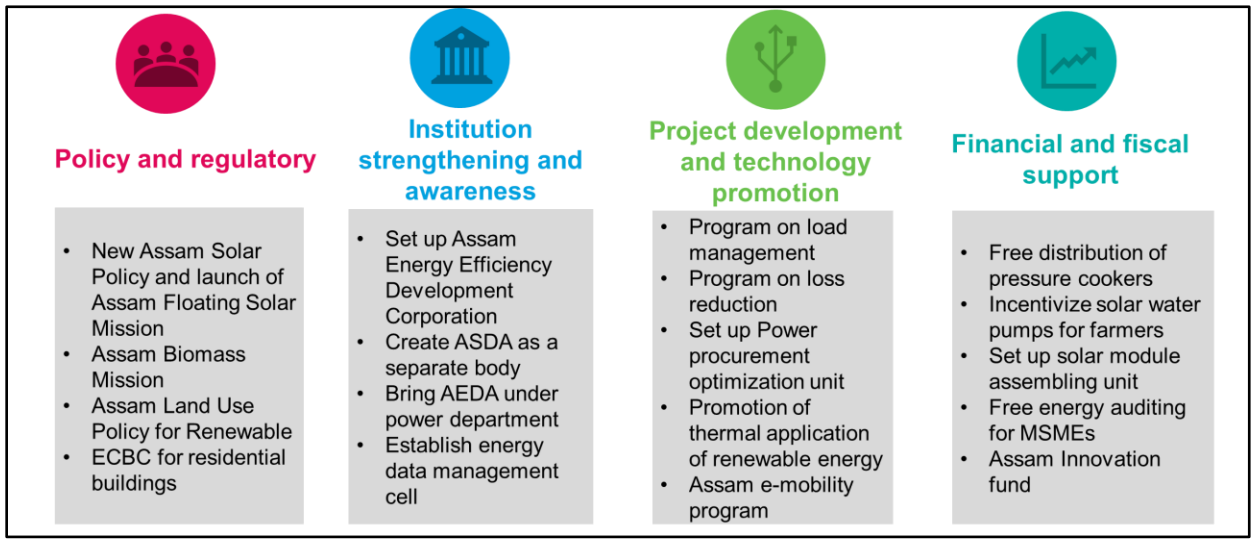


Figure 5: Key action items of Assam Energy Action Plan

In the short term, the action plan focuses more on Policies and Institutional strengthening. Development of projects and creation of new markets will be undertaken in the medium term once the supporting policies and institutional mechanisms are in place. The recommendations on financial schemes that can have a potentially high social impact are suggested for immediate uptake. While financial schemes with high capital outlay are suggested for later years. Figure 6 shows key action items with high impact potential in terms of local economic growth, jobs creation and rural livelihood improvement which can be launched as flagship schemes.

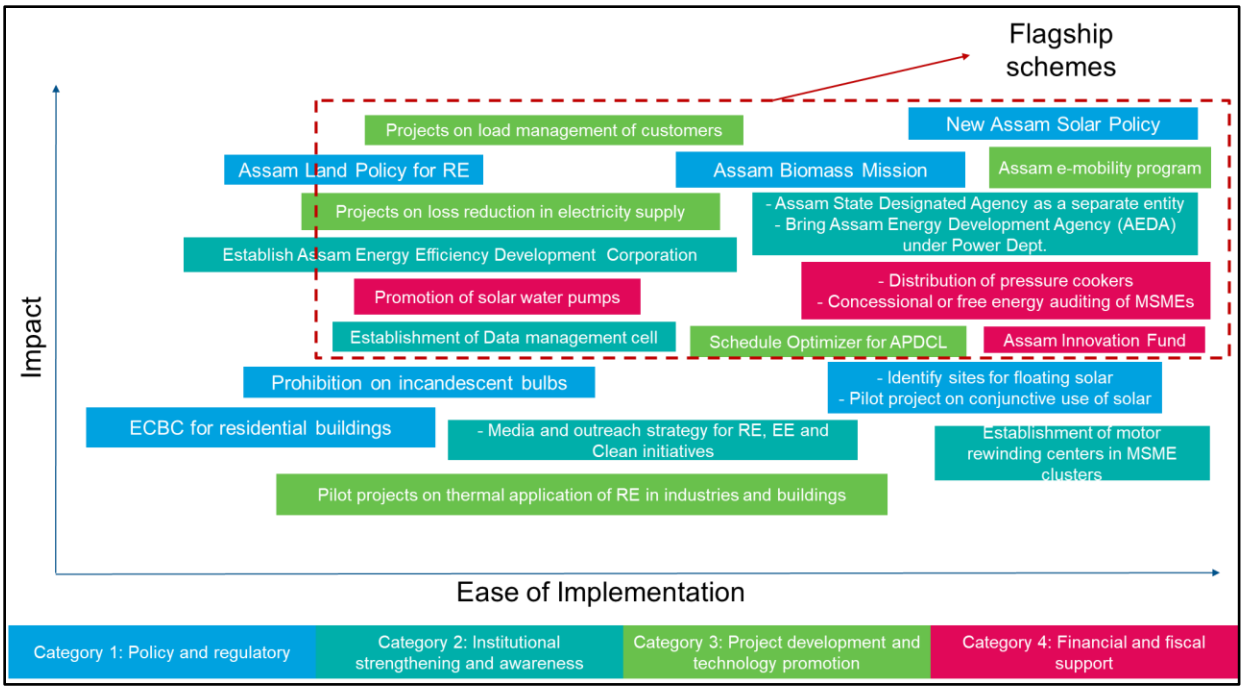


Figure 6: Flagship schemes for Assam Energy Action Plan

In the immediate term, in order to implement actions, Assam needs to do the following:

- ✓ Accept the Assam Energy Action Plan recommendations
- ✓ In-principle approval to implement flagship schemes
- ✓ Set up a high-level committee for strategic guidance/steering for implementation of action plan recommendations. The committee will monitor progress and guide course correction
- ✓ Set up an independent departmental implementation unit to fast track flagship schemes and policies
- ✓ Set up a cell for data management, updating, dissemination and coordination among agencies and departments. This cell may be set up in SITA or in SDG Cell

This report is organized as follows:

- ✓ Chapter I provides a summary of the key goals and objectives defined under Assam Energy Vision - 2030.
- ✓ Chapter II provides tangible targets for different sectors which are linked to the goals and objectives specified in Assam Energy Vision 2030. The chapter also shows the baseline values.
- ✓ Chapter III provides a summary of the key recommendations which are presented in the form of flagship activities. These flagship recommendations are selected from the sector wise action items. This chapter also presents few general activities that are also marked as flagship activities. These activities do not pertain to any specific sector, but they have a cross-cutting impact on several sectors analyzed in this planning exercise.
- ✓ Chapter IV presents a detailed action plan for the general activities.
- ✓ Chapter V presents a detailed action plan for each sector which covers the activities, estimation of investment requirement and suggestion for implementation agency.
- ✓ Chapter VI presents the way forwards towards implementing the action plan.

1. Assam Energy Vision - 2030

The Vision Statement set by the Assam Energy Vision - 2030 is "By 2030, Assam will build a bright future by empowering all residents with affordable and sustainable energy. Assam will lead efforts to promote clean and local energy resources, ensure high economic development and high quality of life for residents, preserve the state's natural bio-diversity, and increase climate resiliency."

The Goals and Objectives set under the Assam Energy Vision - 2030 are shown in Table 1.

Table 1: Goals and objectives of Assam Energy Vision - 2030

Goals	Objectives
Goal 1: Employ clean energy production, conversion and end use technologies	Objective 1.1: Increase share of renewable energy in state's energy mix by an additional 10% by 2030, compared to business-as-usual (BAU) scenario in 2030
	Objective 1.2: Increase share of renewable power generation capacity to 40% by 2030 to contribute towards the national commitment of achieving 40% non-fossil based generation capacity by 2030
	Objective 1.3: Increase share of non-diesel and non-petrol vehicles to 30% of vehicle population by 2030.
	Objective 1.4: Achieve 50% share of battery-operated vehicles in public transport by 2030
	Objective 1.5: Convert at least 20% urban/municipal waste to energy for sustainable waste management
	Objective 1.6: Specify 10% as minimum renewable based self-generation target to high and medium voltage customers of electricity, following the proposed amendment in the Electricity Act (Amendment 2018)
Goal 2: Promote efficiency and conservation in energy generation, conversion, transportation and consumption	Objective 2.1: Achieve 25% reduction in energy intensity by 2030, as compared to 2016 baseline in 2030.
	Objective 2.2: Increase average cooking efficiency by 1.5 times compared to 2015 baseline.
	Objective 2.3: 100% increase in number of passengers and freight load through waterways by 2030, as compared to the business-as-usual (BAU) scenario in 2030.
	Objective 2.4: Achieve 100% Energy Conservation Buildings Code (ECBC) compliance in new commercial buildings by 2023 and 100% compliance in new residential buildings by 2025
	Objective 2.5: Improve specific energy consumption in large industries and MSMEs by 5%, as compared to BAU scenario in 2030.

Goals	Objectives
	Objective 2.6: Reduce transmission and distribution losses (T&D) losses to 10% by 2025 and 5% by 2030.
	Objective 2.7: Increase the energy efficiency in farm irrigation by 30%, as compared to BAU scenario in 2030.
Goal 3: Ensure sufficient and quality modern energy access for everyone to meet their needs	Objective 3.1: Achieve at least 50% share of modern and commercial energy in cooking by 2030.
	Objective 3.2: Shift 50% households using solid cooking fuel in 2015 to modern and commercial energy by 2025.
	Objective 3.3: Meet 100% electricity requirement.
	Objective 3.4: Provide a minimum sanctioned load of 300-500 W per household by 2025; 700-1000 W by 2030.
	Objective 3.5: Promoting microgrids based on biomass and solar for difficult to reach areas (in areas like chars).
Goal 4: Provide energy at affordable cost	Objective 4.1: Achieve 10% cost savings through energy supply side optimization for all end-users by 2030, as compared to BAU scenario in 2030.
	Objective 4.2: Target household spending on energy not to exceed 10% of household income by 2030 for below poverty line (BPL) households.
Goal 5: Provide energy reliability to users at all time	Objective 5.1: Provide 24x7 quality supply to all including agriculture and industries sector.
	Objective 5.2: Achieve benchmark down time in planned and forced supply interruption.
	Objective 5.3: Promote smart microgrids for critical facilities such as in hospitals and emergency response centers to build resilience in responding to climate change hazards
Goal 6: Promote utilization of local resources	Objective 6.1: 20% reduction in energy imports by 2030 compared to BAU scenario in 2030.
	Objective 6.2: Utilize at least 10% of existing power generation potential from biomass (such as agriculture residue, forest biomass), solar and small hydro by 2025, 15% by 2030.
	Objective 6.3: Promote sustainable use of forest residue for decentralized energy generation in areas with geographical and locational disadvantages.

2. Targets to achieve

A summary of key targets derived from Assam Energy Model on the energy demand sector are presented in Table 2, the key targets for the energy supply sector are presented in Table 3.

Table 2: Energy demand side targets for Assam

Parameter	Unit	Baseline (2015)	Target for 2030[1]	Linkage to Objectives
Cooking sector				
Parameter 1: Number of households using improved cookstoves (as % of total number of households)	Million	0 (0%)	1.25 (13%)	Objective 2.1, 2.2, 3.1 and 3.2
Parameter 2: Number of households using LPG cookstoves (as % of total number of households)	Million	2.3 (33%)	4.9 (51%)	Objective 2.1, 2.2, 3.1 and 3.2
Parameter 3: Number of households using PNG connections (as % of total number of households)	Million	0 (0.5%)	1.4 (15%)	Objective 2.1, 2.2, 3.1 and 3.2
Parameter 4: Number of households using electricity for cooking (as % of total number of households)	Million	0 (0%)	1.45 (15%)	Objective 2.1, 2.2, 3.1 and 3.2
Transport sector				
Parameter 5: Number of electric buses (as % of total number of buses)	Thousand	0 (0%)	8 (50%)	Objective 1.3 and 1.4
Parameter 6: Number of electric two-wheelers (as % of total number of two-wheelers)	Thousand	0 (0%)	1,000 (30%)	Objective 1.3
Parameter 7: Number of electric three-wheelers (as percentage of total number of two-wheelers)	Thousand	0 (0%)	20 (20%)	Objective 1.3 and 1.4
Parameter 8: Number of electric cars (as % of total number of cars)	Thousand	0 (0%)	55 (15%)	Objective 1.3
Parameter 9: Number of CNG buses (as % of total number of buses)	Thousand	0 (0%)	1.5 (8%)	Objective 1.3 and 1.4

[1] Derived from Assam Energy Model – Assam Clean Energy scenario

Parameter	Unit	Baseline (2015)	Target for 2030[1]	Linkage to Objectives
Parameter 10: Number of CNG three-wheelers (as % of total number of three-wheelers)	Thousand	0 (0%)	20 (20%)	Objective 1.3
Parameter 11: Number of CNG cars (as % of total number of cars)	Thousand	0 (0%)	55 (15%)	Objective 1.3
Parameter 12: Share of public transport in road transport (passenger)	%	25	33	Objective 2.1
Residential sector				
Parameter 13: Penetration of LED in lighting appliances	%	1	100	Objective 2.1
Parameter 14: Penetration of high efficiency fans in ceiling fans	%	0	45	Objective 2.1
Parameter 15: Penetration of other high efficiency appliances in other appliances[2]	%	2	45	Objective 2.1
Parameter 17: Number of high efficiency AC (as % of total AC population)	Thousand	4 (2.4%)	345 (45%)	Objective 2.1
Parameter 18: Number of high efficiency refrigerators (as % of total refrigerator population)	lakh	0.3 (2.5%)	17 (45%)	Objective 2.1
Commercial sector				
Parameter 19: ECBC compliance of new constructions	%	0	100	Objective 2.1 and 2.4
Parameter 20: Retrofit of old buildings	%	0	100	Objective 2.1 and 2.4
Agriculture sector				
Parameter 21: Number of electric pumps (as % of total number of pumps)	Thousand	3.5 (3%)	115 (31%)	Objective 2.7
Parameter 22: Number of solar pumps (as % of total number of pumps)	Thousand	0.03 (0)	250 (69%)	Objective 2.7

[2] Other appliances include washing machine, mixers, grinders, microwave, oven, electric irons etc.

Parameter	Unit	Baseline (2015)	Target for 2030[1]	Linkage to Objectives
Industrial sector				
Parameter 23: SEC[3] of fertilizer industries	TWh/MT[4]	12.23	10.16	Objective 2.5
Parameter 24: SEC of cement industries	TWh/MT	0.88	0.80	Objective 2.5
Parameter 25: SEC of refineries	TWh/MT	1.08	0.98	Objective 2.5
Parameter 26: SEC of iron and steel industries	TWh/MT	7.33	6.49	Objective 2.5
Parameter 27: SEC of tea industries	TWh/MT	9.07	8.26	Objective 2.5
Parameter 28: SEC of other industries	TWh/Billlion INR	0.01	0.01	Objective 2.5

Table 3: Energy supply side targets for Assam

Indicator	Unit	Baseline (2015)	Target for 2030[5]	Link to goals
Power (within state)				
Parameter 29: Coal generators	MW	0	890	Objective 6.1
Parameter 30: Gas generators	MW	440	430	Objective 6.1
Parameter 31: Hydro generators	MW	250	370	Objective 6.1
Renewable energy				
Parameter 32: Utility scale solar	MW	0	1,300	Objective 1.1, 1.2, 3.3, 6.1, 6.2 and 6.3
Parameter 33: Decentralized solar	MW	0	250	Objective 1.1, 1.2, 3.3, 6.1, 6.2 and 6.3

[3] SEC – Specific Energy Consumption. It is usually measured in energy/production units
[4] TWh/MT – Terra Watt hour energy consumed per metric ton of production
[5] Derived from Assam Energy Model – Assam Energy Secured scenario

Indicator	Unit	Baseline (2015)	Target for 2030[5]	Link to goals
Parameter 34: Wind	MW	0	40	Objective 1.1, 1.2, 3.3, 6.1, 6.2 and 6.3
Parameter 35: Small hydro	MW	4	100	Objective 1.1, 1.2, 3.3, 6.1, 6.2 and 6.3
Parameter 36: Biomass	MW	0	300	Objective 1.1, 1.2, 3.3, 6.1, 6.2 and 6.3
Parameter 37: Waste to electricity	MW	0	20	Objective 1.1, 1.2, 1.6 3.3, 6.1, 6.2 and 6.3
Power (imports)				
Parameter 38: Hydro generators	MW	240	280	Objective 4.1
Parameter 39: Gas generators	MW	300	300	Objective 4.1
Parameter 40: Coal generators	MW	185	185	Objective 4.1
Parameter 41: Renewable imports	MW	25	680	Objective 1.1 and 4.1
Transmission and Distribution Losses (%)				
Parameter 42: T&D loss	%	20%	5%	Objective 2.6

3. Summary of action plan

This action plan report comprises of 49 action items. The sector specific activities are presented under four broad categories:

- ✓ Category 1: Policy and regulatory
- ✓ Category 2: Institutional strengthening and awareness
- ✓ Category 3: Project development and technology promotion
- ✓ Category 4: Financial and fiscal

In addition to sector specific activities, there are few general activities that do not pertain to any specific sector. These activities have a cross-cutting impact on several sectors analyzed in this planning exercise. The high priority activities in these categories are presented in Table 4. It is worthwhile mentioning here that the estimated expenditure covers the indicative cost of undertaking policy studies and program design, preparation of proposals and detailed project reports (DPRs), undertaking demonstration projects, and preparation of tender and other related activities. The estimates need to be updated through a detailed assessment at the time of implementation. Moreover, the expenditure shown here does not include the cost of subsidies and the investment required for scaling up of implementation activities.

Table 4: High priority activities

Activity	Execution time[6]	Cost[7]
General activities		
Set up a 'Data Management Cell' to maintain Assam Energy Model and sustain energy planning activities	3 months	30 lakhs per annum
Develop a communication and media strategy for promotion of EE, RE and clean initiatives of all departments	6 months	50 lakhs
Create Assam ASDA as a separate body	6 months	-
Frame Assam land policy for RE projects to address the issue of property rights for development of green energy projects	12 months	50 lakhs
Bring AEDA under the aegis of Power Department	6 months	-

[6] Reflects the time needed to design, conduct or prepare policies, studies or notifications. This does not include implementation time.
[7] The costs are indicative of preparatory work and do not reflect the cost of project implementation

Activity	Execution time[6]	Cost[7]
Integrate RE and EE in curriculum of ITIs, polytechnics, engineering colleges and other technical training institutes	9 months	30 lakhs
Set up 'Assam Innovation Fund'	3 months	20 crores per annum
Category 1: Policy and regulatory		
Prepare a New Assam Solar Policy which includes new technologies like floating solar, BIPV, canal top solar and storage.	6 months	50 lakhs
Prepare proposal for Assam Biomass Mission. The mission will allocate areas for biomass collection, promote briquette and pellet manufacturing and set up 300 MW biomass to electricity plants.	9 months	75 lakhs
Expand scope of ECBC to cover multi-story residential buildings	12 months	-
Category 2: Institutional strengthening and awareness		
Prepare business plan to set up Assam Energy Efficiency Development Corporation (AEEDC). AEEDC will provide technical and implementation support for EE projects.	6 months	50 lakhs
Prepare proposal to set up Bio-fuel Development Agency. The board will promote plantation and processing of bio-fuels[8] in Assam.	6 months	40 lakhs
Undertake impact-assessment study of Small Hydropower Development Policy (2007). The study will identify barriers in development of small hydro projects and propose measures to address them.	3 months	25 lakhs
Category 3: Project development and technology promotion		
Prepare a proposal to set up Motor Rewinding Centers. The centers will provide quality motor rewinding services to MSMEs.	6 months	30 lakhs
Design a program for 'strategic load growth' in off-peak hours and day time. The program will cover DR and DSM measures.	9 months	50 lakhs

[8] Comprises solid, liquid and solid fuels

Activity	Execution time[6]	Cost[7]
Prepare proposal for demonstration projects on technologies like heat pump, solar cold storage, district heating and cooling, and other.	3- 6 months each	25 lakhs
Category 4: Financial and fiscal support[9]		
Design a program to distribute pressure cookers	6 months	25 lakhs
Design a scheme to incentivize energy auditing in MSMEs	3 months	20 lakhs
Design Energy Insurance Scheme to promote uptake of EE projects	6 months	25 lakhs
Design a subsidy program for solar water pumps	3 months	20 lakhs

[9] Reflects the budget required to design the program and not the actual financial support proposed.

4. General activities

This section presents activities that do not pertain to any specific sector and have a cross-cutting impact on sectors analyzed in this planning exercise.

Activity 1: Set up a 'Data Management Cell'

Availability of accurate and timely data is essential to take forward any energy planning activity. This makes Assam Energy Model the backbone of Assam Energy Action Plan. The model provides analytical base for energy planning and a platform to develop consensus amongst stakeholders with contrasting viewpoints. This makes it essential to have a team which will claim ownership of the model, and will:

- ✓ Collect necessary data to update model
- ✓ Update the database
- ✓ Add new scenarios and technologies in the model
- ✓ Undertake energy planning related activities
- ✓ Undertake capacity building training on energy planning

In this context, a proposal to set up a 'Data Management Cell' at State Innovation and Transformation Aayog (SITA) with support from the Power Department should be prepared. The proposal preparation process is likely to take up to 3 months and will cost around INR 5 lakhs. The proposal will cover funding for human resource and infrastructure required for setting up the cell and also propose an organizational structure.

Since Assam Energy Model is a yearly planning tool, it is expected that the cell will update the model at least on an annual basis. The cell will prepare an annual roadmap for updating the model and a streamline process to collect information from various departments and sources.

The cell will undertake energy modeling exercise with updated data and then coordinate with stakeholders to change course of Assam Energy Action Plan as and when needed. The data management cell is expected to be set up in three months and will require INR 30 lakhs annually for its operations.

Activity 2: Develop a communication and media strategy for promotion of EE, RE and clean initiatives of all departments

It is envisaged that the recommendations of Assam Energy Action Plan will be implemented by various government departments. Since awareness creation is a key component of several recommendations, several departments will have to allocate their resources to devise awareness programs.

These resources both in terms of manpower and money could be saved through a comprehensive communication and media strategy which will cover all EE, EE and clean initiatives. For simplicity of this report, the awareness related recommendations are presented under various sectors. The communication and media strategy is likely to be prepared in 6 months with a budget of INR 50 lakhs.

Activity 3: Establish Assam State Designated Agency (ASDA) as a separate entity

Presently, the Chief Electrical Inspector-cum Adviser (CEIA) is the State Designated Agency in Assam, forcing the organization to discharge dual duties. This has stretched the organization's already limited resources and limited its capacity to coordinate, regulate and enforce energy efficiency provisions.

ASDA as a separate institution is prerequisite to implement energy efficiency recommendations of Assam Energy Action Plan. In this context, assistance may be provided to the Power Department to draw out a plan to create ASDA as a separate entity. This process is already in motion and it is likely to take up to six months for completion.

Activity 4: Frame Assam land policy for RE projects

Assam has a high share of land under agriculture and forest cover, which makes less area available for renewable energy projects. To promote renewable energy projects, which form the core of Assam Energy Action Plan, it is essential that Assam frames a policy to earmark areas for green projects development. The policy will thus overcome barriers related to property rights which create bottlenecks in land acquisition. The policy preparation process is expected to take up to 12 months and will cost INR 50 lakhs.

Case study: Gujarat Land Policy

Due to high wind and solar power potential in Gujarat, the central agency Solar Energy Corporation of India (SECI) and state agency Gujarat Urja Vikas Nigam Ltd. (GUVNL) have sanctioned many solar projects in the state. Since the state government was not consulted during allocation of project by central agency, the state government was reluctant to lease land for projects. This became a barrier for development of projects as developers were stuck in situation where they had no clarity over availability of land.

To overcome this situation, Government of Gujarat has released its land policy for renewable energy projects. The policy has earmarked areas of development of 30 GW projects and all future solar, wind and solar-wind hybrid projects will be set up in these areas. This policy addresses the problems faced by project developers over land acquisition and property rights.

Activity 5: Bring AEDA under the aegis of Power Department

Assam should also consider bringing AEDA under the power department. This will help to harmonize the activities between NRE (New and Renewable Energy) department of APDCL and AEDA. The arrangement to constitute ASDA as a separate body and bringing AEDA under power department is likely to give the necessary impetus required for RE. Assam may also consider merging ASDA and AEDA into a single entity. Such a move will help harmonize the activities and facilitate sharing of resources. This arrangement will bring Assam at par with majority of the Indian states where SDAs and SNAs are same bodies. This activity is likely to be completed in six months. If this proposal will be accepted, further references of NRE or AEDA in this document imply involvement of both the agencies.

Activity 6: Integrate RE and EE in curriculum and design certification courses for working professionals

It is essential to develop local skilled workforce to ensure sustenance of energy efficiency and growth of renewable energy in the state. Also, skilled workforce is required to promote electric vehicles. In this context, it is recommended that AEDA and ASDA should work with academic institutions like IIT-Guwahati, Industrial Training Institutes (ITI), polytechnics and other technical training institutes to introduce energy efficiency, renewable energy and electric vehicles in their curriculum. The curriculum rather than being theory oriented should include hands on experience where site visits to renewable energy projects (biomass gasifier, solar plant, waste to electricity and others), energy audits with experts in industrial units or college campus and hands on training on energy modeling may be undertaken. In addition, institutions may be encouraged to design and run short duration certification courses for skilling of working professionals. The AEDA and ASDA should also work with Skill Council for Green Jobs on areas including solar, biomass, biofuels, clean cookstoves fields. Through the consultations, it is learnt that Skill council for Green Jobs has already prepared a training curriculum for Tezpur University. AEDA and ASDA should work to increase the scope of training and skilling and expand the program to other institutes and universities in the state.

Activity 7: Set up 'Assam Innovation Fund'

Assam Energy Action Plan identifies innovation as a key driving force for sustainable and balanced growth in the state. The action plan had identified following areas/technologies as part of this segment:

- ✓ *Conjunctive use of land for agriculture and solar power generation* as means to overcome land availability constraints to develop solar projects in the state. Demonstration projects will be undertaken to assess economic feasibility of these systems.
- ✓ *Brush less DC (BLDC) solar pump* offer higher operating efficiency than AC solar pumps. However, these systems tend to be more expensive. Demonstration projects will be undertaken to assess techno-economic feasibility for a large scale program to promote these systems.
- ✓ *Heat pumps* are highly efficient technologies and have high potential for energy savings in industrial sector. Demonstration projects will be undertaken to assess techno-economic feasibility of these systems for industrial and commercial facilities.
- ✓ *District heating and cooling systems* are efficient means to reduce energy consumption in industries and large commercial buildings. Demonstration projects to assess economic-feasibility of these systems may be undertaken.
- ✓ Trigeneration systems are efficient means to generate electricity and provide energy for heating and cooling needs. Demonstration projects to assess economic feasibility of these systems may be undertaken.
- ✓ *Building-integrated photovoltaic systems* offer opportunities to harness solar energy from areas otherwise utilized. These systems have shown slow growth in the Indian market. However, *solar charging stations* for electric vehicle station may provide lifeline to this segment. Demonstration projects may be undertaken to assess techno-economic feasibility of these systems.
- ✓ *Electric induction cooking* as a tool for strategic electricity demand growth in areas with low electricity demand and to reduce dependence on fossil fuels.

- ✓ **Hybrid coal and biomass gasification and power generation** facility that will utilize the low-grade north-east coal and organic biomass. Demonstration projects for proof of concept and to assess techno-economic feasibility of these systems may be undertaken.

These technologies identified under the innovation segment are covered in detail in the sector wise action plan.

The Government of Assam had constituted the State Innovation Council in 2011 to promote innovation in the state by encouraging young talent, local universities, colleges, Micro, Small and Medium Enterprises (MSMEs) and research and development institutes. In addition, the Assam Startup Policy (2017), launched by the Department of Industries and Commerce provides support to incubate innovative ideas into businesses.

To give impetus to innovation, SITA should consider preparing a proposal to set up 'Assam Innovation Fund' under its ownership or increasing the budget outlay of State Innovation Council. The proposal preparation process is likely to take up to 3 months.

The Government of Assam could earmark INR 20 crores for the fund annually. In addition, SITA may receive funding from individuals and private organizations. The SITA will also design a mechanism to identify projects, technologies and research work to be funded.

Case study: Micro-light turbine (Assam local innovation)

Development of large hydro plants in North-East India has witnessed stagnation due to sheer scale of social and environmental impacts. Micro-hydel projects of 5-100 kW capacity are being considered for perennial flowing rivers.

Mr. Kamal Chandra Saikia has designed small turbine that can generate 6-8 kW of power from low flowing rivers at a static head of only one meter. Electricity generated using this turbine is expected to cost Rs. 4-4.5 per unit.

Mr. Kamal Chandra with microlight propeller hydro turbine

5. Sector wise activities

Energy consumption in each sector is a function of several factors. In order to make the energy footprint of these sectors efficient and clean, Assam Energy Action Plan recommends action items covering energy demand and supply. These activities are presented under 8 sectors.

5.1 Power sector

For the power sector, four strategic areas are identified as shown in Figure 7.

- ✓ *Load Management* which is aimed to focus on demand side interventions.
- ✓ *Capacity Addition* focuses on installation of new power plants and refurbishment of existing power plants.
- ✓ *Procurement Optimization* focuses on optimal purchase of electricity from outside of the state through establishment of systems and process.
- ✓ *Loss Reduction* is aimed to reduce the technical and commercial losses incurred by APDCL as a part of the distribution business.

Figure 7: Power sector strategic areas

Activity 8: Prepare and implement a load management strategy

This activity is under Category 3: Project development and technology promotion

The load management strategy proposed for APDCL will have two pillars as mentioned below:

1. Peak Load Management: This is to reduce the evening peak demand by either shifting the evening peak demand to off-peak periods or curbing the evening peak demand. Currently the evening peak is double the day time demand. With more solar electricity expected in the system and additional demand from newly electrified customers under Saubhagya, the gap between peak and off-peak demand is likely to increase.
2. Strategic Load Growth: This strategy will focus on increasing the day time load (valley filling), which will reduce the gap between peak and off-peak requirement.

Peak Load Management

1. Conduct a study on "Time of Day" or ToD tariff to determine the incentive/penalty which will induce customers to shift their demand from peak to off peak period. The study will cover the below important aspects which are generally not considered while designing ToD tariff.

- ✓ Load research study to determine the price elasticity in demand and to determine the exact customer types for which customer demand coincides with system peak.
- ✓ System study to determine the peak and off-peak hours.
- ✓ Determination of penalty and incentives which will result in overall benefit to APDCL.
- ✓ Determination of overall expected impact.

AERC may consider essential aspects considered by Kerala (as an example) in designing ToD tariff (Figure 8), to design ToD tariff structure for Assam.

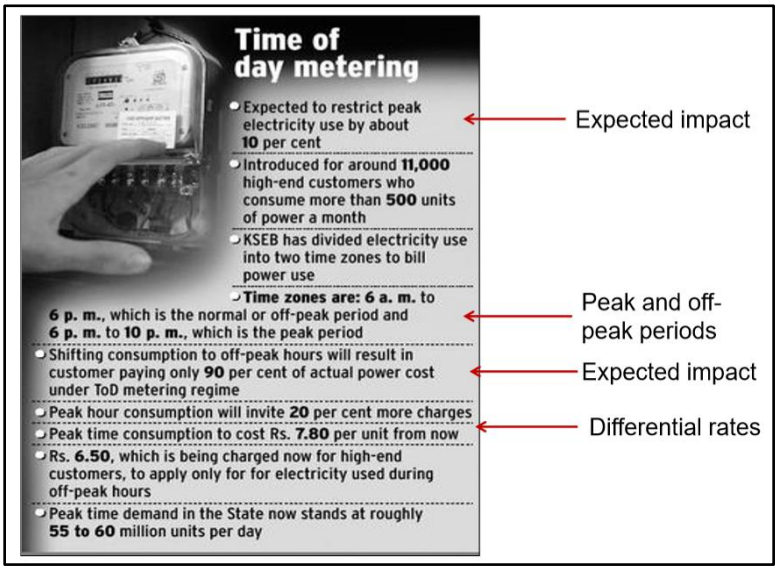


Figure 8: ToD tariff in Kerala[10]

Study to determine ToD tariff for Assam is expected to cost the state government around 40 lakhs over two years (Table 5).

Table 5: Timeline and fund requirement for ToD tariff study

Fund requirement (INR lakhs)	2019	2020
Cost of study to determine Time of Day Tariff	20	20

2. Design and implement a demand response (DR) program for clipping of peak load and shifting of peak load. The program will target commercial, industrial and institutional customers initially and will not target domestic customers as the cost of program administration increases with a greater number of smaller sized customers. The demand response program could be manual or automated. APDCL can set a goal for 50-100 MW reduction through this program. Assam already has a DSM regulation in place which enables APDCL to implement DSM programs which are cost effective. However, APDCL needs approval from AERC for implementation. Hence, a program design document will have to be prepared by APDCL for approval from AERC. The program design document will cover the program

[10] http://myenergyauditor.blogspot.com/2013/02/time-of-day-tod-metering-is-introduced.html

size, target customer category, demand response measure (e.g. smart thermostat), program cost, DSM cost effectiveness analysis, monitoring and verification plan.

In India, several DR projects have been implemented in pilot and commercial scale mode, some of which are shown in Figure 9.

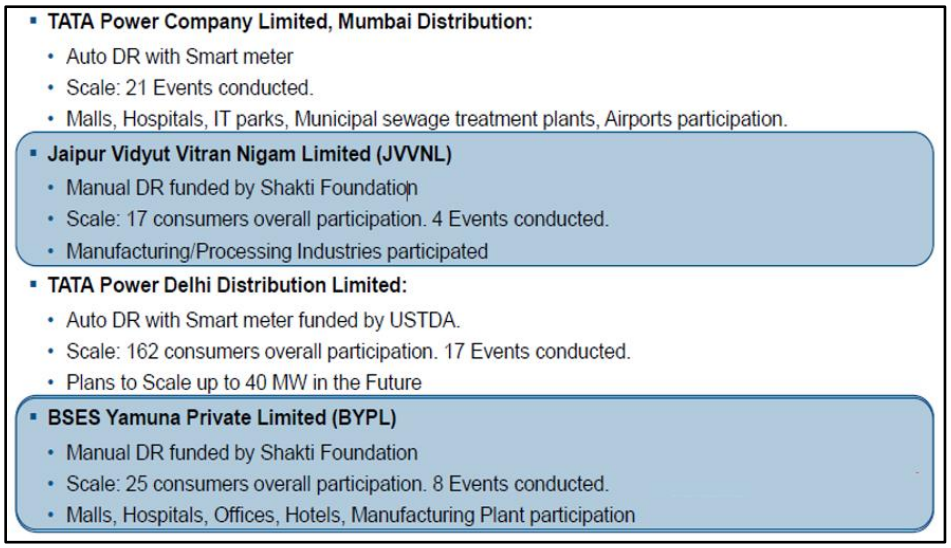


Figure 9: DR projects in India

Figure 10 shows the participant types and demand reduction achieved from a pilot project in BYPL region. The project had participation from a mix of commercial, industrial and municipal customers.

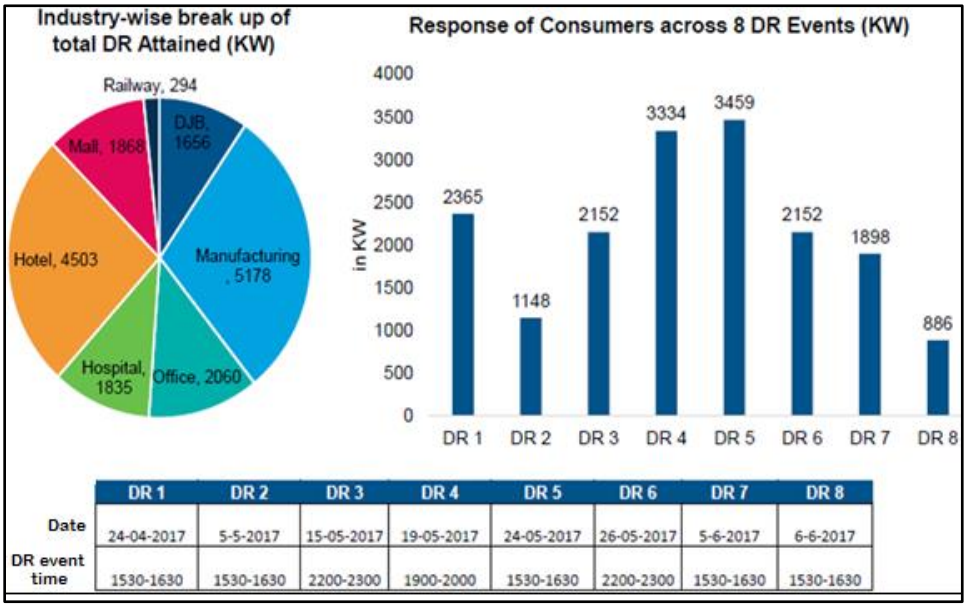


Figure 10: BYPL DR project highlights

The bar graph in Figure 10 shows the demand reduction from each DR event, pie graph is a cumulative breakup of demand reduction by customer type and the table at the bottom shows the date and duration of DR events in (BYPL) DR project. Design and implementation of DR program is expected to cost the state government around 1.15 crores over two years (Table 6).

Table 6: Timeline and fund requirement for DR program

Fund requirement (INR lakhs)	2019	2020
Cost of designing DR Program	30	
Cost of petition preparation for DR Program		10
Cost of implementing a 10-20 MW DR program (Hardware, software, promotion cost)		75
Cost of incentives for DR		Will become a part of tariff rate base

3. Design and implement a pilot project on use of energy storage at DT/feeder level for peak load management. APDCL can conduct a techno-economic feasibility study for deployment of energy storage (pole mounted or in substation). Based on the feasibility study, identify distribution transformers (DTs) where energy storage can provide peak load management and capex deferral. On few DTs, a pilot project can be implemented to study the benefits of storage in loss reduction, peak management, asset life extension, power quality improvement and capex deferral.

The Figure 11 shows the schematic of a 10 MWh battery storage project implemented in Tata Power Delhi where the storage is tied to 66 kV distribution network.

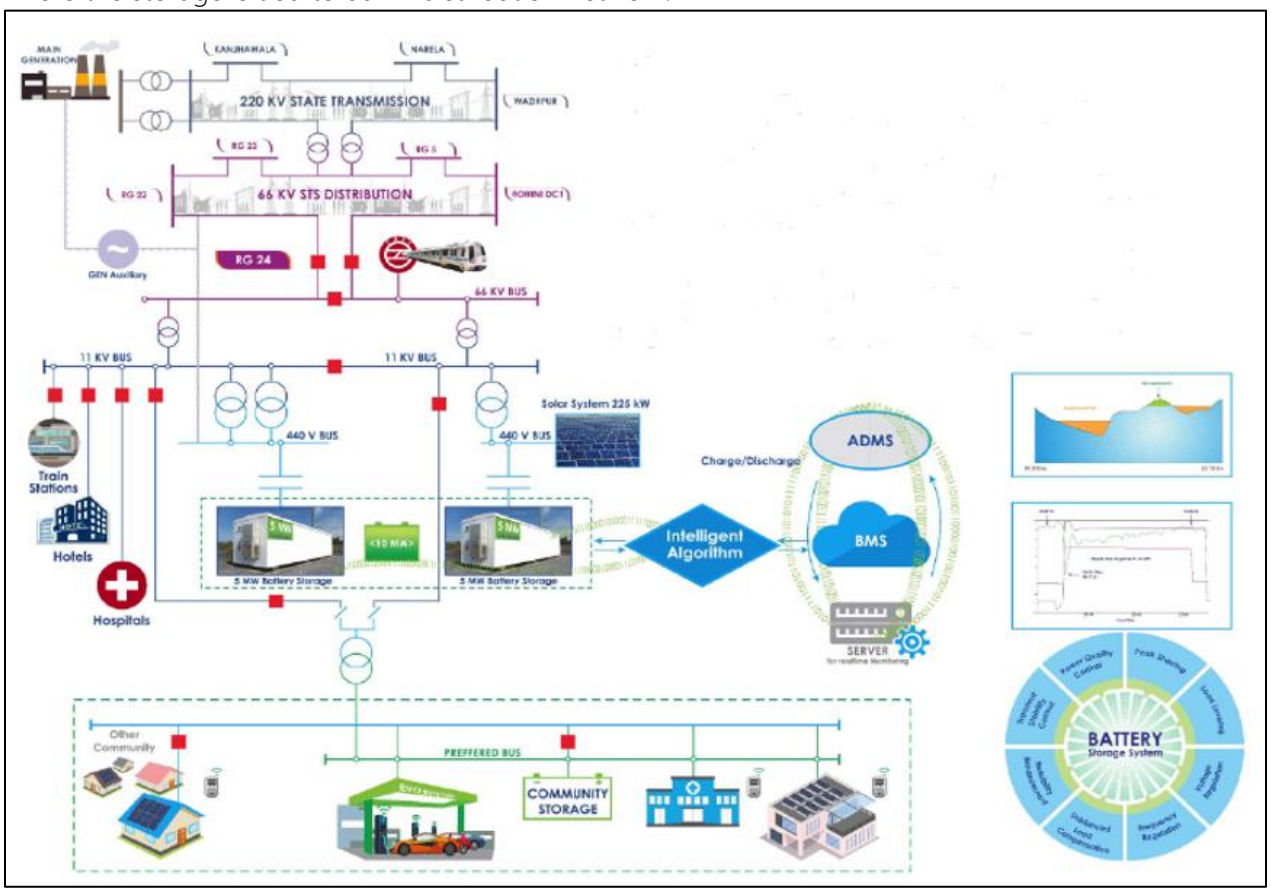


Figure 11: Schematic of TPDDL's BESS project (Source TPDDL)

The feasibility study is expected to be completed in six months at a cost of around 30 lakhs. The pilot project is expected to cost around INR 10 crores (Table 7).

Table 7: Timeline and fund requirement for storage feasibility study

Fund requirement (INR lakhs)	2020	2021
Cost of feasibility study for storage	30	
Cost of pilot project on storage		1,000

4. Design a program (like FiT or net metering) to promote behind the meter solar plus storage solutions to incentivize solar generation in late afternoon and evening time. This will help shift the solar generation to the evening time which will alleviate the grid from peak load condition. As the first step, technical and economic feasibility of this idea must be assessed. APDCL will prepare a program design document for the AERC on solar plus storage system. The program design document will include target customers, eligible solution, benefit cost analysis, suggestions for tariff, and process of monitoring and verification. The program design is likely to take up to 6 months and will cost INR 30 lakhs (Table 8).

Table 8: Timeline and fund requirement for program to promote behind the meter storage

Fund requirement (INR lakhs)	2019	2020
Cost of technical and economic feasibility study	20	
Cost of program design document preparation		30

5. Design a demand side management (DSM) program to focus on energy efficiency in appliances that contribute to evening peak demand. The appliances of priority could be ceiling fans and water heaters. APDCL will prepare a program design document for the AERC on DSM. The program design document will include target customers, eligible solution, benefit cost analysis, and process of monitoring and verification. In 2015, the state had around 66 lakh ceiling fans and under the business as usual trends, the ceiling fan population is expected to reach around 1.3 crores by 2030. A mere 9% of the 2030 population is expected to be highly efficient. To achieve the targets set under the Assam Energy Vision - 2030, 45% of the 2030 ceiling fan population has to be highly energy efficient. This would require an investment of around 13 billion INR. Figure 12 shows the annual investment required in both the cases. The difference between the two lines illustrates the additional investment required for highly efficient fans. It is worthwhile mentioning here that the incremental investment need not be supported by the state exchequer.

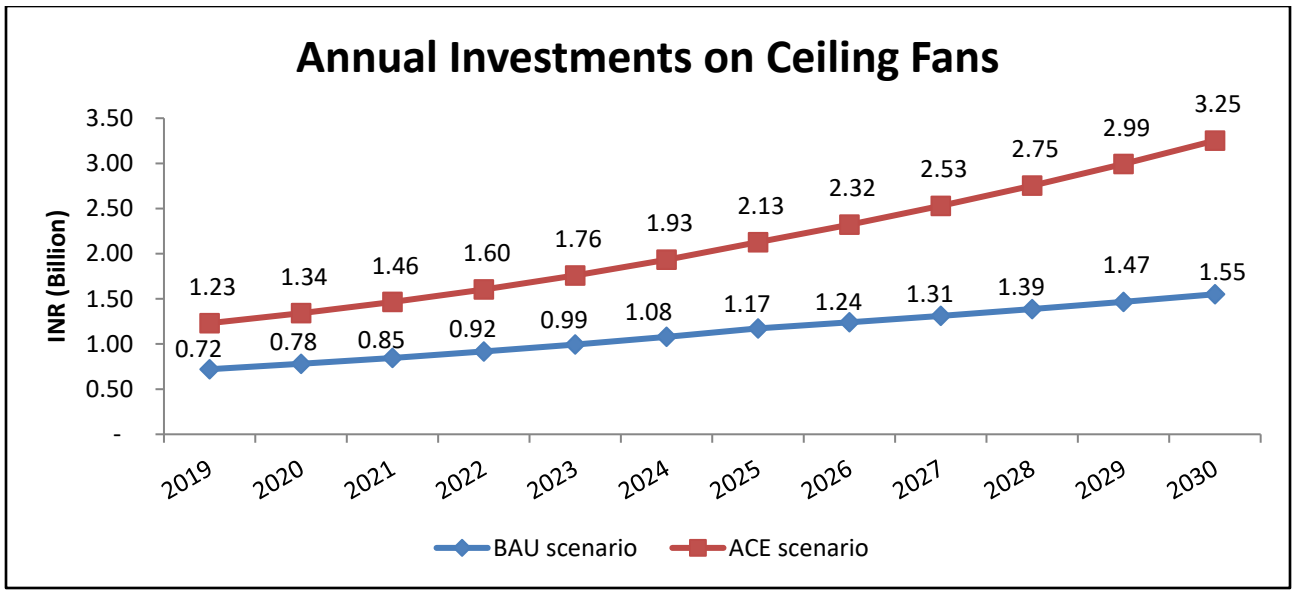


Figure 12: Annual investment[11] on ceiling fans

The DSM program designing process is likely to take up to six months and will cost around INR 30 lakhs while the cost of program implementation, if any incentives will be given, will become part of the annual revenue requirement of APDCL (Table 10).

Table 9: Timeline and fund requirement for DSM program

Fund requirement (INR lakhs)	2019	2020
Cost of DSM program design document	30	-
Cost of DSM program implementation	-	Will become part of tariff base

Strategic Load Growth

1. This strategy is focused towards increasing the day time load through promotion of products and equipment which can be used at the day time. Examples of such products are electric induction cooker and electric vehicles. Promotion of these products, in addition to increasing the electricity demand, will also lead to reduction in fossil fuel usage.

By 2019, the state had no electric buses and if the business as usual trends continue, the state is expected to have a fleet of around 150 electric buses. However, to achieve the targets set under Assam Energy Vision - 2030, the state will require a fleet of around 8 thousand electric buses by 2030. Figure 13 compares the annual investment required in both the scenarios. The investment shown here is for the segment and may come from the government and the private sector.

[11] Investment for the sector, not for the government

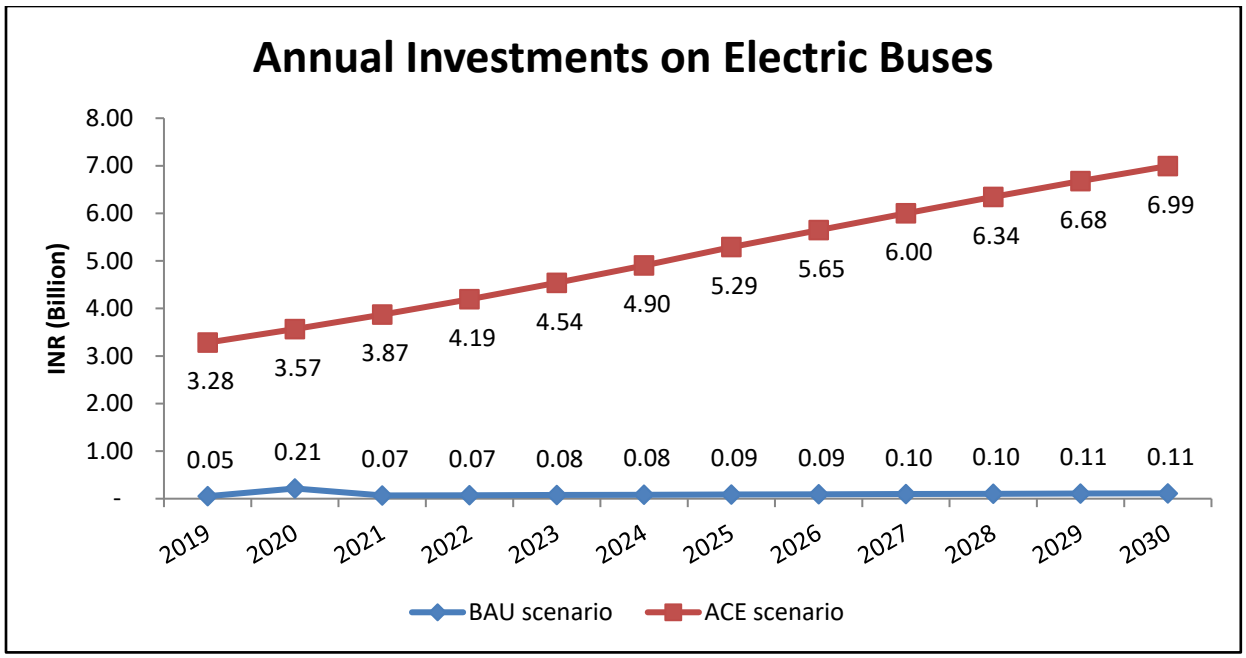


Figure 13: Annual investment required by the electric buses segment

In 2019, no household in Assam was using only electric induction heaters to meet their cooking needs. It is expected that the state will have around 1.2 million households using electric induction heaters for cooking by 2030 under the business as usual trends. However, to achieve the targets set under the Assam Energy Vision - 2030, the state must target an additional 0.25 million households to use electric cooking. This transition would require an additional investment of 0.45 billion. Figure 14 shows the annual investment requirement for this transition (difference between the two lines).

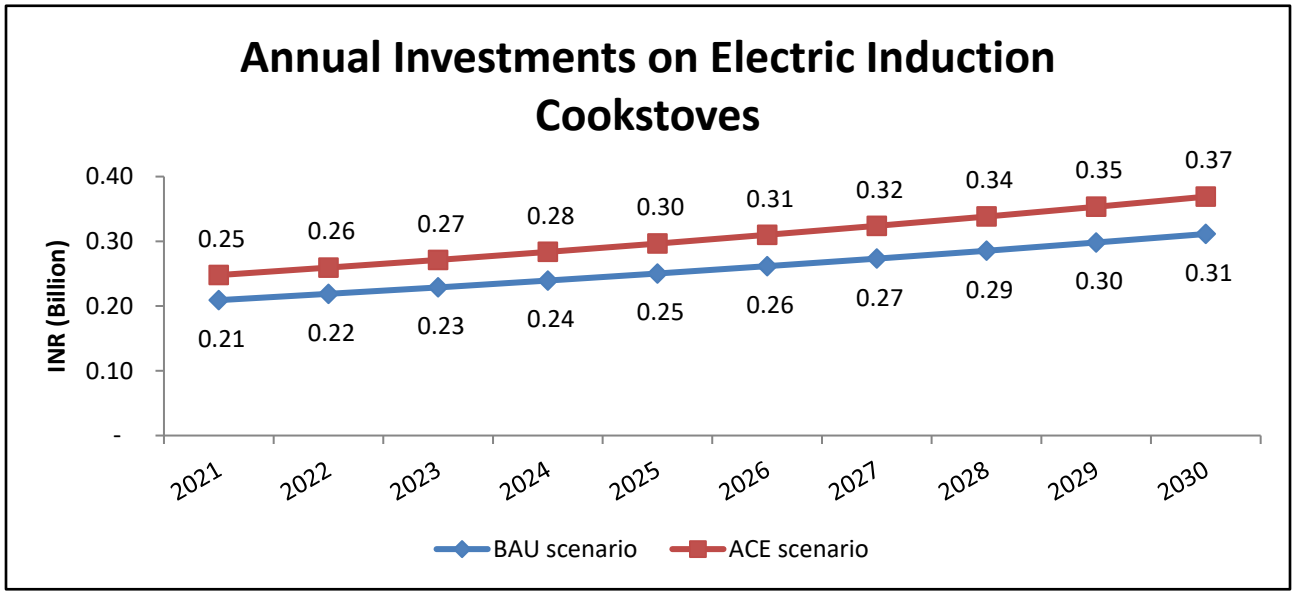


Figure 14: Investment requirement for electric cooking

The study to prepare strategy for load growth is expected to be completed in 6 months at a cost of 20 lakhs, while the cost of program implementation (if any incentives given) will become part of tariff rate (Table 10).

Table 10: Timeline and fund requirement for strategic load growth program

Fund requirement (INR lakhs)	2019	2020
Cost of study to prepare the strategy for load growth through fuel substitution	20	
Cost of program implementation		Will become a part of tariff base

Activity 9: Plan for optimal capacity addition in the state

This activity is under Category 3: Project development and technology promotion

In the Assam Energy Secured (AES) scenario, the state is expected to increase the power generation capacity within the state. Figure 15 shows the year-on-year power generation capacity required to meet Assam's electricity demand in the AES scenario.

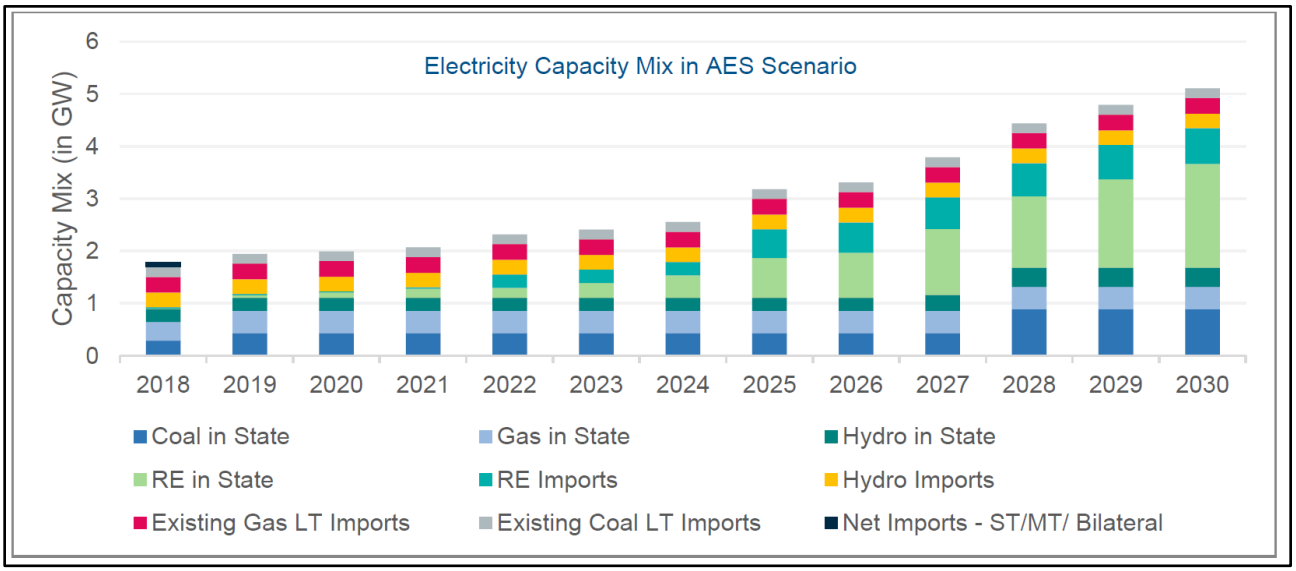


Figure 15: Electricity capacity mix in AES scenario

The new expected capacity in the state will be dominated by renewables at 1.9 GW, however, new coal capacity of 0.45 GW is also expected. In addition to solar, there will be 0.3 GW biomass-based capacity, 0.1 GW small hydro-based capacity, ~0.04 GW wind-based capacity, 0.02 GW waste to electricity-based capacity by 2030. Figure 16 shows the year-on-year renewable capacity required to meet Assam's electricity demand in AES scenario.

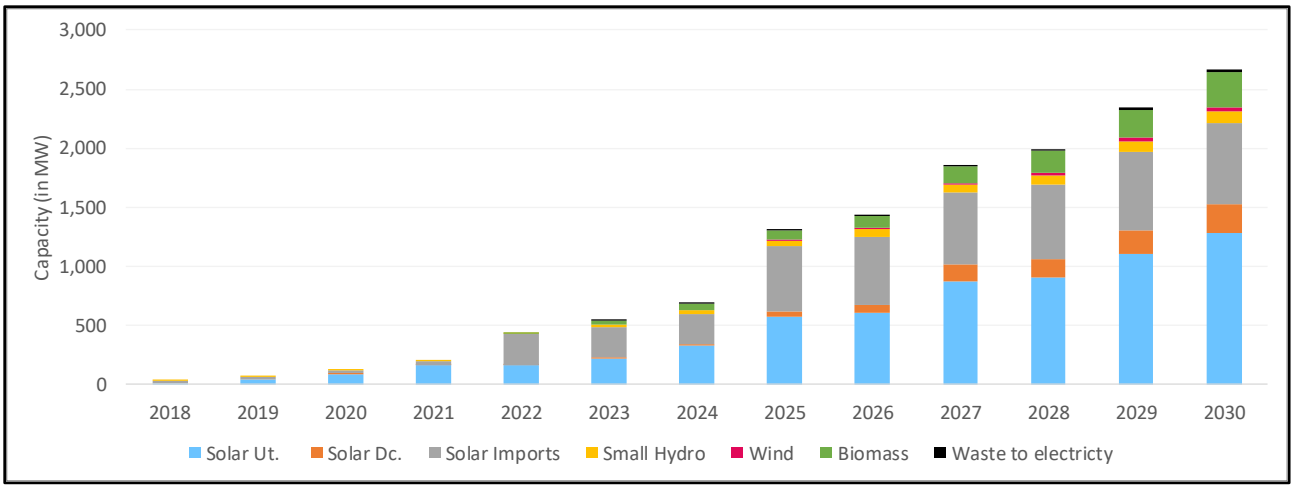


Figure 16: Renewable capacity mix in AES scenario

To achieve the expected electricity capacity mix illustrated in Figure 15 and Figure 16, following recommendations are made:

- 450 MW coal from NTPC Margherita
- 120 MW large hydro at Lower Kopili
- 1,550 MW solar (1300 MW grid scale; 250 MW distributed)
- 300 MW biomass
- 100 MW small hydro
- 20 MW waste to electricity

To achieve this capacity addition, it is estimated that the new investments required till 2030 will be INR 421 billion (Table 11). Please note that the investment shown in the table below are an estimate of the total capital required and doesn't indicate whether the investment will come from state, center or private sector. Details of the investment estimate is provided in "Long Term Scenarios Assessment" report.

Table 11: Cost estimation for electricity generation capacity addition in Assam

Cost in INR billion[12]	2019-2025	2026-2030
A. Capital Cost of New Capacity in the state	51	197
Coal in State	0	76
Gas in State	0	0
Hydro in State	0	21
RE in State	51	100
B. Inter-state Transmission Cost	3	1
C. Intra-state Transmission and Distribution Cost	74	95

[12] Cost at constant 2018 prices (Coal plant - INR 10.50 crore/MW, Gas plant - INR 7 crore/MW, Hydro plants - INR 11 crore/MW, Utility scale solar - INR 5-5.25 crore/MW, decentralized solar - INR 5.6 - 6.2 crore/MW,

Cost in INR billion[12]	2019-2025	2026-2030
D. Total (A+B+C)	128	293

In addition to new capacity, refurbishment of existing gas plants which operate at a very poor efficiency needs to be carried out. It is recommended that the two units of 20 MW each of Lakwa gas plant may be undertaken for refurbishment. It is currently operating at a very high heat rate (poor efficiency) compared to other gas plants from which Assam buys power (Table 12).

Table 12: Heat rates of gas power plants

Fuel type	Heat Rate (kCal/kWh)
Namrup Gas	1,893
Lakwa Gas	**2,698**
Kathalguri Gas	2,250
AGTPP Tripura Gas	2,534
Palatana OTPC Tripura Gas	1,754

Activity 10: Plan for efficient procurement

This activity is under Category 3: Project development and technology promotion

In addition to setting up new capacities in the state, Assam also needs to procure power from outside. While figure 15 shows the imported power capacity (in MW) required till 2030, the annual electricity imports requirement is shown in Figure 17 below.

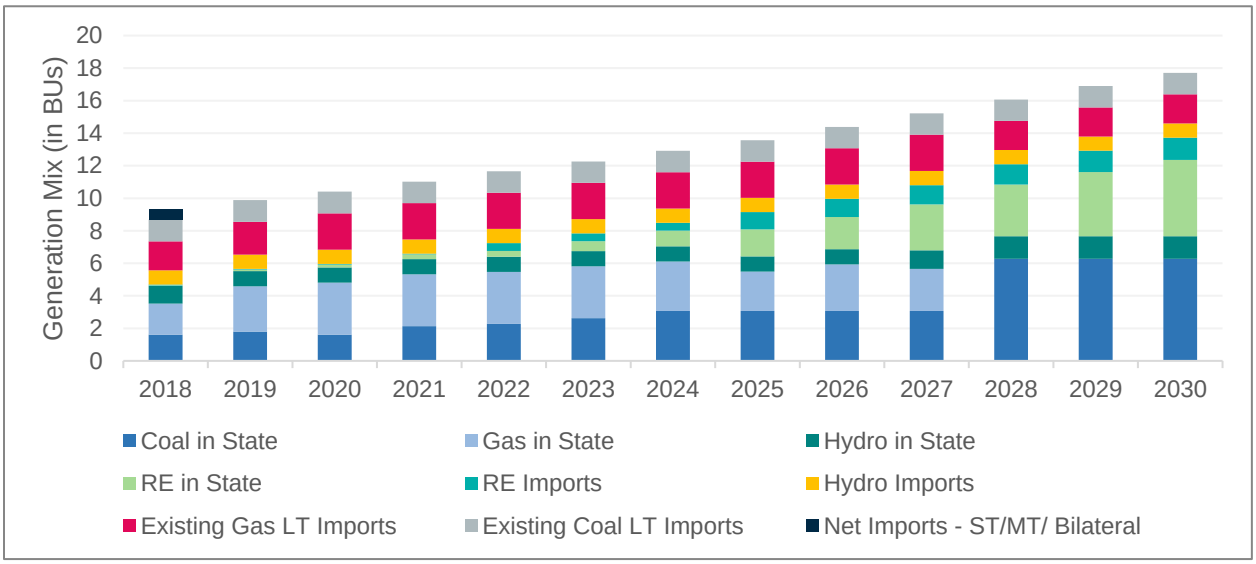


Figure 17: Electricity Generation Mix in AES Scenario

This estimation is based on an annual energy modeling which doesn't provide details for daily and monthly procurement requirement. Thus, Assam needs to undertake an hourly energy modeling in order to decide if the state is better off buying a round the clock (RTC) power or peaking power. The strategies for an efficient procurement system are mentioned below:

1. *Establish a dedicated "Schedule Optimizer" unit for efficient procurement of power through market/analysis and commercial contracts.*

Given both the demand and supply side volatility, it becomes extremely challenging to maintain the demand supply balance technically and economically. On one hand, increasing power purchase cost is a challenge for APDCL, at the same time the difference between peak and off peak is becoming severe. The problem is likely to exacerbate if more solar is added to the system. In order to minimize the cost, optimal scheduling of peak and off-peak power is extremely critical. Hence power procurement and scheduling optimization become immediate short-term initiatives which can help reduce the financial burden. It is proposed that APDCL deploys an end-to-end solution for effective management of demand and supply. The solution is proposed to have the following modules

1. Load Forecasting: Real time intra-day, Day ahead, Week ahead, etc.
2. Schedule Optimizer: Risk based Schedule optimizer to ensure that the demand and generation schedule is matched economically and technically to minimize the cost of power yet reduce the risk of non-availability of power.
3. Portfolio and Trade optimizer: Day Ahead, medium and Long-term portfolio optimization.
4. Integration with the existing system for real time network monitoring.

Action Item:

- APDCL to prepare a tender to procure this solution. As a part of the tender, the solution provider will operate and maintain the solution for 2 years and build capacity of APDCL staff for eventual transfer.

The timeline and cost to be incurred for Schedule Optimizer procurement is shown in Table 13.

Table 13: Timeline and fund requirement for 'Schedule Optimizer' procurement

Fund requirement (INR lakhs)	2019	2020	2021	2022
Cost of bid management for hiring of entity to develop Schedule Optimizer	20			
Cost for development of Schedule Optimizer	30	120		
Annual cost for operation and maintenance of Schedule Optimizer			40	40

2. *Exploring power trade with neighboring countries*

The cost of hydro power generation in Bhutan varies significantly depending on whether the project is developed under Inter-governmental model (IG) mode or Joint Venture (JV) mode. The JV mode is

expensive and lies in the range of INR 5.0/kWh to INR 6.0/kWh for power delivery within Bhutan Grid. The cost of landed power in Assam is likely to be Assam at INR 5.07/kWh to INR 6.07/kWh (excluding import duty/taxes). However, in the IG mode, costs could be in the range of INR 3.0/kWh to INR 3.50/kWh. Hence, Assam should explore getting a share of hydro generation from plants being developed via IG mode. Assam has already tied up for 120 MW capacity of Nikacchu HEP through PTC India. If there is any capacity left to be tied up, then Assam may approach PTC for off-taking the residual capacity. It is worth mentioning that regardless of the mode of development, Hydro projects in Bhutan have a potential risk of cost over-runs and time over-runs which can lead to increase in tariffs.

Likewise, Assam may also explore buying power from Nepal. Nepal is building a number of storage hydro projects which can potentially assist Assam for integrating RE and meeting its evening peak. The cost of power generation in Nepal lies in the range of INR 5.0/kWh to INR 5.5/kWh for power delivery within Nepal Grid. The cost of delivered power in Assam is likely to be between INR 5.30/kWh to INR 5.80/kWh (excluding import duty/taxes) assuming a point of injection (PoC) charges of INR 0.30/kWh. Similar to Bhutan, cost over-runs are well known for hydro projects in Nepal, which can result in high procurement cost of power. Assam can also explore Banking arrangements with Nepal for the excess hydro generation in Nepal during monsoon seasons. Assam can potentially explore the option and tie-up its thermal generation against hydro generation under 'Banking' agreement.

3. Exploring power purchase from central hydro plants

Explore buying long term power from proposed central sector hydro plants at Kameng, Subansiri, Punatasangchu and Mangdechu (Figure 18) which will also enhance flexibility in operations.

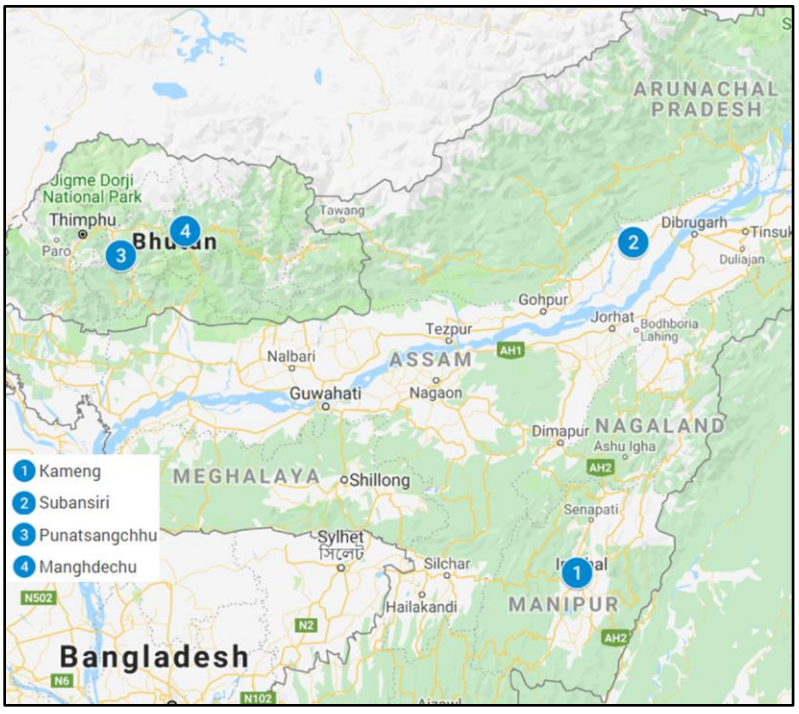


Figure 18: Central hydro power plants for Assam to explore long term power trade

Activity 11: Prepare a loss reduction strategy

This activity is under Category 3: Project development and technology promotion

Assam suffers from a high level of AT&C loss. This is one of the reasons for a high average cost of supply. The loss levels are expected to increase in future because of increased grid electrification in far off areas. A three-prong strategy for APDCL is proposed to deal with the high loss and bring it down expeditiously. The three strategies need to be studied in detail for implementation. The loss reduction program for APDCL will have a technical package, institutional development package, and regulatory package. The recommendations are based on leading practices adopted by DISCOMs elsewhere in the country. The broad elements of these packages are described below:

Technical Package

- Identify areas to carry out predictive maintenance of transmission and distribution system using drones.
- Replacement of bare LT conductors with AB cable in theft prone areas and congested areas.
- Deploy Outage Management System to record for load shedding which will monitor Feeder and DT wise outage monitoring.
- Replacement of all the Electro mechanical meters with tamper proof electronic meters or AMRs
- Feeder & DTR level Energy Audit to identify root cause of loss & its elimination.
- Use HVDS solution to supply residential and agricultural customers in areas with focus on areas where billing efficiency is poor.
- Develop a system (squad) for regular maintenance of DTs. The squad will be given an O&M manual for oil leakage monitoring, oil level check, phase balancing, condition based monitoring.
- Automated Power Factor Correction (APFC) panel for agriculture feeders, industrial and urban feeders and DTRs.
- Constitute and empower fully equipped anti-power theft squad which will conduct regular drives for removal of unauthorized hooking/tapping from distribution network. Efficacy of drives are being monitored through tablets utilizing AMR data of Distribution Transformers.
- Increasing decentralized generation of electricity powered by renewable especially in far off areas to reduce the grid supply losses.

Institutional development package

- Undertake impact-assessment studies for smart grid pilot project to help scale up efforts
- Strengthen the smart grid and DSM cell to undertake more projects on smart grids
- Constitute and empower fully equipped anti-power theft squad which will conduct regular drives for removal of unauthorized hooking/tapping from distribution network. Efficacy of drives are being monitored through tablets utilizing AMR data of Distribution Transformers. The culprits
- Name and shame policy to discourage power theft
- Enforcement of penal provisions for power theft

Regulatory package

- Design appropriate tariff mechanism such as prepaid tariffs for customers in multi housing society and areas with poor collection efficiency: APDCL to prepare a petition for AERC's approval for a special tariff category for prepaid metered customers. The petition will include details benefit of prepaid metering, target customer category (e.g. group housing), target territory (e.g. with high AT&C loss), proposed rebate amongst other things. In order to design the tariff, first undertake an Impact assessment study of pre-paid metering programs already implemented in the state.

The timeline and cost for developing loss reduction program is shown in Table 14.

Table 14: Timeline and fund requirement for loss reduction program

Fund requirement (INR lakhs)	2019	2020
Cost to prepare loss reduction program	50	100

Instead of assessing demand side, transmission, capacity addition and imports separately, Assam may alternatively plan for an Integrated Resource Planning (IRP) which will help Assam power companies in improving their long-term planning and decision-making approach. However, utilities while pursuing activities under resource planning, must ensure that the process addresses not only generation, but also demand-side management and transmission/distribution. Figure 19 shows a typical IRP process.

It is recommended that the IRP be undertaken every five years in Assam. The IRP process is expected to cost around 1.5 crores over two years (Table 15).

Table 15: Timeline and fund requirement of IRP

Fund requirement (INR lakhs)	2019	2020
Cost of IRP	30	120

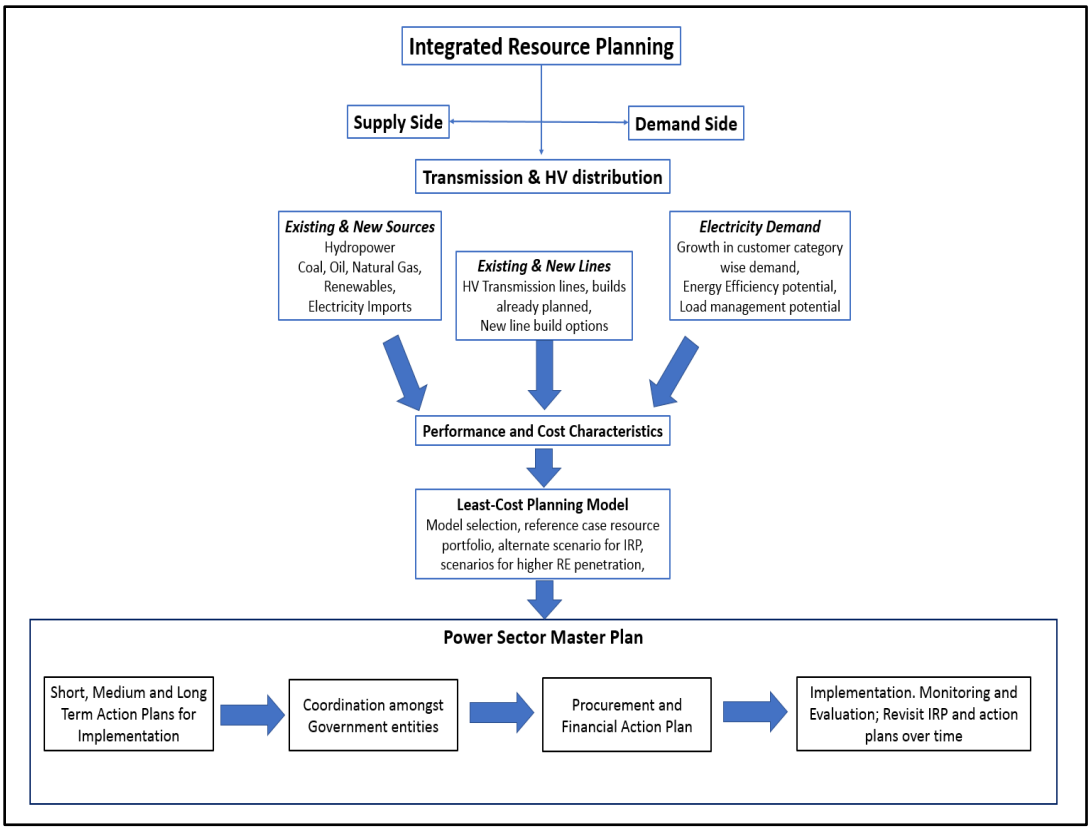


Figure 19: Typical IRP process (Source: ICF)

Activity 12: Undertake demonstration project on fuel upgradation for efficient and sustainable power generation

This activity is under Category 3: Project development and technology promotion

The current research trends on energy sector in North-Eastern (NE) states indicate increasing focus on locally available resources with minimal or no pollution. This region has abundant availability of low grade coal and biomass. To harness these resources APDCL should consider preparing a proposal for demonstration project for usage of these fuels.

In addition to the low grade of NE coal, large amount of low grade coal is generated when high grade coal gets mixed with mud and soil in the coal fields. In the current practice, these low grade coals are not effectively utilized and utilization of loose biomass for power generation is a challenge.

The demonstration project will employ a gasifier unit and an anaerobic digester unit. The gasifier unit will employ a fluidized bed gasifier for co-gasification of low grade coal and biomass. The contents in the gasifier will be treated to remove water. The producer gas from this unit will be mixed with the biogas generated from the anaerobic digester unit. The mixture of gases will then be used for electricity generation.

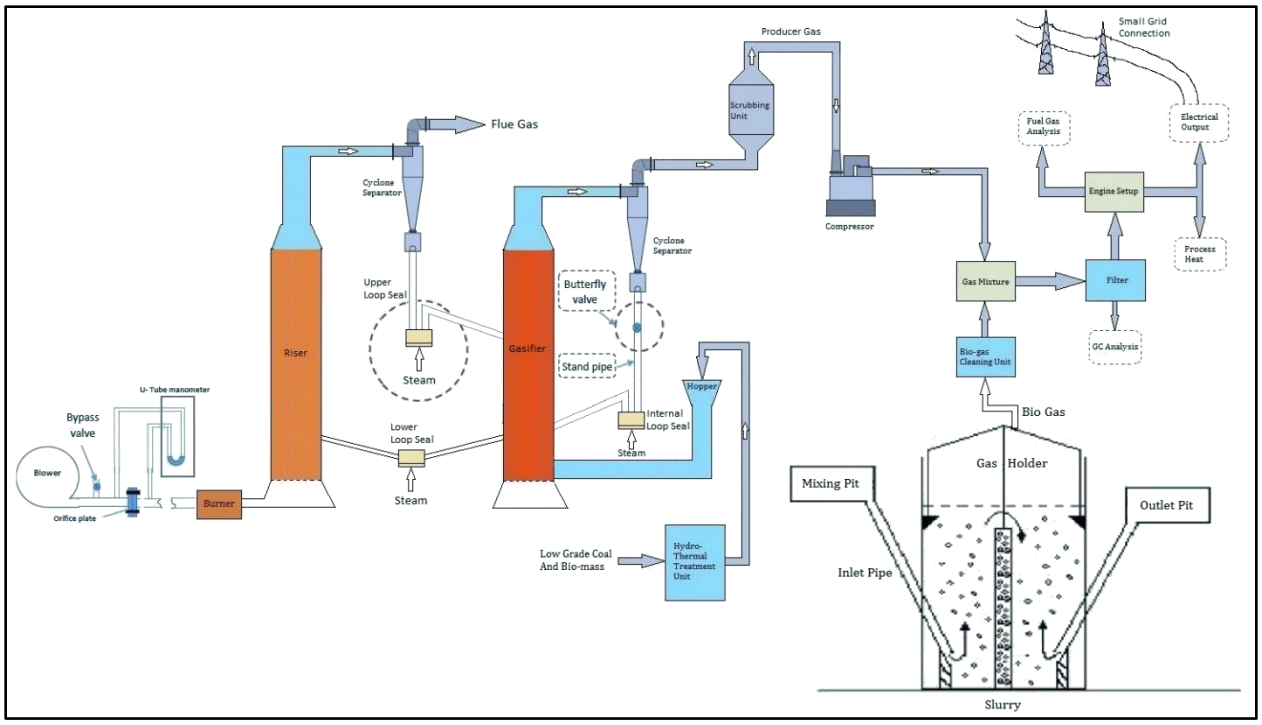


Figure 20: Schematic of the proposed demonstration project[13]

APDCL should consider joining hands with academic and research institutions like IIT Guwahati to undertake two demonstration projects. The projects will serve as a proof of concept and assess the techno-economic feasibility of these systems. The demonstration projects may be undertaken for 5 kW systems, which are likely to cost INR 1 crore each (Table 16).

Table 16: Timeline and fund requirement for demonstration project on hybrid coal and biomass gasification and power generation

Fund requirement (INR lakhs)	2020	2021
Cost of demonstration project (@100 lakhs per project)	100	100

Based on the results of the demonstration project, a decision could be made to roll out a program to promote these systems on a larger scale, both in terms of numbers and size.

Summary

The proposed activities require a budgetary support of INR 1.9 crores for the preparatory phase. The proposed activities will have following impacts compared to business as usual trends:

- Reduce Assam's power import dependency from (60% in BAU) to 30% in 2030
- Reduce projected emissions from the power sector (11.95 million tons CO_2 in 2030 in BAU) by 33%

[13] Source: IIT-Guwahati

- Reduce projected peak demand (4.1 GW in 2030 in BAU) by 30%
- Reduce projected electricity demand (20.5 TWh in 2030 in BAU) by 14%
- Increase in the share of renewables in electricity mix (10% in 2030 in BAU) to 34% by 2030
- Reduce projected Average Power Purchase Cost (APPC) (INR 7.72/kWh in 2030 in BAU) by 5.5% in 2030

5.2 Industrial sector

Energy consumption in industrial sector is a function of production volume, equipment efficiency and the source of energy. In Assam, the industrial energy consumption is set to increase from 2,210 ktoe in 2015 to 3,400 ktoe in 2030 under business as usual trends (Figure 21). Since more than 90% of the industries demand was met by fossil fuels in 2015, it is anticipated that this increase in energy demand will significantly increase the carbon footprint of industrial sector in Assam.

In order to reduce this projected energy consumption by 7.5% (Figure 21), and to make this sector efficient and clean, the action plan for industrial sector has identified the following strategic intervention areas:

- ✓ Improvement in energy efficiency
- ✓ Use of modern technology
- ✓ Use of alternate fuels

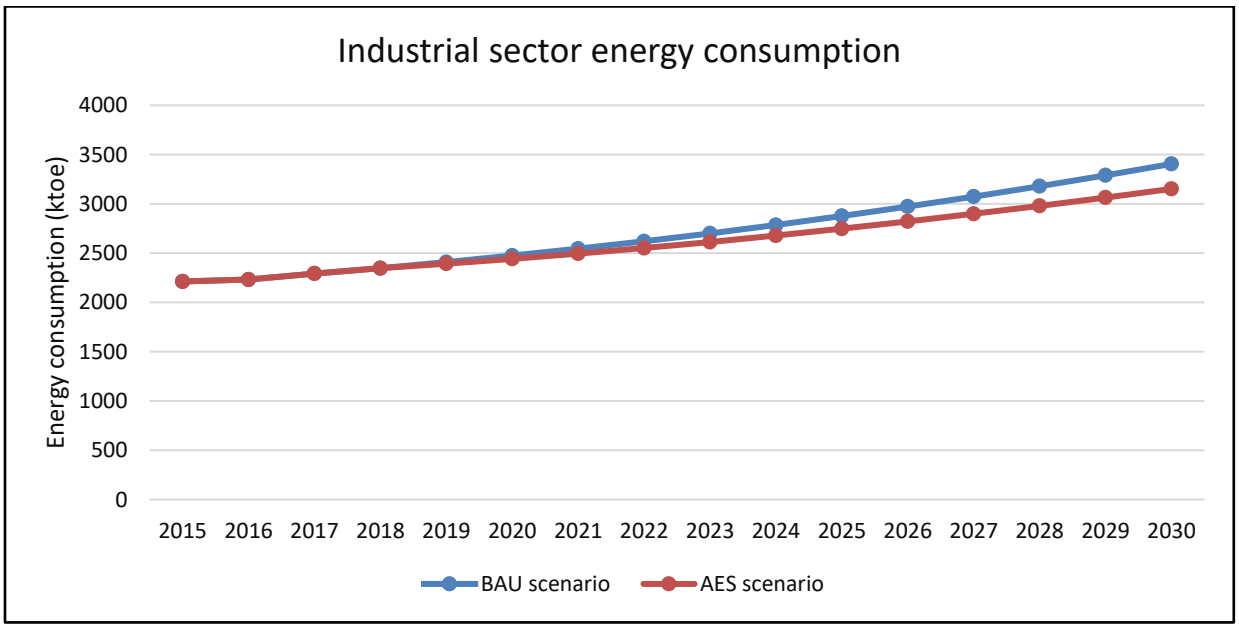


Figure 21: Energy consumption projections for BAU and AES scenario

Activity 13: Design "Laghu Udyog Urja Ankeshan evam Dakshta Yojana'

This activity is under Category 1: Policy and regulatory

In 2017, Assam was home to more than 45 thousand MSME units.[14] The high specific energy consumption in these units presents potential for energy savings through energy efficiency measures. The ASDA or AEEDC should design a program to harness this potential. The program may be planned in three parts:

- ✓ Awareness on benefits of energy efficiency and support from government to implement measure
- ✓ Energy auditing to identify MSME units with high scope for energy savings
- ✓ Assisting identified units to adopt energy saving measures

In the first part of the program, awareness campaigns will be undertaken in MSME clusters with focus on energy efficient techniques and technologies, benefits of energy efficiency and auditing, and the support available from government schemes. For awareness outreach, MSME clusters will be identified with support of MSME Development Institute and Industrial Associations like North Eastern Small Scale Industries Association (NESSIA), Federation of Industry and Commerce of North Eastern Region (FINER), Laghu Udyog Bharti, Federation of Indian Chambers of Commerce and Industry (FICCI), Confederation of Indian Industry (CII).

The awareness campaigns may be planned as a day's engagement with participation of at least 25 MSME units. The first phase of program will target to carry out 50 such engagements. The ASDA will identify experts from ASDA, IIT-Guwahati, NITs, or consultants, for awareness campaigns. This phase of the program is expected to cost around INR 50 lakhs over two years (Table 17).

Table 17: Timeline and fund requirement for awareness workshops

Fund requirement (INR lakhs)	2019	2020
Number of workshops	15	35
Cost of workshops (@ 1 lakh per workshop)	15	35

The second phase of the program will focus on inculcating a culture of energy audits in MSME units. During this phase, 1,000 energy audits will be undertaken. The energy audits will identify the lapses in energy usage, areas to improve, level of energy consumption and recommend measures to enhance energy savings. The program will reimburse INR 50 thousand to MSME units upon submission of audit reports. Annual targets for number of MSME units to be reimbursed may be set and reimbursement may be made on first come first basis. This phase of the program is expected to cost the state government around INR 5 crores over three years (Table 18).

Table 18: Timeline and fund requirement for energy audits

Fund requirement (INR lakhs)	2020	2021	2022
Number of audits	100	350	550
Cost of audits (@ 0.50 lakh per audit)	50	175	275

[14] Economic Survey Assam 2017-18

The third phase of program will focus on assisting MSME units to adopt energy efficiency measures identified during energy audits. In this phase, financial assistance will be provided to 300 MSME units to adopt energy saving measures. The units will be identified based on energy savings potential indicated in energy audits. The ASDA or AEEDC (AEEDC is proposed as a part of this action plan) will then categorize these units based on the type of product they make.

For six such categories, the general scope of work for energy savings will be captured in Master Detailed Project Reports (DPRs), to be prepared through stakeholder consultation. These Master DPRs will then be used to prepare subsequent DPRs for individual units. Each Master DPR may require 3-6 months for preparation. The model DPRs will help save cost and time as the manufacturing process and technologies in each category are expected to be near identical. The state government will cover the expenses of Model DPRs and 75% cost of the individual unit's DPR. The remained 25% will be contributed by the beneficiary unit. After DPR finalization, assistance will be provided to MSME units for the following equipment:

- ✓ High efficiency burners and boilers
- ✓ Equipment to substitute oil and coal with Natural Gas or LPG
- ✓ Equipment for exhaust gas heat recovery from boilers, air discharged from ventilation coil and, condensers
- ✓ Equipment for power cogeneration systems
- ✓ Equipment for combined heating and cooling systems that use solar energy and biomass for own consumption purposes
- ✓ Equipment to use biomass for heating purposes
- ✓ Equipment for energy management systems

This may require the state government to spend at an average 15 lakhs per MSME unit (50% subsidy assuming 30 lakh investment per MSME unit based on examples from other MSME clusters in India) to cover the cost of machinery and equipment replaced, retrofit and technology acquired for improving energy efficiency. At the time of implementation, the subsidy percentage will be revisited and structured in a manner that projects with high pay-back period may be given higher subsidy compared to projects with lower pay-back period. This phase of program is expected to cost the state government around INR 50 crores over five years (Table 19).

Table 19: Timeline and fund requirement for energy efficiency measures

Fund requirement (INR lakhs)	2021	2022	2023	2024	2025
Number of Master DPR	2	4			
Cost of preparing Master DPR (@ 10 lakh per Master DPR)	20	40			
Number of DPRs	25	50	100	125	
75% Cost of DPR (@ 1 lakh per DPR) borne by Assam Govt.	18.75	37.5	75	93.75	
25% Cost of DPR (@ 1 lakh per DPR) borne by MSME units	6.25	12.5	25	31.25	

Fund requirement (INR lakhs)	2021	2022	2023	2024	2025
Number of units granted assistance		25	50	100	125
Assistance cost (@15 lakh per unit)		375	750	1500	1875

Activity 14: Establish Assam Energy Efficiency Development Corporation (AEEDC)

This activity is under Category 2: Institutional strengthening and awareness

The ASDA is responsible for spreading awareness and undertaking initiatives to promote energy efficiency and energy conservation in Assam. The agency however is not involved in implementation of energy efficiency and conservations projects. At present, this work is being undertaken by private energy services companies (ESCOs) and agencies like Energy Efficiency Services Ltd. (EESL). EESL's focus has been on driving energy efficiency appliance by appliance like energy efficient lighting, ACs and smart meters. This has left a void for an organization to support comprehensive energy efficiency for all segments of industrial sector.

In this context, the ASDA should prepare a proposal for creating a Special Purpose Vehicle (SPV) to promote energy efficiency and conservation projects in Assam. The proposal will set to establish Assam Energy Efficiency Development Corporation (AEEDC) as joint venture between Government of Assam and APDCL.

The proposal will cover the organizational structure, human resource requirements, infrastructure requirement, budget requirements and business proposal for the corporation. The business plan for AEEDC may be drawn on lines of Andhra Pradesh Energy Efficiency Development Corporation Ltd.'s (APSEEDCO) business plan (Figure 22). The corporation will:

- ✓ Promote and develop energy efficiency activities in Assam
- ✓ Invest in energy efficiency projects in ESCO model
- ✓ Carry out investment grade energy audit for the clients
- ✓ Bring in necessary capital from private organizations for investing in energy efficiency projects in a psalm developed commercially viable projects for 3rd party funding died may be implemented to capture energy efficiency apart unities
- ✓ Procure and distribute energy efficiency appliances at affordable price aggregating that demand
- ✓ Promote local manufacturing of energy efficient appliances
- ✓ Provide energy efficiency consulting services to consumers
- ✓ Provide technical assistance to industries real estate developers and other large energy consuming entities for implementing energy efficiency projects
- ✓ Engage and collaborate with academic and research institutes to promote energy efficient technologies and global best practices in industries and other high energy intensity sectors
- ✓ Undertake capacity building and awareness generation programs to promote cleaner technologies and efficient equipment

The proposal preparation process is likely to take up to 6 months and may cost around INR 50 lakhs.

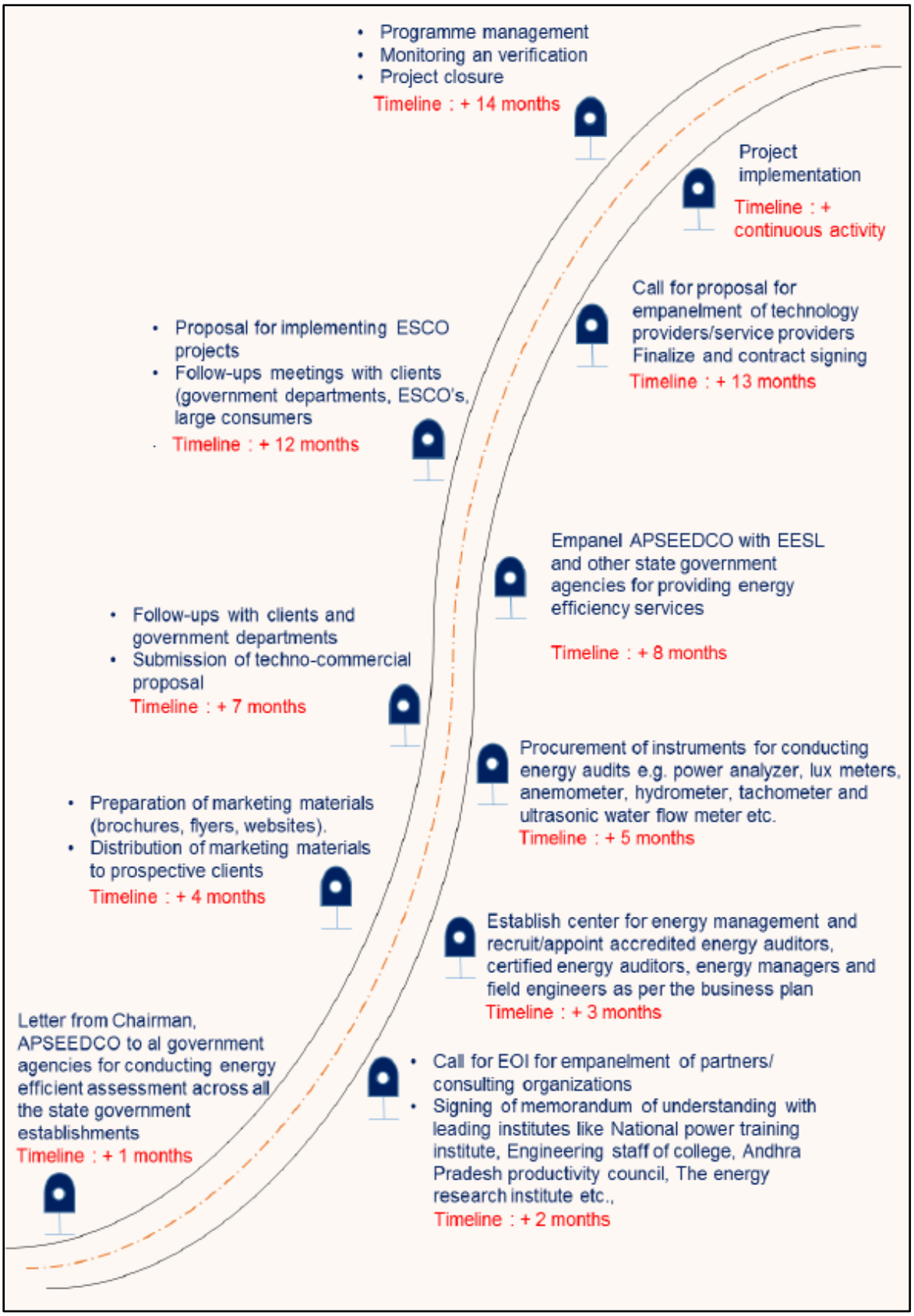


Figure 22: Business plan for APSEEDCO (Source: ICF)

Activity 15: Establish 'Motor Knowledge Center'

This activity is under Category 2: Institutional strengthening and awareness

The Motor Knowledge Center will support industrial units in enhancing operational and technical know-how of motors and demonstration of best practices and quality assurance in a sustainable manner.

The broad scope of this knowledge center will be to propagate the knowledge of good O&M practices to the motor users, check rewound motors for efficiency, provide periodic training to manpower deployed at Motor Rewinding Centers and Kisan Sewa Kendras. It is recommended that the state ASDA or AEEDC prepare a proposal to establish Motor Knowledge Center. The proposal will cover:

- ✓ Physical infrastructure required: building, equipment, utilities (electricity, water)
- ✓ Human Resource requirement to operate the center
- ✓ The initial and recurring investment required to operationalize the center
- ✓ The business model to ensure sustainability of the center

The proposal will be prepared through stakeholder consultations with industrial associations, academic and research institutes like IIT Guwahati, technical training institutes like NPTI. The proposal preparation process is likely to take up to 6 months and will require INR 30 lakhs. The proposal will be submitted to the Department of Industries and Commerce. The proposal will seek financial assistance from the government to set up the center. After the center is established, it will be operated by industrial associations, academic and research institutes, and technical training institutes. The state government will need to spend around INR 75 lakhs crores to set up Motor Knowledge Center and a further INR 25 lakhs annually for its operations. The timeline for setting up Motor Knowledge Center is shown in Table 20.

Table 20: Timeline and fund requirement for setting up Motor Knowledge Center

Fund requirement (INR lakhs)	2020	2021
Cost of proposal preparation	30	
Cost of establishing the center establishment		75

Activity 16: Set up Motor Rewinding Centers

This activity is under Category 2: Institutional strengthening and awareness

The high specific energy consumption in over 45 thousand MSME units[15] of Assam provides lots of scope for energy savings. Experience from BEE-World Bank study in Faridabad MSME clusters suggests that a

[15] Economic Survey Assam 2017-18

motor loses efficiency of about 1.03% per improper rewinding (Figure 23). This loss in efficiency led to an economic loss of about 2 lakhs annually per MSME unit in Faridabad.[16]

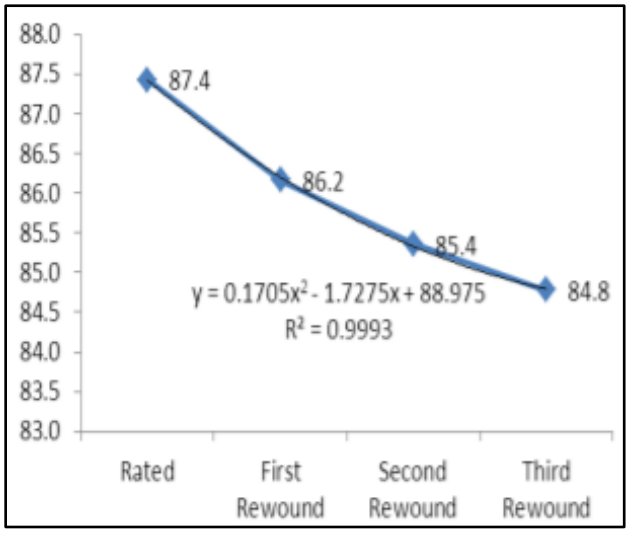


Figure 23: Efficiency loss due to rewinding of motors (Source: ICF)

For a same level of economic loss, Assam is suffering from an economic loss of INR 900 crores annually. This loss will further increase with increasing motor age and number of rewinding. To prevent this economic loss and give MSMEs access of proper servicing of motors, the ASDA should prepare a proposal to set up 'Motor Rewinding Centers'. These centers will provide rewinding services to industrial consumers at a minimal cost or at a rebate so that consumers are attracted towards getting their motors rewound from these certified centers instead of sub-standard local re-winders. A similar initiative is planned in Faridabad MSME cluster. This proposal preparation process may take up to 6 months and will require around INR 30 lakhs.

Students from local ITI, polytechnics and engineering colleges and other interested candidates will be given trainings at Motor Knowledge Center (described in the Activity 16: Establish Motor Knowledge Center) for proper rewinding of pumps. After training, the personnel can then be appointed to run the centers. State can plan to set up 10 such centers in different MSME clusters, industrial growth centers and areas identified by AIDC for industries development (Figure 24). To run these service centres around 50 trained professionals will be needed. The centers may initially be set up in large MSME clusters and industrial growth centers and based on their success a decision could be made for expansion to smaller industrial areas in a phased approach. Setting up of 10 Motor Rewinding Centers is expected to cost around INR 10 crores over two years.

Table 21: Timeline and fund requirement for setting up Motor Rewinding Centers

Fund requirement (INR lakhs)	2020	2021
Number of centers established	4	6

[16] For an MSME unit with 10 motors

Fund requirement (INR lakhs)	2020	2021
Cost of center establishment (@ 100 lakh per center)	400	600
Number of professionals trained	20	30
Cost of training (@ INR 3,000 per person)	0.6	0.9

The major part of the cost of these centers will be the cost to sustain the infrastructure and manpower. The cost incurred in the setting up of these centers can be offset by the revenue generated from rewinding of motors. Once the centers are set up, each center will need to rewind around 450 motors annually for economic sustenance (Table 22). A sample layout of the centers is shown in Figure 25.

Table 22: Business plan for Motor Rewinding Centers

	Implementation cost
Cost of manpower per year (50 trained professionals @ INR 15,000 per month each)	15,000*12*50 = 90 lakhs
Cost of center up keep per year (10 centers @ INR 20,000 per month per center)	20,000*12*10 = 24 lakhs
Total cost per year	**1.14 crores**
Motors to be rewound per center for sustenance of business	= 450 rewinding (Annual cost / [number of centers *Cost per rewinding (Rs 2,500))

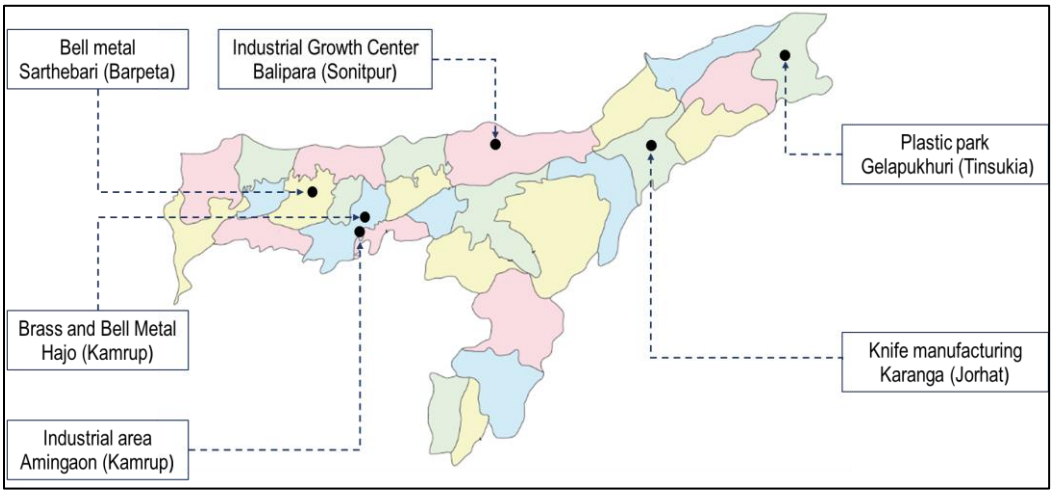


Figure 24: Locations to set up Motor Rewinding Centers

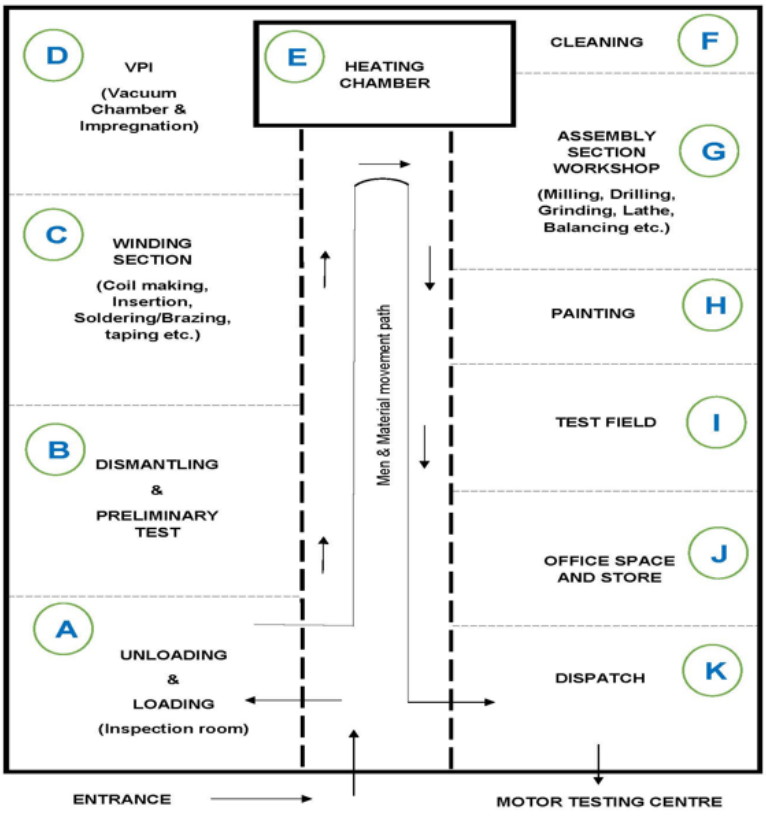


Figure 25: Layout for Motor Rewinding Center (Source: ICF)

Case study: Motor Rewinding Center in Faridabad MSME Cluster

In 2013, electricity accounted for 71% of the total energy consumption in the Faridabad MSME cluster. A large share of this electricity was consumed by motors driving utilities like pumps, blowers and compressors. The number of rewindings per MSME unit per motor was as high as three times per year. The lead time to get a rewound motor back was as high as 5 days. In the absence of skilled labor, the rewinding work was of substandard quality which led to an efficiency loss of about 1.03% per rewinding including a substantial loss in productivity.

Bureau of Energy Efficiency is in the process of setting up a motor rewinding center in Faridabad cluster to provide quality rewinding services. It is expected that the center will help the units to maintain the efficiency after rewinding and decrease the loss in production.

Activity 17: Undertake demonstration projects on waste heat recovery systems

This activity is under Category 3: Project development and technology promotion

Waste Heat Recovery (WHR) are mature technologies and have proven successful applications for energy efficiency. Experts suggest WHR systems can help save up to 20% energy. The adoption of these technologies in Assam however has been limited. To change this, Department of Industries and

Commerce should consider a program to promote WHR systems. The activity may be planned in three segments:

- ✓ A generic study on WHR technologies and their applications
- ✓ Demonstration projects to assess techno-economic feasibility
- ✓ Decision on rollout of larger program

The first segment of the project will be a generic study to assess various WHR technologies, their costs, suitability in context of Assam and cover cost to benefit analysis. The study will identify sources of waste heat (like process exhausts and hot gases) for different industries and recommend WHR technologies (regenerator, vapour absorption machines, heat pumps) and end uses for the recovered heat (like preheating, hot water, environmental cooling). As part of the study, 500 walk-through energy audits will be conducted to capture relevant data. This generic study is expected to be completed in 6-9 months at an expense of 30 lakhs.

In the second segment of the project, demonstration projects will be undertaken for five industrial units with high potential for waste heat recovery. Projects will be undertaken for different WHR technologies, capacities and manufacturers. Detailed Project Reports (DPRs) will be prepared for these projects with the help of consultants and subject matter experts. DPR preparation process for each project is expected to take up to 6 months. The demonstration projects will then be implemented with the help of AIDC and are expected to cost around INR 20 lakhs each. The government of Assam may provide financial support to cover 75% of the project cost. The project will be monitored by the industrial unit and relevant data will be made available to stakeholders as and when needed. The timeline for this activity is shown in Table 23.

Table 23: Timeline and fund requirement for demonstration projects on waste heat recovery

Fund requirement (INR lakhs)	2020	2021	2022	2023
Cost of generic study on WHR technologies	30			
Number of DPRs prepared	2	3		
Cost of DPR preparation (@ 5 lakh per DPR)	10	15		
Cost of demonstration projects (@ 20 lakh per project[17])		20	40	40

In the third segment of the project, policy makers will make an informed decision on rolling out a larger program for promoting waste heat recovery systems. The program may consider mandating and incentivizing adoption of WHR system in industries.

[17] Includes cost for a WHR system of 5 kl/hr capacity @ 15 lakh

Activity 18: Undertake demonstration project on industrial heat pumps

This activity is under Category 3: Project development and technology promotion

With rising cost of energy, industries are striving to keep their consumption as low as possible. Heat pumps are used in many industries including food processing, cold storage and pharmaceuticals. They are used for process cooling, air conditioning and process heating amongst others. Even though this technology is very energy efficient, it has found limited use in Assam. Figure 26 shows the various applications of heat pumps in different industries.

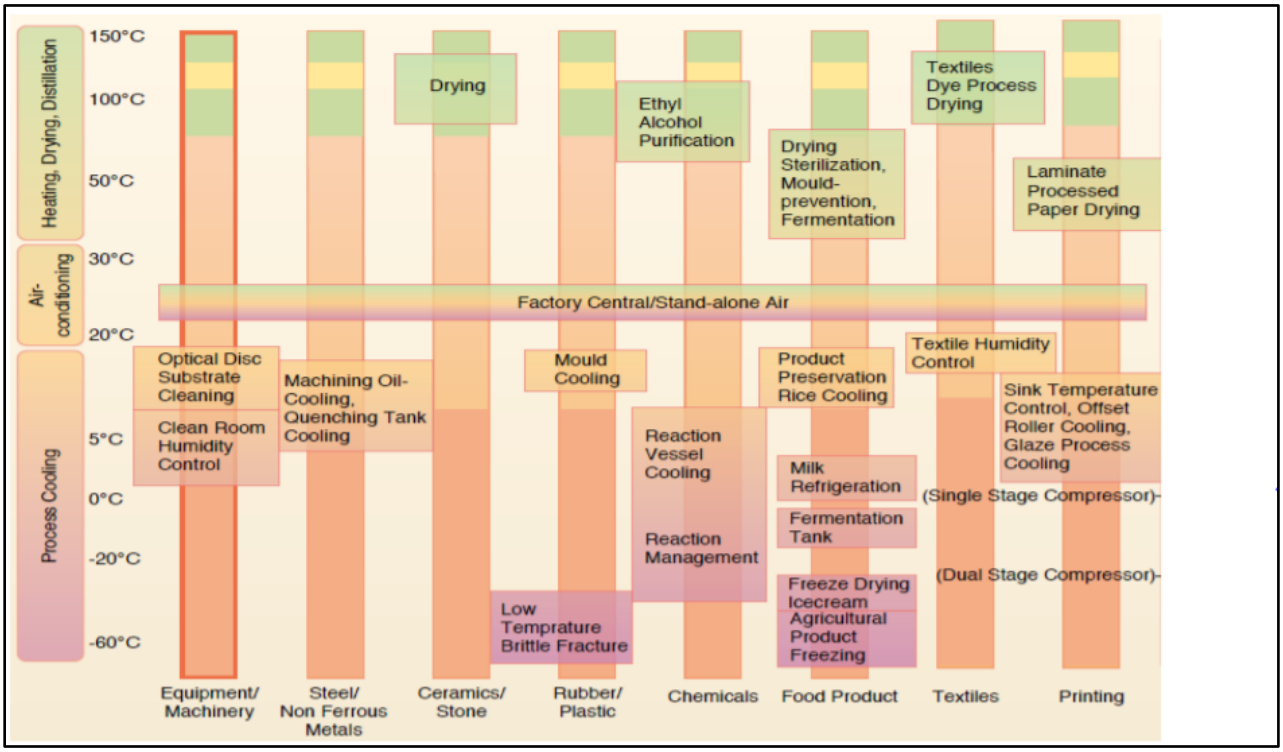


Figure 26: Applications of heat pumps[18]

The first part of the project will be a generic study on heat pumps. The study will cover the heat pump technologies and their suitability for different applications. The study will identify 5 tea and 5 food processing industries for demonstration projects. This study is expected to be completed in 6 months at a cost of INR 35 lakhs. The demonstration projects will be undertaken for different heat pump technologies, capacities and manufacturers. The sites may be chosen in industrial parks being developed by AIDC (Figure 27) or in the existing industries. The pilot projects will assess techno-economic feasibility of heat pumps for various applications.

In the second part of the project, DPRs for the identified project sites will be prepared by AIDC. The state government will cover 75% of the project cost, the remainder will be an investment from the industrial unit. AIDC may assist the industrial units in securing loans for the same. DPR preparation process for each project is expected to take up to 3 months.

[18] www.hasseatpumpcentre.org

The project will be monitored by the industrial unit and relevant data will be made available to stakeholders as and when needed. This program is expected to cost around INR 1.5 crores over four years (Table 24). Based on the outcomes of the demonstration project a decision to roll out a larger program to promote heat pumps may be made.

Table 24: Timeline and fund requirement for demonstration project on industrial heat pump

Fund requirement (INR lakhs)	2020	2021	2022	2023
Cost of generic study on heat pumps	35			
Number of DPRs prepared		4	6	
Cost of DPR preparation (@5 lakhs per DPR)		20	30	
Cost of demonstration projects (@ 10 lakh per project[19])			40	60

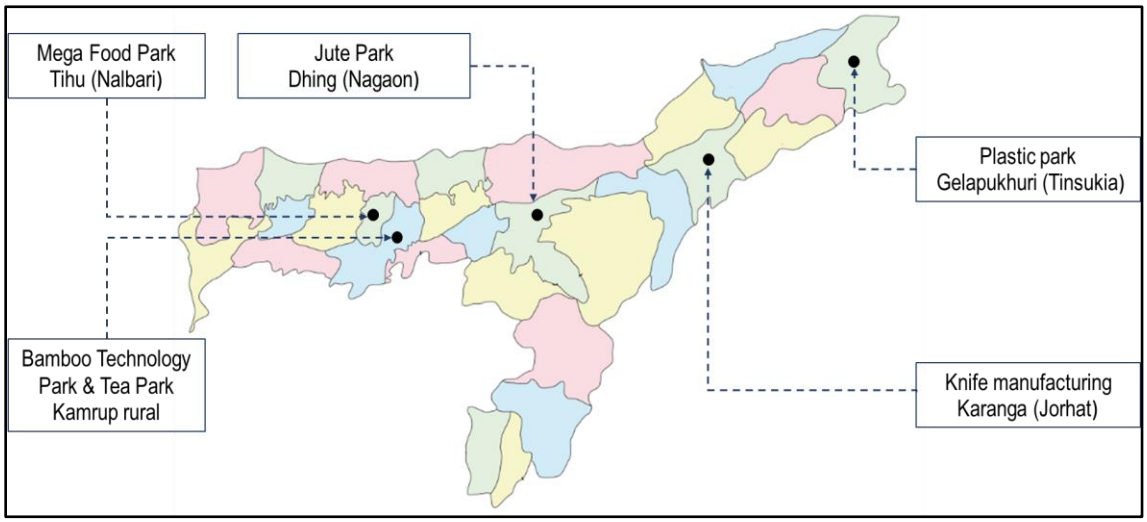


Figure 27: Suggested sites for demonstration projects on heat pumps

Activity 19: Demonstration project on trigeneration and district heating and cooling

This activity is under Category 3: Project development and technology promotion

Trigeneration and district cooling are effective means to reduce energy costs, fuel costs and greenhouse gas emissions. Globally these systems are deployed in industries and commercial buildings, Assam is yet to make a start in this field. A demonstration project to determine techno-economic feasibility of these systems is recommended.

Before undertaking projects, AIDC should undertake a study to assess various types of trigeneration and district heating cooling technologies and their applications. The study will compare the different systems and identify the ones most suitable for Assam. The study will also identify 4 sites for

[19] 2 heat pumps of 4 kW @ 3 lakhs each

demonstration projects on trigeneration and district heating and cooling. The projects will employ systems of different capacities and technologies to ensure diversity. The project sites may be identified along the recently notified industrial corridor (Figure 28). This study is expected to be completed in 4 months at a cost of 30 lakhs.

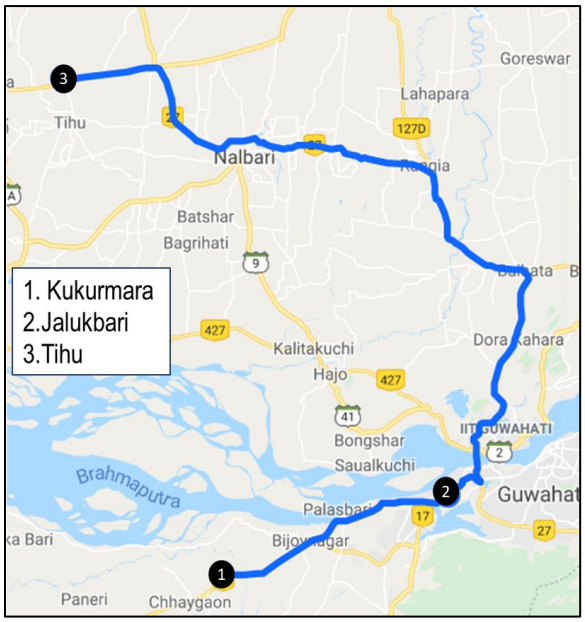


Figure 28: Assam Industrial corridor

Once the sites are identified, the AIDC will prepare DPRs for the projects. The DPR preparation process will involve consultation with industrial associations, research and academic institutions like IIT-Guwahati and subject matter experts. The state government will have to bear the cost of DPR preparation. DPR preparation for each project is likely to be completed in 3 months and is likely to cost around INR 15 lakhs.

Once the DPR is prepared AIDC will roll a tender for project development at identified sites, winner of which will be decided through a least-cost basis. For these projects, the state government will aid AIDC by covering 100% project cost. After commissioning of the systems, the ownership will be transferred to the beneficiary industrial units. These units will be responsible for the operations, maintenance and repair works, and collection of system related data necessary to determine its techno-economic feasibility. The cost of the demonstration projects will depend on the size of system. The timeline for the demonstration projects is shown in Table 25.

Table 25: Timeline and fund requirement for demonstration projects on district heating and cooling systems

Fund requirement (INR lakhs)	2020	2021	2022
Cost of generic study on district heating and cooling	30		
Number of DPRs prepared	1	1	2
Cost of DPR preparation (@15 lakhs per DPR)	15	15	30

Based on the outcomes of the demonstration project, a decision can be made whether a program to promote these systems on a larger scale is viable or not. If proven viable, the program will explore promotion of these systems through financial incentives or mandates.

Case study: GIFT City, Gandhinagar, India

GIFT City is India first globally benchmarked international financial service centre and was developed by Government of Gujarat. The GIFT City is spread across 886 acres and has over 60 million square feet of built up area. With normal air conditioning systems, the electricity demand for air conditioning was calculated to be 240 MW.

Realizing huge potential for energy savings, the developers decided to build three district cooling plants which have reduced the electricity demand for air conditioning to 135 MW.

Activity 20: Design Energy Efficiency Insurance Schemes

This activity is under Category 4: Financial and fiscal

Energy Efficiency Insurance overcomes barriers to investment in energy efficiency through implementation of risk mitigation instruments. It insures energy savings for energy efficiency measures. Unlocking National Energy Efficiency Potential (UNNATEE) by BEE identifies Energy Savings Insurance as an important EE financing instrument.

To promote investments in energy efficiency in Assam, the ASDA or AEEDC will design or market an energy efficiency insurance scheme taking support from BEE. The first step in this regard would be capacity building of local financial institutions like the North Eastern Development Finance Corporation Ltd. (NEDFi), Assam Finance Corporation and RGVN (North East) Microfinance Ltd., and other state and national banks. This will be done through a workshop. The workshop will cover case studies of successful schemes, kind of projects covered under insurances and the rate of return projects are receiving. The workshop will also focus on the industries and kind of projects that may

be covered under energy efficiency insurance scheme in Assam, the market potential and the support from the government. The workshop will also cover business models for the scheme.

To kickstart the scheme, the Government of Assam will provide an initial insurance corpus of 5 crores. Thereafter, enterprises will pay a regular premium for the insurance services. The scheme will aim to involve at least 50 enterprises investing in energy efficiency projects within 3 years. The state government will need to spend INR 5 crores for kick-starting this scheme (Table 26).

Table 26: Timeline and fund requirement to set up Energy Insurance Scheme

Fund requirement (INR lakhs)	2020
Cost of workshop	0.50
Initial corpus for scheme (cost)	500

Energy Insurance Scheme, Mexico

Barriers like high technical and financial risk perception in energy efficiency matters and lack of know-how and EE project management have prevented investments in energy efficiency sector. An energy savings insurance scheme was identified as a solution to overcome these barriers. The Danish Energy Agency with the support of Clean Technology Fund (CTF) and Inter-American Development Bank implemented an Energy Savings Insurance Scheme in Mexico through the FIRA bank. The scheme aims to achieve investment of USD 25 million for 190 energy efficiency projects in the agro-industry sector by 2020.

The scheme covers technologies like efficient boilers, cogeneration equipment, solar energy equipment, modernization of cooling systems, efficient cooling systems and solar water heaters. The scheme is promoting mutual benefits to all the stakeholders such as SMEs and technology services providers (TSPs).

Summary

The proposed activities require a budgetary support of INR 2.55 crores for preparatory phase. The proposed activities will have following impacts:

- Reduce projected energy demand (39.6 TWh in 2030 in BAU) by 7.5%
- Increase the share of electricity in industrial energy mix (7% in 2030 in BAU) by 2%
- Improve the projected SEC (2.6 TWh/million ton in 2030 in BAU) by 7.7%

5.3 Agriculture sector

Energy consumption in agriculture is a function of water requirement for irrigation, efficiency of pump sets being used, and the source of energy. To achieve the targets set by Assam Energy Vison -2030, Assam needs to install 2.52 lakh solar pumps in the state and devise a strategy for replacing all diesel pumps with solar or electric ones. To achieve this transition following strategic intervention areas are identified for the agriculture sector:

- ✓ Reduction in water requirement: Direct energy savings due to reduction in water requirements as it would lead to less working hours for pumps.
- ✓ Improvement in pump set efficiency: Energy savings due to reduction in current drawn by the pump while delivering the same output power.
- ✓ Improvement in power supply to pumps: Energy savings due to reduction in losses in the network supplying power to pump sets while delivering same input current to the pumps
- ✓ Promotion of solar water pumps: Reduction in diesel requirement and grid electricity demand if solar water pumps are promoted instead of diesel and electricity pumps.

Under the business as usual trends the number of solar pumps in Assam are expected to increase to around 80,000 from a mere 30 in 2015 (25% of the pump population in 2030). The state would need to promote an additional 1.7 lakh solar pumps to achieve the targets set under Assam Energy Vision – 2030 (69% of the pump population in 2030). This would entail an investment of INR 17 billion (Figure 29).

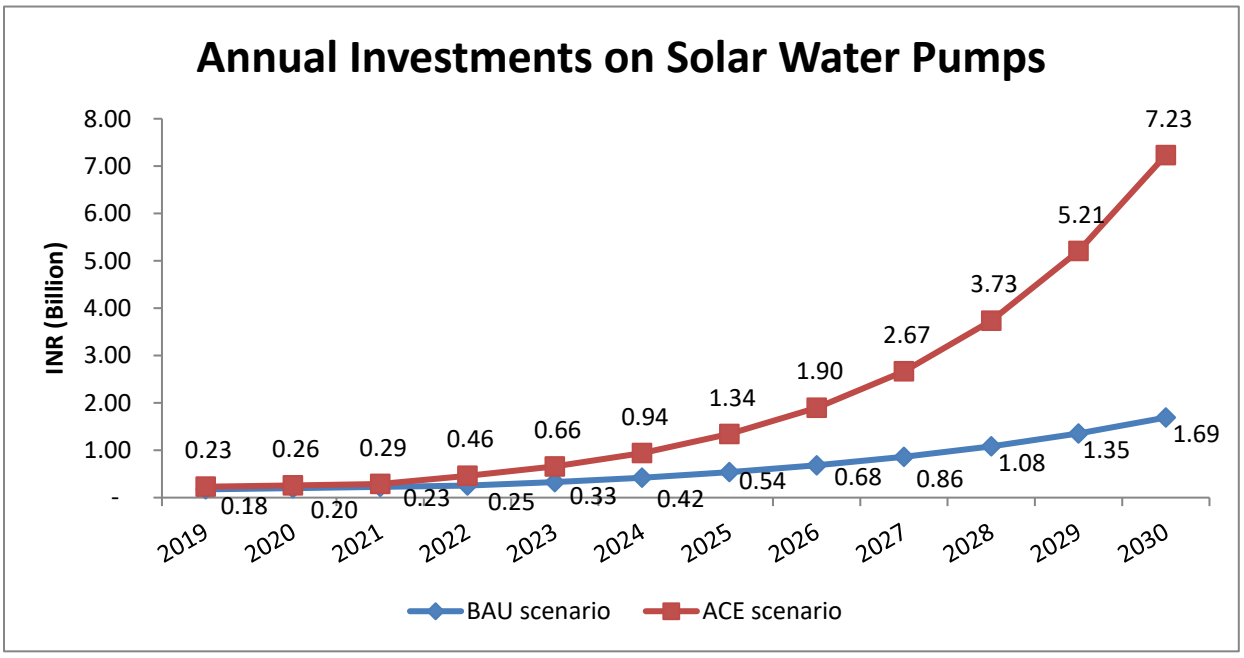


Figure 29: Annual investment required for solar waster pump

Activity 21: Design the 'Suryadhan Krishi Yojana'

This activity is under Category 1: Policy and regulatory

The high cost of solar pumps places them out of reach of farmers. Therefore, all schemes to promote solar pumps focus on providing capital support to farmers. This places a subsidy burden on the government. In situation like this, it makes sense for Assam to take benefits from central schemes and think about state level schemes later when the costs of solar pumps decline.

One such scheme that Assam must take benefit from is the '*Kisan Urja Suraksha evan Utthan Mahabhiyan*' (KUSUM) launched by the Ministry of New and Renewable Energy (MNRE). The scheme will support farmers in installing solar pumps and grid-connected solar plants. The scheme aims to install 17.50 lakh standalone solar pumps and 10 lakh grid-connected pumps all over India by 2022. MNRE is currently in the process of sanctioning state wise allocation of budget.

With less than 1% population of agricultural pumps in India, it is unlikely that Assam will receive a sizeable share of the KUSUM benefits. This makes it prudent for the Government of Assam to seek special assistance from the MNRE to receive larger share of assistance under the scheme. If the benefits of scheme are allocated to states based on the share of pumps, Assam will receive Central Finance Assistance (CFA) of 50% for 17,500 standalone solar pumps and 10,000 grid connected solar pumps. The state government will have to cover 30% of the system cost.[20]

The state government should take advantage of this scheme to replace old diesel pumps by nominating Assam Power Distribution Company Ltd. (APDCL) as the nodal agency. It is estimated that the state government will need to spend around INR 25 crores over 4 years to support this national program (Table 27).

Table 27: Timeline for estimated expenditure by Government of Assam to support KUSUM

Fund requirement (INR lakhs)	2019	2020	2021	2022
Fund for standalone solar pumps[21]	2,250	3,600	4,500	5,400
Fund for Grid-connected solar pumps[22]	750	1,125	2,250	3,375

The impact of this scheme is not large enough to achieve the agriculture sector's targets identified in Chapter 2. However, this scheme will build capacity of the nodal agency to roll out a wider program to promote solar pumps. To give impetus to solar water pumps promotion, The Department of Agriculture should prepare proposal for 'Suryadhan Krishi Yojana'. This scheme will build on from the KUSUM scheme. The scheme will cover 60% cost of system for diesel pump replacement and 50% for new solar pumps and

[20] https://mnre.gov.in/sites/default/files/webform/notices/New%20Scheme%20for%20Farmers%20for%20Installation%20of%20Solar%20Pumps%20and%20Grid%20Connected%20Solar%20Power%20Plants.pdf

[21] Cost of a 3 hp DC system is 3 lakhs

[22] Cost of a 3 hp AC system is 2.5 lakhs

provide easy repayment options for the remainder through banks. The scheme will target replacement of 20 thousand diesel pumps, and 25 thousand new solar pumps (10 thousand standalone systems and 15 thousand grid-connected systems) for which the state government will need to spend around INR 460 crores over five years for this program (Table 28). The proposal preparation process is expected to take up to 6 months.

Table 28: Timeline for expenditure by Government of Assam 'Suryadhan Krishi Yojana'

Fund requirement (INR lakhs)	2023	2024	2025	2026	2027	2028	2029	2030
Fund for Diesel pump replacement	3,500	2,500	1,700	1,500	1,200	1,000	600	
Fund for Solar pumps (standalone)[23]		500	1,000	1,500	2,000	2,750	3,000	4,250
Fund for Solar pumps (grid-connected) [24]	500	750	1,000	1,500	2,250	3,500	4,250	5,000

The scheme will be supported by bulk procurement of panels, controllers and pumps through agencies APDCL which will also serve as the nodal agency. The grid connected solar pump systems will inject power into the grid at a feed-in tariff (FiT) determined by the Assam Electricity Regulatory Commission (AERC) or net-metering and will help APDCL meet its Solar Renewable Purchase Obligation (RPO).

The scheme will also support pilot projects on high efficiency brushless DC pumps (BLDC) for shallow tube-wells in relatively high solar insolation areas with shallow water table. The pilot projects will assess the performance and suitability of BLDC pumps for a wider rollout. Agriculture Department will identify 10 sites for pilot projects and provide implementation support. The pilot projects are expected to cost around INR 3 lakhs per site. Based on the results of pilot project a decision on a program for wider rollout of BLDC pumps can be taken. The timeline for the pilot projects is shown in Table 29.

Table 29: Timeline for pilot projects on BLDC pumps

Site identification	Implementation	Monitoring
3 months	3 months	12 months

Case study: BLDC pumps scheme in Andhra Pradesh

BLDC motors offer lower inertia and better torque control with 20-25% higher efficiency than conventional AC motors. Thus, BLDC pumps discharge 20% more water compared to AC pumps. The Government of Andhra Pradesh, to realize this potential, is planning Grid connected solar BLDC pump scheme for farmers. The scheme will supply 3 and 5 hp pumps to farmers. The scheme will push agricultural connections to solar connections, which will ensure daytime power supply and cost efficient irrigation to farmers. In addition, the subsidy burden for new agricultural connections will be reduced from the government. The surplus electricity generated by solar panels can be injected back into the grid.

[23] Cost of 3 hp system is 3 lakhs
[24] Cost of 3 hp AC system is 2.5 lakhs

Activity 22: Set up 'Kisan Sewa Kendra'

This activity is under Category 2: Institutional strengthening and awareness

The number of electrical pumps in the state is expected to rise from 3,500 in 2015 to 1.15 lakhs by 2030 and the solar pumps from a mere 30 in 2015 to 2.5 lakhs by 2030. To promote energy efficiency in agriculture sector, it is essential that these pumps besides being BEE star rated are given proper repair, maintenance and rewinding services. In this context, the Agriculture Department along with ASDA or AEEDC should prepare a proposal to set up 'Kisan Sewa Kendra' or service centers for rewinding of all types of pumps. These Sewa Kendras will be set up to provide rewinding services to agricultural consumers at a minimal cost or at a rebate so that consumers are attracted towards getting their pumps properly rewound instead of sub-standard re-winding. Staffs and students from local ITI, polytechnics and engineering colleges will initially be given trainings (training to be given by Motor Knowledge Center) on proper rewinding of pumps who can then be appointed to run these Sewa Kendras. The proposal preparation process is expected to take up to 6 months and would require INR 30 lakhs.

The state may plan to set up 10 such kendras spread across agriculture intensive areas. To run these service centres, about 50 trained professionals will be needed. The training will be provided through the Motor Knowledge Center. For setting up these kendras the state government will have to spend around 10 crores over three years (Table 30).

Table 30: Timeline and fund requirement for setting up 'Kisan Sewa Kendra'

Fund requirement (INR lakhs)	2020	2021	2022	2023
Cost of proposal preparation	30			
Number of centers established		2	4	4
Cost of center establishment (@100 lakhs per center)		200	400	400
Number of professionals trained		10	20	20
Cost of training (@ INR 3,000 per person)		0.3	0.6	0.6

The major part of the cost of these kendras will be the cost to sustain the infrastructure and manpower. The cost incurred in the setting up of these kendras can be offset by the revenue generated from rewinding of pumps. The annual number of pumps to be rewound per Kendra for sustainability is shown in Table 31.

Table 31: Business plan for 'Kisan Sewa Kendra'

Business plan for 'Kisan Sewa Kendra	Implementation
Cost of manpower (50 trained professionals @ INR 15,000 per person per month)	15,000*12*50 = 90 lakhs
Cost of upkeep (10 centers @ INR 20,000 per kendra per month)	20,000*12*10 = 24 lakhs
Pumps to be rewound per kendra for sustenance of business (@ INR 2500 per rewinding)	= 450 rewinding

Summary

The proposed activities require a budgetary support of INR 30 lakhs for preparatory phase. The proposed activities will have following impacts:

- Reduce projected energy demand (18.4 TWh in 2030 in BAU) by 8%
- Increase the projected share of solar pumps (25% of pump population in 2030 in BAU) to 69% in 2030

5.4 Commercial sector

Due to the rising urbanization rate, per capita income and standards of living, the commercial floor area in Assam is expected to rise from around 13.5 million m^2 to 52 million m^2 by 2030. Under the business as usual trends, around 20% of the projected floor space in 2030 will be ECBC compliant. However, to achieve the objectives of AES scenario, 100% of the projected floor area has to be ECBC compliant. This would entail an additional investment of INR 660 billion (Figure 30).

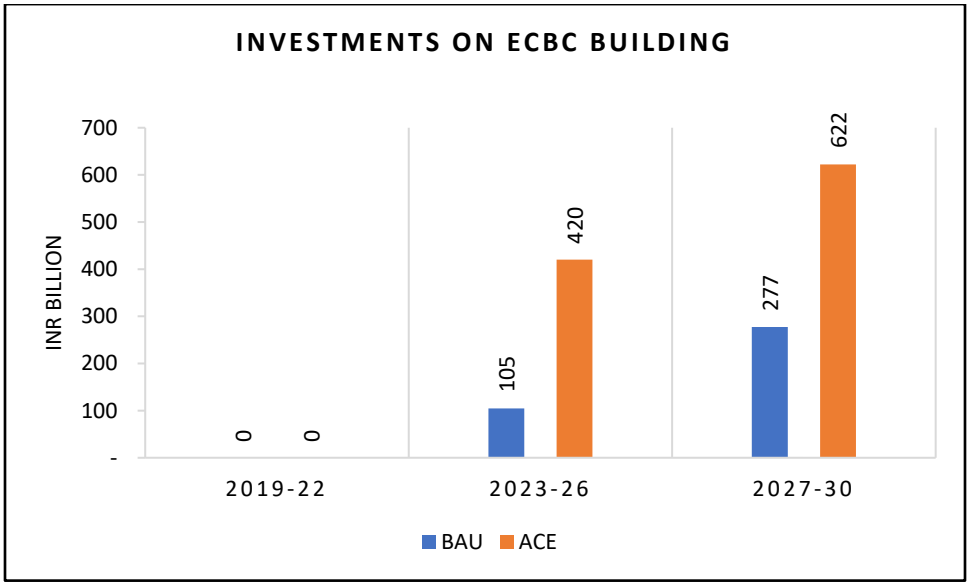


Figure 30: Investment required for commercial sector

For the commercial sector to achieve the targets set under Assam Energy Vision – 2030 following strategic intervention areas are identified:

- ✓ Increasing scope of ECBC to cover multi-story residential buildings
- ✓ Mandating and incentivizing ECBC compliance
- ✓ Setting 24 - 25 ˚ C as the default temperature for cooling
- ✓ Adopting modern technologies

Activity 23: Design a program to promote ECBC compliance

This activity is under Category 1: Policy and regulatory

Compared to 2015, the commercial area availability per person in Assam is expected to increase by more than three times by 2030. This will lead to a proportional rise in energy consumption in this sector, if left unchecked. Energy Efficiency and Conservation Codes (ECBC) by setting minimum energy efficiency standards for buildings will play a key role in shaping the energy consumption of commercial sector.

Assam has already taken a leap in this segment with the Assam State Designated Agency preparing the draft Assam Energy Conservation Building Code (ECBC) 2018 and work is in progress towards finalizing the codes.[25]

To promote ECBC compliance, the first focus area for Assam should be to extend the scope of draft codes to cover multi-story residential buildings. In this context, the ASDA should prepare a proposal to amend the scope of the draft codes. The proposal will be prepared through a consultative process with building associations, real estate developers, resident welfare associations and urban local bodies. The proposal preparation process should include two workshops. The first workshop will aim to sensitize stakeholders about the codes, material used in ECBC compliant construction and the benefits they can draw by adopting them and seek participants' inputs on the support required from the governmental towards adoption of ECBC. The participants' inputs will be used to design incentives like granting of extra floor area ratio (FAR) and tax benefits for complete and partial ECBC compliance.

The second workshop will focus on consensus building on the scope and the incentives. The incentives can be like granting of extra floor area ratio (FAR) and tax benefits to builders for ECBC compliance. The proposal preparation process is expected to take around 12 months ad will require INR 7 lakhs.

Once the codes are finalized and notified, urban local bodies (ULBs) may start considering amendments in bye-laws to mandate all new commercial and multi-story residential buildings to be ECBC compliant. Thus, the second focus area for the program should be development of regulations for ECBC compliance. In this regard, ULBs may follow a sequential approach where large buildings like hospitals, shopping malls and hotels are mandated first followed by smaller ones like warehouses, retail outlets and residential buildings. The state government will not have to bear any cost for amendment as this is part of ULB's duty and precedence from other states can be followed.

After the ECBC compliance is mandated, real estate developers will need to source material that is necessary for ECBC compliant construction. Thus, the third focus area for the program should be to check local availability of these materials. In this context, the ASDA/AEEDC should undertake a study to assess the local availability of materials and their quality. This study is expected to be completed in 12 months at a cost of INR 50 lakhs.

The fourth and final focus area for the program should be the sustenance of ECBC principles. This will be done through capacity building of engineers, project managers, quality inspectors, site supervisors and architects. In this context, the ASDA may plan a series of trainings for government departments (like UDD, ULBs, PWD and GDD), private real estate companies and research and academic institutions. The ASDA should consider working with academic institutions like IIT-Guwahati, Assam University and Tezpur University to introduce certification courses on ECBC. While the focus for private sector will be on

[25] https://cei.assam.gov.in/sites/default/files/swf_utility_folder/departments/ioe_power_uneecopscloud_com_oid_8/latest/DRAFT%20ECBC%20ASSAM%20ENERGY%20CONSERVATION%20BUILDING%20CODE%202018.pdf

developing a skilled workforce with know-how of ECBC compliant construction, for public sector the focus will be on compliance and quality checks.

Table 32: Timeline and fund requirement for program to promote ECBC compliance

Fund requirement (INR lakhs)	2020	2021
Cost of proposal preparation	5	
Cost of workshop 1	1	
Cost of workshop 2		1
Cost of study to assess local availability of material used in ECBC complaint construction		50

Activity 24: Prepare a notification on setting 24°C as default temperature in commercial buildings

This activity is under Category 1: Policy and regulatory

With per capita commercial space set to increase more than three times by 2030 compared to 2015, the energy consumption in the sector will increase manifold, if left unchecked. Air conditioning and cooling will account for a chunk share of the projected energy demand. Since a similar story is witnessed at the all India level, the Bureau of Energy Efficiency (BEE) has issued guidelines to major commercial establishments with the objective of conserving energy through optimum temperature settings for ACs within the comfort zone. The guideline suggests large premises like airports, hotels, shopping malls, offices and government buildings to maintain internal temperature at 24-25°C which is adequate for human comfort.[26]

In this context, the ASDA should prepare a notification and identify commercial establishments like airports, malls and offices to set 24-25 °C as the default temperature for air conditioners. The ASDA should explore the feasibility of mandating 24-25 °C as the operational temperature for above mentioned premises. This notification preparation process is expected to take up to 3 months.

Increase in temperature of room by 1°C can save about 6% electricity. Typically, room temperatures are set between 20-21°C whereas, as per comfort chart, it is suggested that ideal temperature could be maintained around 24-25°C. Considering this change, there exists a potential to save about 24% of electricity consumption towards ACs.

Activity 25: Demonstration project on building-integrated photovoltaic (BIPV) technology

This activity is under Category 3: Project development and technology promotion

The BIPV systems in India have failed to grow beyond a small niche market for a host of reasons including concerns over high costs, difficulty in installation and doing away with the aesthetics of buildings.

[26] https://beeindia.gov.in/sites/default/files/press_releases/Recommended%20Guidelines.pdf

BIPVs can be used as roof or exterior walls with solar awnings providing shade while absorbing solar energy and generating electricity. The benefits of BIPV are manifold: BIPV not only produces on-site clean electricity without requiring additional land area but can also impact the energy consumption of a building through daylight utilization and reduction of cooling loads. BIPV can therefore contribute to developing net-zero energy buildings. Furthermore, the diverse use of BIPV systems opens many opportunities for architects and building designers to enhance the visual appearance of buildings. Finally, yet importantly, building owners benefit from reduced electricity bills and the positive image of being recognized as "green" and "innovative". With several Indian companies moving into manufacturing and use of these systems it is prudent for Assam to consider these systems as part of their future energy segment.

APDCL should undertake demonstration projects to assess the techno-economic feasibility of these systems. To initiate the demonstration projects, APDCL should work with Assam State Transport Corporation (ASTC) to identify five sites for setting up BIPV integrated charging stations. The site selection process may give high priority to bus-depots and Inter State Bus Terminals (ISBTs). One of the suggestions for the sites could be ISBT at Khanapara (Guwahati). Thus, APDCL should prepare proposal for the demonstration projects. This process is expected to take up to 3 months and will require INR 5 lakhs.

Several photovoltaic panel manufacturers claim that their systems are strong and sturdy enough to replace the traditional roofs, at a cost which is around 20-30% cheaper than building a roof and solar panel separately. the proposal may also explore feasibility of using these systems in houses being supported by Pradhan Mantri Awas Yojana (PMAY).

After the sites are identified, DPRs should be prepared with APDCL and ASTC sharing the cost. The demonstration projects may be implemented in PPP mode where APDCL and ASTC could contribute 50% of the project cost and the private entity contributes the remainder. APDCL and ASTC could take joint responsibility for monitoring. This activity is expected to cost around INR 5.5 crores over three years (Table 33).

Table 33: Timeline and fund requirement for demonstration projects on BIPV

Fund requirement (INR lakh)	2019	2020	2021
Cost of proposal preparation	5		
Number of DPRs prepared	2	3	
Cost of DPR preparation (@15 lakh per DPR)	30	45	
Number of projects implemented		2	3
Cost of project implementation (@100 Lakh per project)		200	300

Figure 31: BIPV charging station [27]

Activity 26: Prepare a notification to fast track development of natural gas infrastructure in buildings

This activity is under Category 1: Policy and regulatory

The 9th round of city gas distribution (CGD) organized by the Petroleum and Natural Gas Regulatory Board (PNGRB) has earmarked two geographical area in Assam for CGD development. The first geographical area comprises of the Cachar, Hailakandi and Karimganj districts while the second geographical area comprises of the Kamrup and Kamrup Metropolitan districts. In addition, the districts Tinsukia, Dibrugarh, Sibasagar, Jorhat and Golaghat are part of the Upper Assam CGD network which has been operational since 1985 (Figure 32). The planners have envisaged CGD development in these areas over 8 years. The ULBs in the two geographical areas earmarked for CGD development should find ways to fast track the process.

In this context, the ULBs in above mentioned districts should prepare notifications for all new multi housing societies, hotels, restaurants and malls to develop PNG supply infrastructure. The notification should consider incentives like tax rebates for new constructions to abide by these notifications. Till the time these new constructions are connected to the CGD system, cascaded LPG cylinder or central tanks may be used as alternatives for CGD supply (Figure 33). The notification preparation process is expected to take up to 3 months for each ULB.

[27] Source: Chevrolet

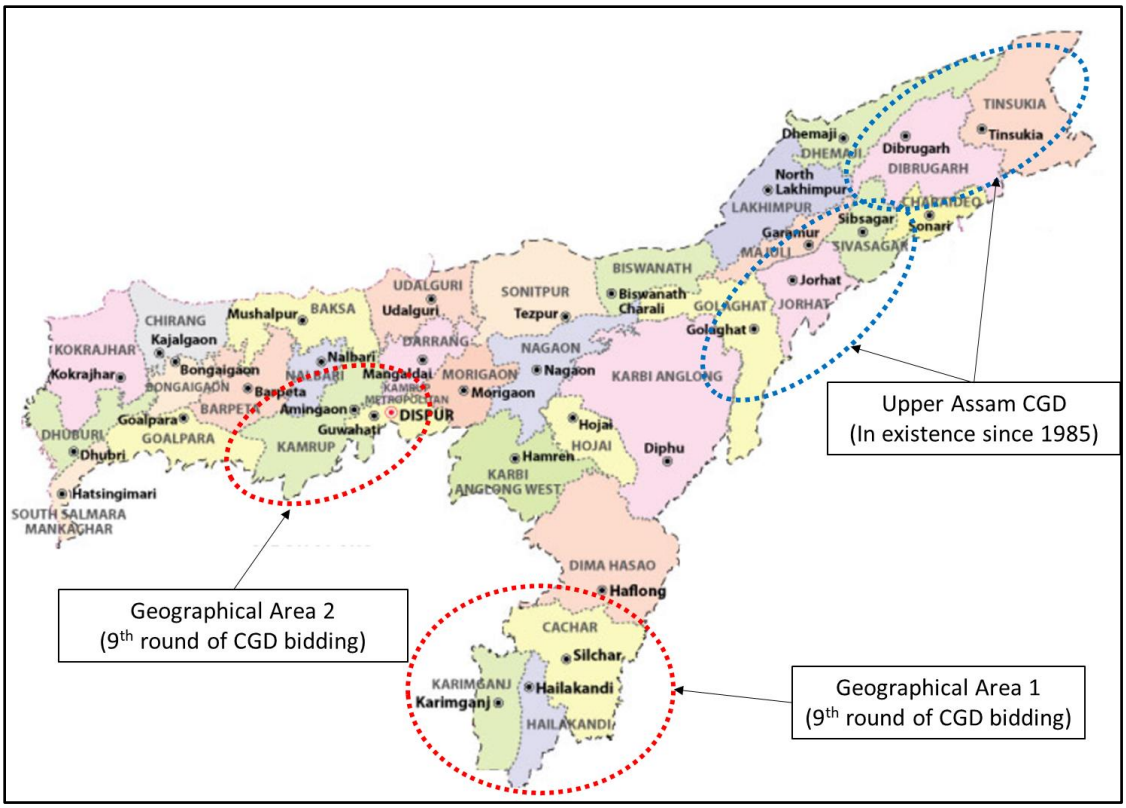


Figure 32: Areas having or will have CGD network

Figure 33: Central tank (left) cascade system (right)

Summary

The proposed activities require a budgetary support of INR 62 lakhs for preparatory phase. The proposed activities will have following impacts:

- Reduce the projected energy demand (5 GWh in 2030 in BAU) by 20%

5.5 Renewable energy sector

Even though Assam has high potential of renewable resources like biomass, small hydro and solar, the progress towards harnessing these resources has been slow. The renewable energy capacity mix in AES scenario is shown in Figure 34.

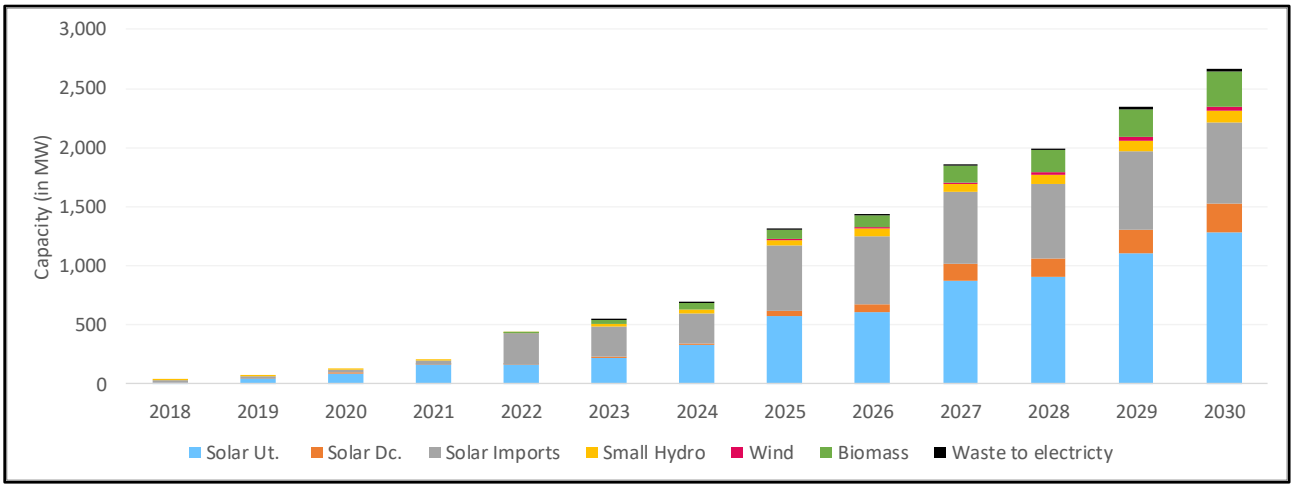


Figure 34: Renewable energy capacity mix in AES scenario

To achieve the desired capacity mix following strategic intervention areas have been identified:

- ✓ Strengthening policy and regulatory potential of biomass, solar and small-hydro power resources
- ✓ Promoting use of renewables in new segments

Activity 27: Design 'Assam Biomass Mission'

This activity is under Category 1: Policy and regulatory

Assam is highly rich in both agriculture and forest biomass resources. The local availability of these resources makes them an important means to reduce energy import dependence. Lack of awareness on the concept, access to finance, policy and regulatory support has left this resource untapped. It is prudent for Assam to intervene in this segment to utilize these resources. In this context, AEDA should prepare a proposal for the 'Assam Biomass Mission`. The proposal preparation process is expected to take upto 9 months and will require INR 75 lakhs. The mission will:

- ✓ Target to set up 300 MW biomass (forest and agriculture residue) to electricity plants by 2030
- ✓ Undertake demonstration projects to set Viability Gap Funding (VGF) mechanism to make biomass to electricity plants competitive
- ✓ Identify and allocate biomass collection areas
- ✓ Promoting use of biomass in industries to substitute fossil fuels
- ✓ Promote biomass briquette and pellet manufacturing
- ✓ Support research and development work of indigenous products and solutions

✓ Establish Assam Bio-fuels Development Agency

The first segment of the mission will focus on use of biomass for electricity. This segment will be kickstarted by undertaking a study covering various biomass to electricity conversion technologies with their comparison to assess suitability for Assam, identify economic uses for the by-products, identify rich biomass regions to earmark biomass collection areas and identify five sites for demonstration projects. The demonstration projects will determine techno-economic feasibility of these systems and determine VGF requirement.

The demonstration projects will be undertaken in PPP mode. The private players may be identified through 'Expression of Interest' and 'Request for Qualification' stages. Government of Assam and private entity will jointly bear the cost of DPRs for the sites. The demonstration projects will be of different sizes, employ different technologies and equipment from different manufacturers. AEDA will appoint a nodal officer for monitoring of the projects post commissioning. The officer will collect relevant information and make it available to stakeholders as and when needed. Based on the information from the M&V phase, a decision can be made on the level of VGF to be provided to make biomass to electricity plants competitive against other technologies. The Government of Assam could consider VGF to attract developers for initial projects.

This will be followed by a notification to earmark areas for biomass collection. The notification will be prepared in consultation with Agriculture Department and the Environment and Forests Department. The biomass collection areas may be set up in biomass rich districts like Nagaon, Nalbari, Barpeta and Baksa (Figure 35).

The second segment of the mission will focus on use of biomass for fuel substitution in industries. This segment will be kickstarted by a generic study to identify industries and processes where biomass can substitute use of fossil fuels. An example could be replacing coal based dryers in industrial sector with biomass based dryers. After conclusion of the study, Government of Assam should consider notifying guidelines for pulp and paper, plywood, sugar, tea and other industries to use biomass as fuel. The guidelines by setting targets for industries to meet a minimum level of their energy requirements through biomass, could be on the RPO lines and set a suitable penalty mechanism for non-compliance may be prepared.

After biomass collection areas are identified and the need for biomass is established in market, the stage will be set to promote biomass pellets and briquettes manufacturing. In this context, AEDA should work with Department of Industries and Commerce to attract entreprenuers and enterprises to set up biomass pellet and briquette manufacturing units in biomass collection areas, where existing infrastructure like the anaj mandis may be used as collection centers.

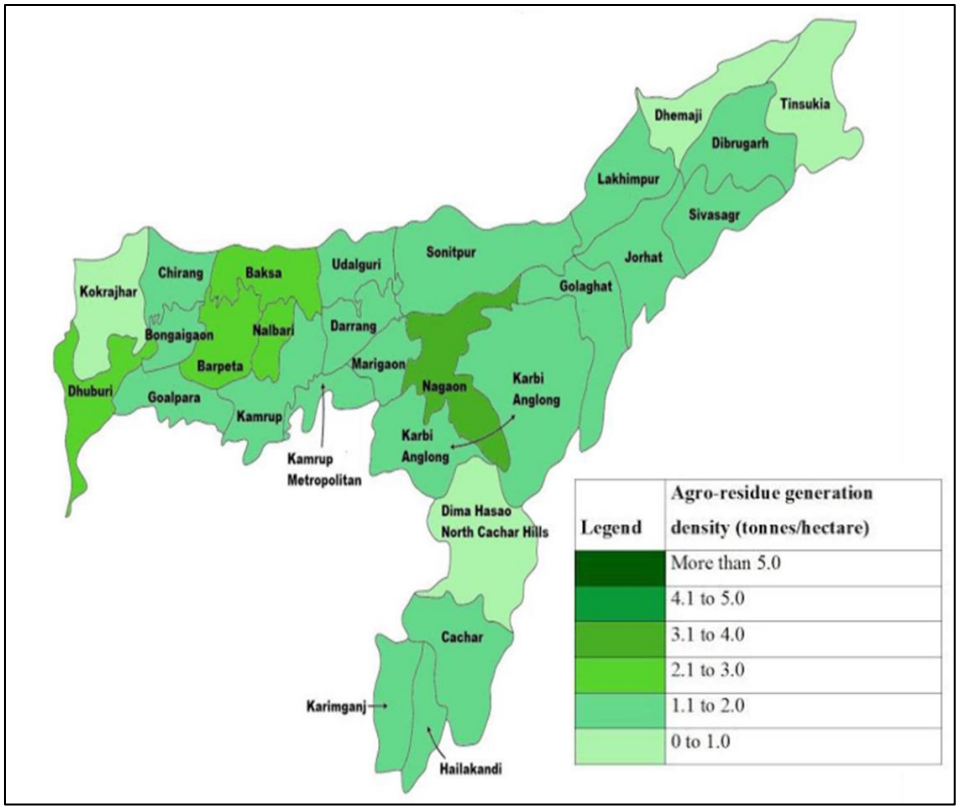


Figure 35: Agro-residue map of Assam[28]

The Government of Assam could support research and development work on indigenous products and solutions in academic and research institutes like IIT-Guwahati, TERI-NE, Assam University and Tezpur University; demonstration projects and business proposals from entreprenuers from rural areas

The third segment of the mission will focus on promotion of bio-fuels. The Jatropha plants, which are the most sought after crops for bio-fuels, grows naturally in Assam and is commonly called as 'Bhoot Era'[29]. The bio-fuel crops like Nahar seeds are found in upper Assam, Darrang and Cachar districts, the Indian Beech locally refered to as Koroch, is found in Lakhimpur, Sibsagar, Dibrugarh, Darrang, Kamrup and Nagon districts. To harness the availale potential of bio-fuels, the state should consider setting up Assam Bio-fuel Development Agency. The agency will be set up with the objective of ensuring sustainable sources of supply of feedstock for bio-fuel production.

In this context, AEDA should work with the Agriculture Department to prepare a proposal for estalishing the Assam Bio-fuel Development Agency. The proposal will cover the scope of work for the agency, infrastructure and manpower requirements and the organisational structure for the

[28] https://biomasspower.gov.in/map-assam.php
[29] https://core.ac.uk/download/pdf/6614685.pdf

agency. The proposal will also include the business model for the agency. This proposal preparation process is expected to take 6 months and will require 40 lakhs.The agency will:

- ✓ Promote bio-fuel plantation in wastelands (Figure 36)
- ✓ Promote bio-fuel plantation in agriculture land without affecting food security
- ✓ Attract investments in bio-fuel segment in the state
- ✓ Provide technical assistance to the state government on bio-fuel related matters

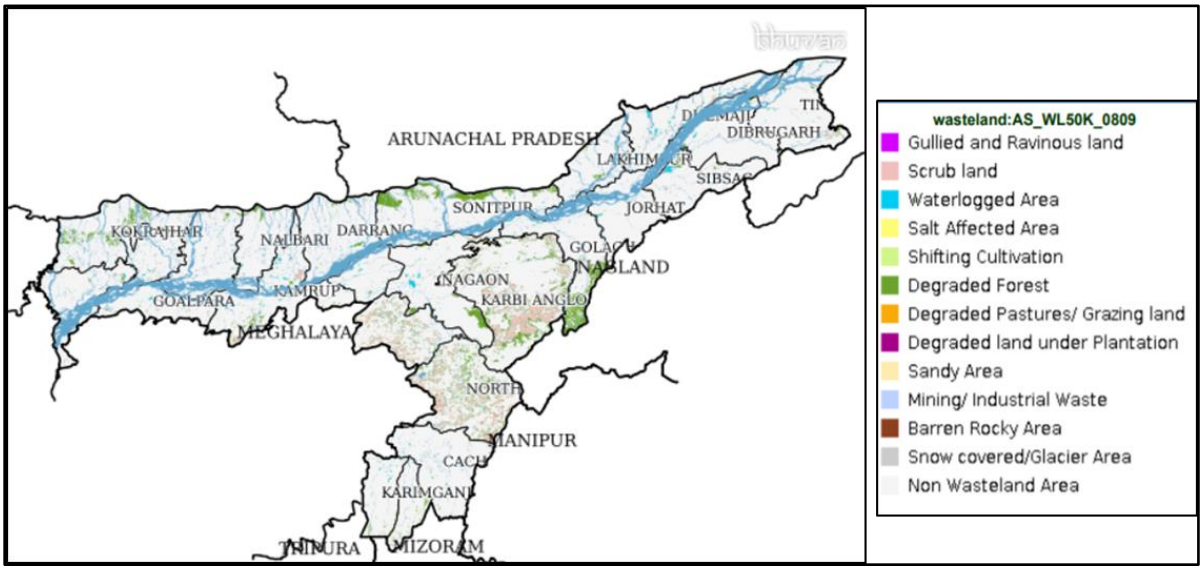


Figure 36: Wasteland map of Assam[30]

The agency will be set up with the objective to achieve 20% blending of ethanol in petrol and 5% blending of biodiesel in diesel by 2030. These are the indicative targets specified by the 'National Policy on Bio-fuels'.

National Thermal Power Corporation (NTPC) successfully demonstrated the co-firing of 7% blend of biomass pellets with coal in its Dadri power plant. Approximately 500-600 kg biomass pellets are required per MW per day, for 7% blending.

Activity 28: Prepare a new Assam Solar Policy

This activity is under Category 1: Policy and regulatory

The Assam Solar Energy Policy, 2017 has specified a target of 590 MW solar capacity by FY20. Due to a variety of reasons, the policy is all set to miss this target. It is recommended that the Power Department prepare a new solar policy (or amend the existing one) to remove hurdles in the uptake of solar and promote new technologies like floating solar, conjunctive land use for solar generation and agriculture,

[30] https://bhuvan-app1.nrsc.gov.in/state/AS

BIPV, canal top and storage with an aim to achieve 1,550 MW solar by 2030. The operationalization of this policy will be supported with the following studies:

- ✓ Study to identify land for installing 1,300 MW utility scale ground mounted projects (Covered in land Use policy for Renewable Energy)
- ✓ Study to assess rooftop solar potential in the state (AEDA is currently working on this)
- ✓ Study to reassess solar potential in the state. The 13 GW solar potential in Assam calculated by MNRE needs to be reverified. Besides revisiting the numbers, the study should include surveys to grade the land based on suitability to install solar, solar insolation and area. This study is expected to be completed in 12 months at a cost of INR 1 crore.

The new policy should amend the existing grid connected solar regulation to encourage net metering through virtual aggregation, banking arrangement, and account for locational and temporal benefits. Preparation of the new Assam Solar Policy document is expected to be completed in 6 months and will cost the state government around INR 50 lakhs. The timeline of this activity is shown in Table 34.

Table 34: Timeline and fund requirement for preparing new Assam Solar Policy

Fund requirement (INR lakh)	2019	2020
Cost of study to reassess solar potential in Assam	100	
Cost of drafting the policy		50

Activity 29: Prepare a proposal to include waste to electricity generation as a strategic intervention in 'Assam Urban Waste Management Policy' (2018)

This activity is under Category 1: Policy and regulatory

'Swachh Bharat Abhiyan' is a nation-wide campaign that aims to clean up streets, roads and infrastructure of cities, towns and rural areas. Following in the footsteps of the mission, the Urban Development Department (UDD) of the Government of Assam is in the process of preparing 'Assam Solid Urban Waste Management Policy'. The draft policy document was made available to the public in 2018.[31] The draft policy identifies six strategic interventions:

- ✓ Door to Door Collection of waste generated
- ✓ Waste minimization and promotion of recycling of waste
- ✓ Engaging stakeholders in implementation
- ✓ Processing, Treatment and Disposal of Waste
- ✓ Strengthening the capacities of the ULBs
- ✓ State Level Institutional arrangements & Program support

[31] https://assam.gov.in/documents/10180/537f967e-a24f-4482-8e31-5d704e3be484

The document focuses on waste segregation at source, strengthening of collection efforts and how to streamline the process by involving waste collectors the rag pickers. The documents highlight waste to electricity (WTE) as a possible means for end treatment of collected waste. With an average household waste generation of 100-200 gm/day in rural areas, 150-400 gm/day in semi-urban and 400-600 gm/day in major urban centers, it is prudent for Government of Assam to intervene in this segment.

In this context, AEDA should prepare a proposal to include waste to electricity generation as a strategic intervention under this policy. The proposal will identify sites to set up 20 MW waste to electricity plants in PPP mode in major cities in the state by 2030. The target should include both centralized and decentralized plants based on the waste collection process. The proposal preparation process is expected to take around 3 months and will require INR 5 lakhs.

To prepare this proposal, AEDA should organize a workshop with residential welfare associations, government departments like the UDD, GDD and PWD, entrepreneurs, equipment manufacturers and others to discuss the proposal. The agenda for the engagement could be to sensitize stakeholders about the benefits of WTE and explore various business models for the same.

In addition, the proposal should suggest five projects to assess the economic feasibility of both the centralized and decentralized waste to electricity plants. The projects may be undertaken in high waste generation areas shown in Figure 37.

After identification of sites, DPRs should be prepared. The cost of the projects will depend on the size of the WTE plant. For implementation of these projects, AEDA should appoint a nodal officer who will collect all necessary information and assist policy makers in making an informed decision on rolling out of program to promote large scale deployment of WTE.

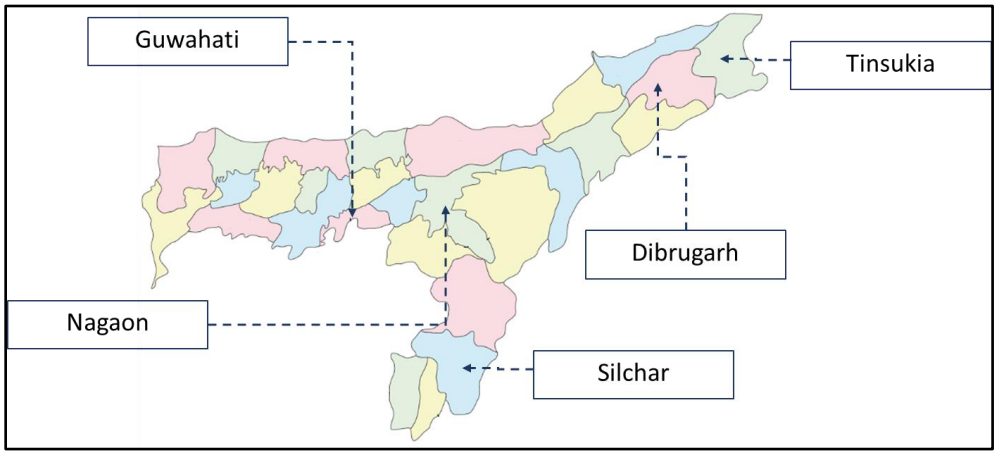


Figure 37: Sites suggested for WTE demonstration projects

This activity is expected to cost the state government around 1.05 crores over three years (Table 35).

Table 35: Timeline and fund requirement for demonstration projects on waste to electricity

Fund requirement (INR lakhs)	2019	2020	2021
Cost of proposal preparation	5		
Cost of DPR preparation (@20 lakhs per DPR)		40	60

Activity 30: Undertake demonstration project on conjunctive use land for solar and agriculture

This activity is under Category 3: Project development and technology promotion

With high proportion of land under forest and agriculture cover, the availability of land for renewable energy projects especially solar is limited. This has proven to be a barrier for development of solar projects in the state. In a situation like this, it is essential to find innovative ways to utilize existing agricultural land.

In this context, AEDA should undertake demonstration projects on conjunctive use of land for agriculture and solar generation. Such a system employs solar panels mounted high above the ground so that the crops planted below receive ample sunshine (Figure 38).

Figure 38: Conjunctive use of solar with agriculture[32]

The demonstration projects besides assessing techno-economic feasibility of this system will serve as proof-of-concept and assess the impact of solar panels on yield of different crops like jute, potato, sugarcane and jute. For implementing projects, AEDA should join hands with the Assam Agricultural University and undertake two pilot projects of 250 kW each in the regions highlighted in Figure 39. The sites will be identified such that power can be evacuated easily.

The DPRs for the demonstration projects will be prepared by AEDA and APDCL will provide necessary technical support for the implementation. The DPR preparation process is expected to take up to 3 months for each site. Each pilot project is expected to cost around INR 2 crores. The timeline for this activity is shown in Table 36.

Table 36: Timeline and fund requirement for demonstration projects on conjunctive use of land for agriculture and solar

Fund requirement (INR lakhs)	2019	2020	2021
Cost of DPR preparation (@ 15 lakhs per DPR)	15	15	
Cost of Project implementation (@ 2 crores per project)[33]		200	200

[32] https://www.ise.fraunhofer.de/en/press-media/press-releases/2017/harvesting-the-sun-for-power-and-produce-agrophotovoltaics-increases-the-land-use-efficiency-by-over-60-percent.html

[33] Cost of solar @ 6 crore/MW + structure cost

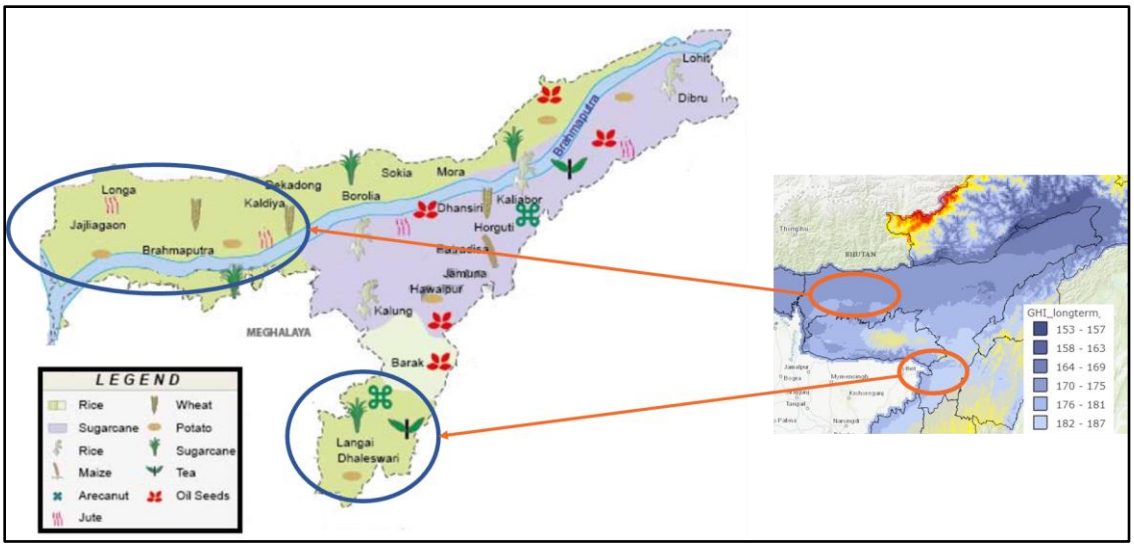
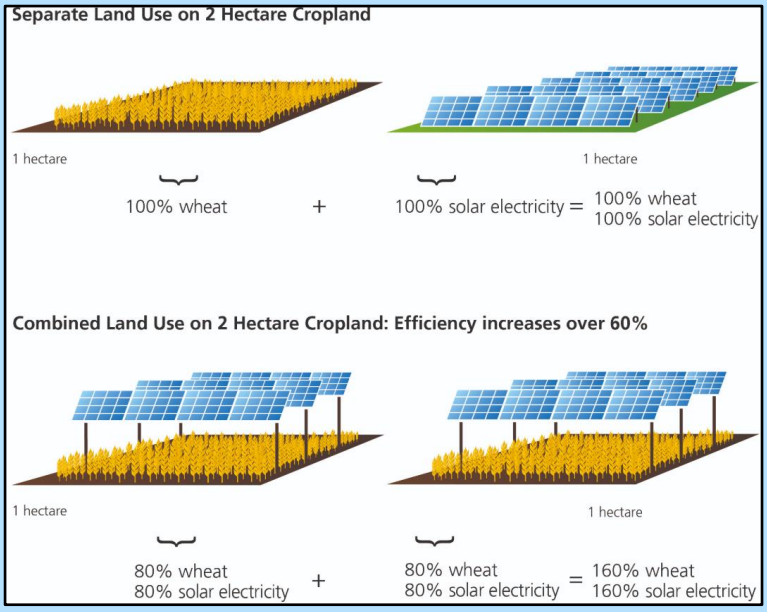


Figure 39: Areas suggested for pilot project on conjunctive use of land for solar plant and agriculture[34]

AEDA will appoint a nodal officer to collect relevant information for assessing techno-economic feasibility of conjunctive use of land for agriculture and solar power generation. The officer will be responsible for providing information and assisting policy makers to make informed decision on a program for wider roll out of these systems.

KUSUM scheme launched by the Government of India aims to set up 10,000 MW decentralized ground mounted solar plants in rural areas of capacities up to 2 MW. Due to constraints on availability of land to set up solar plants, the farmers in Assam may find it difficult to reap benefits of this scheme.
Conjunctive use of land for agriculture and solar power generation is an innovative solution to address this solution. Research by Fraunhofer indicates that such systems have the potential to improve total productivity of land by over 60%.



[34] Source of solar map: NREL, Agriculture map: www.mapsofindia.com

Activity 31: Undertake demonstration projects on Solar Cold Storage

This activity is under Category 3: Project development and technology promotion

Assam has several cold storage units with an aggregate capacity of about 100,000 MT. These cold storage units are used for storing commodities like potato, fruit, meat and dairy products. These storage units on an average consume around 25 MUs of electricity annually. Solar cold storage units offer opportunities to reduce this electricity consumption. Although these systems are widely accepted across the world, their growth in India has been limited.

To promote these systems in Assam, AIDC should consider undertaking five demonstration projects to assess techno-economic feasibility of these systems. These projects may be undertaken in Kamrup, Cachar and Hailakandi districts, which have many cold storage units and have relatively higher solar insolation. The demonstration projects may be undertaken for different technologies employing different phase change materials.

The project may be implemented in PPP mode, with the participation of AIDC, Assam State Agricultural Marketing Board and private entities. AIDC will appoint a nodal officer for data collection and coordinate with stakeholders. The nodal officer will make relevant information available to the stakeholders to assist them in making an informed decision on rolling out a wider program for promoting solar cold storage systems.

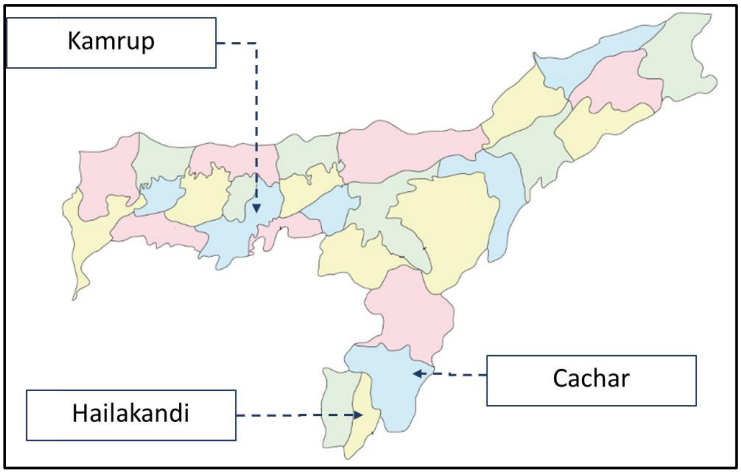


Figure 40: Districts recommended for Solar Cold Storage demonstration projects

For this activity the state government may need to spend around INR 5.75 crores lakhs over three years (Table 37).

Table 37: Timeline and fund requirement for demonstration projects on solar cold storage

Fund requirement (INR lakh)	2020	2021	2022	2023	2024
Cost of DPR preparation (@15 lakh per DPR)	30	45			
Cost of project implementation (@100 lakh per project)[35]			100	200	200

[35] Cost for 100 kW_p solar storage system

Activity 32: Undertake impact assessment study for Assam Small Hydropower Development Policy (2007)

This activity is under Category 1: Policy and regulatory

Assam has high hydropower potential and to harness this resource Assam Small-hydro Power Development Policy was enacted in 2007. The policy had identified 88 sites with potential of 117 MW. However, the progress under the policy has been fairly slow and no large scale investments are seen in this segment.

In this context, AEDA should undertake impact-assessment study of this policy to identify bottlenecks in development of small hydropower in the state. Based on the study, AEDA should work with AERC, APGCL, APDCL and other stakeholders to propose amendments in the policy. The amendment should target to set up 100 MW small hydropower projects by 2030. This study is expected to be completed in 3 months and will require INR 25 lakhs.

The amendment will be supported by a new resource potential study and GIS mapping because the earlier study did not capture land required to set up power system (it only captured water storage possibility). This study is expected to be completed in 6-9 months at a cost of INR 1 crore.

Table 38: Timeline and fund requirement for impact assessment and resource potential study for small hydropower

Fund requirement (INR lakhs)	2019	2020
Cost of impact assessment study	25	
Cost of resource potential study		100

Activity 33: Undertake a study to determine the cost of large scale variable renewable energy (VRE) integration

This activity is under Category 3: Project development and technology promotion

The report of the Central Electricity Authority's (CEA) technical committee on study of optimal location of various types of balancing energy sources/energy storage devices to facilitate grid integration of renewable energy sources and associated issues, calculates the cost of VRE integration for India's goal of 175 GW RE to be Rs. 1.11/kWh. The breakup for this cost is shown in Figure 41.

AERC should conduct a study to determine the grid integration cost for RE in Assam. The study will capture the need for additional balancing resources, network strengthening, improved RE forecasting amongst other things. The study should assess the cost of VRE integration for different levels of penetration. This study is expected to be completed in 3 months at a cost of INR 40 lakhs.

Details of calculation for All India scenario for 2022

Item No.	Balancing Cost	Rs./Unit
1	Total balancing charge for Gas based station (fixed +fuel charge)(Rs/kWh)-Spread over renewable generation	0.04
2	Impact of DSM per unit- Spread over renewable generation	0.30
3	Impact on tariff (Rs/kWh) for All India discom for backing down Coal based generation assuming solar and wind at Rs. 2.50/kWh and tariff of coal based generation at Rs. 3.50/kWh- Spread over renewable generation	0
4	Stand by charge (Rs/kWh)- Spread over renewable generation	0.50
5	Extra transmission charge (Rs/kWh)- Spread over renewable generation	0.26
	Total Impact- Spread over renewable generation (Rs/kWh)	1.11

Figure 41: Cost of VRE integration at India level[36]

Activity 34: Launch 'Assam Floating Solar Mission'

This activity is under Category 1: Policy and regulatory

With Assam having a large share of land area under forests and agriculture, availability of land for solar projects is constrained. In a situation like this, Assam has no choice other than exploring new avenues for solar deployment. Water bodies in the state offer high potential for solar deployment. In this context, AEDA should consider undertaking 3 demonstration projects of 250 kW capacity on floating solar plants.

The demonstration projects will serve as a proof of concept and will assess the following:

- ✓ Techno-economic feasibility of floating solar plants
- ✓ Impact of floating solar plants on fisheries
- ✓ Impact of cooling due to water on the solar panel efficiency

APDCL will be responsible to identify sites where power generated by floating solar plant can be easily evacuated using the existing infrastructure. APDCL should then float out a tender inviting private players to set up demonstration floating solar plants. The tender preparation process is expected to take around 3 months. The least cost bidding criterion may be considered for awarding the projects to developers. The timeline for this activity is shown in Table 39.

[36] Source: Central Electricity Authority (CEA)

Table 39: Timeline and fund requirement for demonstration project on floating solar

Fund requirement (INR lakh)	2019	2020	2021	2022
Cost of tender preparation (@10 lakh per DPR)	10	20		
Cost of project implementation (@150 Lakh per project)		150	150	150

The project developer will be responsible for O&M and collect data necessary to assess the objectives of demonstrations projects (mentioned above). APDCL will appoint a nodal officer who will be responsible to present all relevant information to policy makers and assist them in making an informed decision on rolling out 'Assam Floating Solar Mission'. The mission will:

- ✓ Target to set up 300 MW floating solar plants in Assam
- ✓ Assist village panchayats to set up floating solar plants in pukhuris
- ✓ Promote use of domestically manufactured components (like installation structure)

For drafting the mission, following sub-activities will need to be undertaken:

Firstly, the Department of Panchayat & Rural Development will prepare a database of pukhuris in villages. The database will cover area of pukhuris, number of households and agriculture pumps in villages, solar insolation and coordinates of pukhuris. The ownership of database will then be transferred to AEDA. The agency will then collect similar information on cooling ponds of thermal power stations and dams which will be used to prepare the waterbodies map of Assam by locating the coordinates from database on a map. AEDA will then assess the overall states floating solar potential.

Secondly, AEDA will then identify 20 villages for setting up 100 kW floating solar plants. The villages will be selected in areas with relatively high solar insolation. AEDA should then work with APDCL to float out a tender inviting developers to build floating solar plants with a storage component. The tender preparation process is expected to take 3-6 months. The power generated may be used for community services like street lighting, lighting panchayat office, anganwadi or injected into the grid. The projects are expected to be implemented over 4 years at a cost of 12 crores (Table 40).

Table 40: Timeline and fund requirement for implementing floating solar projects

Fund requirement (INR lakh)	2020	2021	2022	2023	2024
Cost of tender preparation	15				
Number of projects implemented		2	5	5	8
Cost of project implementation (@60 lakh per project)[37]		120	300	300	480

AERC should issue benchmark cost for floating solar systems based on the demonstration projects. To promote uptake of these systems the commission may consider providing 15% premium to developers for initial uptake which may then be gradually reduced year on year.

[37] For 150-200 kW system

Activity 35: Design a program to promote solar cooking in community kitchens and institutional buildings

This activity is under Category 3: Project development and technology promotion

The cooking sector is the largest energy consuming sector in Assam. The sector is heavily dependent on conventional fuels. Solar energy is a proven resource to reduce the carbon footprint of the cooking sector. Although Assam has relatively low solar insolation, solar based cooking systems can be used in community kitchens, colleges, temples, hostels, mid-day meal kitchens, hotels and government institutions like Assam Administrative Staff College (AASC). Solar cooking is ideally suited for cooking rice and lentils – the staple food in Assam.

The Government of India is promoting solar cooking through schemes like "Off-grid & Decentralized solar applications" which was launched under 2nd phase of Jawaharlal Nehru National Solar Mission. The 'Assam Solar Cooking' program will be Assam's first leap in cooking segment. For implementation of these projects the state government will have to spend around INR 4.5 crores over six years (Table 41).

Table 41: Timeline and fund requirement for program promoting community solar cooking

Fund requirement (INR lakh)	2021	2022	2023	2024	2025	2026
Number of dish type solar cooker installed	5	10	20	30	45	75
Cost to be borne by state government (@0.50 lakh per dish type solar cooker)	2.5	5	10	15	22.5	37.5

Case study: New Prasadalaya, Shirdi, Maharashtra

The New Sai Prasadalaya in Shirdi serves meals to over 25,000 devotees every day. When the prasadalayam was established in 2009, the management with support from MNRE through a grant established a solar kitchen. The kitchen uses 40 Scheffler dishes which raise 2,600 kg of steam per day. The system is used on over 300 days every year and helps save 13 LPG cylinder every day.

Activity 36: Develop a unified single window clearance portal for processing solar rooftop PV applications

This activity is under Category 2: Institutional strengthening and awareness

The interconnection procedure for rooftop solar plants is time exhaustive and consists of many steps which involves money as well as documentation. Along with this, the cumbersome process of availing incentives for rooftop solar is a bottleneck for uptake for rooftop solar in the state.

To make the interconnection and incentive distribution process smooth and efficient, APDCL should consider developing a 'unified single window' clearance portal to process all solar rooftop applications. In this context, APDCL should first review existing interconnection process and work with stakeholders to identify the areas for improvement. It should then hire a third party to develop and maintain an online portal/mobile application that will track application status, approvals, commissioning and payment of subsidy for rooftop solar projects in the Assam. Similar procedures and portals have been prepared (or under preparation) in other states of India with the assistance of GIZ, World Bank and ADB. The activity is expected to be completed in 6 months at a cost of 75 lakhs.

Activity 37: Greening the tea sector

This activity is under Category 3: Project development and technology promotion

Assam accounts for more than 50% of India's and 16% of world's tea production. It is cultivated along the Brahmaputra and Barack plains, mainly in Tinsukia, Dibrugarh, Sibsagar, Jorhat, Golaghat, Nagaon and Sonitpur districts (Figure 42). The major energy consumption areas in tea sector are process heat and machinery.

Figure 42: Tea growing regions in Assam[38]

[38] Source: https://bhuvan.nrsc.gov.in/bhuvan_links.php#

Tea sector is highly dependent on fossil fuels to meet its energy needs. This presents an opportunity to harness energy from renewable sources. AEDA should develop a scheme to promote use of solar dryers in tea sector. The scheme may focus at Tinsukia and Dibrugarh districts at first and then be rolled out for other districts in a phased approach. The scheme would provide 50% subsidy and easy repayment options for the beneficiaries. The scheme is expected to cost around 36 crores (Table 42).

Table 42: Timeline and fund requirement to promote community solar cooking

Fund requirement (INR lakh)	2020	2021	2022	2023	2024	2025	2026
Number of solar dryers	100	200	500	1,000	2,500	5,000	10,000
Cost to be borne by state government (@0.50 lakh per solar dryer)[39]	25	50	125	250	625	1,250	2,500

Summary

The proposed activities require a budgetary support of INR 3.7 crores for preparatory phase. The proposed activities will have following impacts:

- Increase the projected installed capacity of solar generation (590 MW in 2030 in BAU) by 2.5 times and Small hydro (9 MW in 2030 in BAU) by over 10 times
- Install 21 MW Waste to Electricity and 300 MW biomass capacity

[39] For 25 kg capacity

5.6 Cooking sector

Access to clean cooking energy is an important social goal to pursue. The widespread use of traditional cookstoves (65% households in 2015) in Assam poses serious risk to health and women's empowerment. Traditional biomass cookstoves are highly inefficient (13% cooking efficiency) and cause high level of household air pollution (HAP). The pollution comprises of cocktail of toxic gases and particles known to cause acute and chronic respiratory diseases as well as other health problems. HAP is the cause of 15,000 death annually in Assam.[40]

Inefficient cookstoves need larger quantity of fuel and lead to higher fuel costs. They also take longer time to cook food and therefore take away time which otherwise could be devoted to productive activities. In India, women spend approximately spend 374 hours collecting firewood and 1,460 hours every year for cooking on traditional biomass cookstoves.[41]

Traditional biomass cookstoves also pose a global warming threat as they produce large quantities of carbon dioxide. Many households using traditional biomass cookstoves rely on firewood, which has consequences like deforestation.

Access to clean cooking energy has the potential to curb the health risk posed by traditional cookstoves. It will reduce the time spent by women in collecting fuel for cooking. Simply by switching to improved biomass cookstoves women could save around 425 hours every year in cooking and significantly more in wood collection. It will not only help women devote more time towards other productive activities but will also reduce the environmental impact of cooking sector.

The overall goal of Assam Energy Action Plan is to make cooking sector cleaner, efficient, affordable while using locally available resources. In order to effectively and efficiently achieve this goal, the cooking sector must begin to look at how it can strategically target various segments initially and then build off its own momentum in order to reach larger scale.

[40] https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196(18)30261-4/fulltext
[41] http://cleancookstoves.org/about/news/05-05-2015-women-spend-374-hours-each-year-collecting-firewood-in-india-study-finds.html

Activity 38: Design Clean Cooking Awareness Program

This activity is under Category 2: Institutional strengthening and awareness

Evidence from clean cooking programs in Haiti, Tanzania and other countries, and several Indian states confirm that awareness of the concept of "improved cookstoves" and the risks associated with traditional cooking practices are not sufficient to trigger changes.

Based on AEDA's interactions with locals, it is perceived that alternative cookstoves and fuels do not create the same taste in food. Many do not believe that alternative cookstoves are suited for prolonged use due to perceived high fuel cost (like for LPG). Feedback from IIT and AEDA suggests that safety of clean-fuel technologies is also a barrier to adoption. Often, it only takes a single "horror-story" (LPG cylinder explosion) to distort perception on safety.

It is therefore critical for awareness to focus on key messages and concepts that resonate with the target audience and trigger a desire to change. AEDA should propose a state wide public awareness program to educate population about the following:

- ✓ Health benefits of making a transition to cleaner and modern fuels or cookstoves
- ✓ Socio-economic benefits of making a transition to cleaner and modern fuels or cookstoves
- ✓ Environmental benefits of making a transition to cleaner and modern fuels or cookstoves
- ✓ Suitability of cleaner and modern fuels and cookstoves in preparing local cuisine with the same taste
- ✓ Financial assistance available through government schemes for making transition to cleaner and modern fuels and cookstoves
- ✓ Places to procure or register for access to cleaner and modern fuels and cookstoves

The awareness raising campaigns will make use of mass media, demonstrations, competitions, exhibitions, road shows, dramas and leaflets. Preparing the awareness program is expected to cost around 50 lakhs and will require up to 6 months.

Figure 43: Awareness campaign for PMUY

Under the awareness program demonstrations on improved cookstoves and LPG cookstoves at places like melas, community kitchens, temple kitchens and schools will be undertaken. The demonstrations will include:

- ✓ Testimonials from users who have adopted and are using improved cookstoves or LPG for cooking
- ✓ Food preparing session to demonstrate time saving
- ✓ Food tasting session to address the taste perception
- ✓ Safety demonstration to extinguish LPG cylinder fire by the Fire & Emergency Services of Assam
- ✓ On spot registration for improved cookstoves or LPG connection

In addition, AEDA may plan to organize 'Clean Cooking Week'. In this week following activities may be undertaken:

- ✓ A state wide drawing competition in schools and colleges to design the logo for Clean Cooking Awareness Program. The winners may be felicitated by the Chief Minister.
- ✓ A stakeholder engagement workshop with representatives from government, donor agencies, research and academic institutes, trade associations and NGOs to discuss the content, outreach channels, target audience and timelines of Clean Cooking Public Awareness Program. The discussion will also cover next steps, roles and responsibilities of stakeholders, potential market value to realize and the support government will provide.
- ✓ A Clean Cooking Exhibition at Regional Science Centre in Guwahati. Besides showcasing improved cookstoves, LPG cookstoves and their safety; the exhibition will showcase case studies from around the globe.
- ✓ Launch a mobile clean cooking exhibition. The exhibition for rural areas will be oriented towards triggering desire to adopt improved cookstoves. In urban areas it will be oriented towards triggering desire to adopting modern fuels like LPG.
- ✓ Organize street plays at melas, community kitchens, temple kitchens and other social places.
- ✓ Launch a Clean Cooking Public Donation Program. The donations will be used explicitly for procuring cleaner and modern cookstoves for sections of population which cannot afford them and the awareness program.
- ✓ Launch an online portal to disseminate collection amount, how to donate, top one hundred donors and where the donations will be used. The portal will also have photographs and videos from the public awareness campaigns along with the plan including timeline of when a given city and village will be covered by mobile exhibition. The portal will also include the contents of awareness program, testimonials from users of improved cookstoves and modern cookstoves and the locations from where public can procure improved or modern cookstoves.
- ✓ Distribute 10,000 improved cookstoves to villagers in districts with relatively higher poverty like Darrang, Morigaon, Golaghat and Udalgari.
- ✓ Appoint a celebrity as an ambassador for clean cooking.

Activity 39: Design a program to promote manufacturing of improved cookstoves and develop supply chain

This activity is under Category 3: Project development and technology promotion

Once the public awareness program has triggered the desire to adopt improved cookstoves, the market supply should respond to increase in demand. With an estimated requirement of over 1.2 million improved cookstoves, it is imperative to intervene in the manufacturing segment.

Bureau of Indian Standards (BIS) had developed standard and test protocols for portable natural draft and forced draft improved cookstoves in 1991. In view of newer designs of cookstoves that came to market in recent years, the standards and test protocols were revised in 2013. The cookstoves satisfying the performance parameters shown in Table 43, were approved by MNRE. From the 41 designs submitted for seeking approval none has been from Assam.[42] With Assam Energy Vision – 2030 emphasizing on local resources it is essential to set up domestic base for manufacturing high performance improved cookstoves in Assam.

Domestic manufacturing will promote utilization of local resources and generate employment avenues, which in line with the Assam Energy Vision – 2030.

Table 43: MNRE parameters for clean cookstoves

Sl. No.	Type of Biomass cookstove	Standard Performance Parameters		
		Thermal Efficiency (%)	CO (g/MJd)	PM (mg/MJd)
1	Natural draft type	≤25	≤ 5	≤ 350
2	Forced draft type	≤35	≤ 5	≤ 350

Considering the uncertainty over social acceptability, affordability and limited demand for few years, small scale manufacturing units for improved cookstoves could be set up through investment capital support. The support will be provided for the technical and operational capabilities to profitably manufacture improved cookstoves. The program will support businesses looking to expand their operations in the improved cookstoves market or enter the segment and for businesses that have identified Assam as a potential expansion market. The program will focus on supporting businesses that show a credible strategy for long-term expansion and financial sustainability. Funds from the program will be provided for:

- ✓ Technical assistance to assist businesses to strengthen their business models, marketing approach and improve own capabilities
- ✓ Agent recruitment and training, marketing to improve consumer awareness and brand recognition
- ✓ Partnership development to create new distribution channels and consumer finance options

[42] https://mnre.gov.in/approved-models-cook-stoves

- ✓ Procurement of raw materials locally

The program may be supported by exempting enterprises involved in improved cookstoves manufacturing from taxes. As suggested by AEDA, the program should focus on two pot cookstoves (Figure 44).

Figure 44: Two pot improved cookstove (Source: Pratki)

It is essential for supply chain network to keep pace with the growing manufacturing capabilities. Following schemes should be considered for developing supply chain:

- ✓ Employer Financing Scheme: Improved cookstove manufacturer and large-scale employer like factories, agricultural cooperatives and large tea gardens could collaborate to distribute improved cookstoves to employees. The employer pays for the improves cookstoves up front and deducts fixed amount from employees monthly salary. This scheme could be implemented at the Plastic Park, Mega Food Park, Jute Park, or the Tea Park developed or to be developed by Assam Industrial Development Corporation Limited.
- ✓ Instalment based recovery Scheme: Under Saubhagya un-electrified households not covered under SECC data are provided electrical connection on payment of Rs. 500. This amount is recovered by DISCOMs in 10 instalments through electricity bills.[43] A scheme on similar footsteps where manufacturers and retailers can collect the improved cookstove's value through instalments, making them affordable could be developed.

In 2015, only 700 households in Assam were using improved cookstoves to meet their cooking needs. The number of households using improved cookstoves for cooking is expected to increase to around 5.3 lakhs under business as usual trends. To achieve the targets set under Assam Energy Vision – 2030, an additional 7 lakh households would need to be transitioned. This transition would require an investment of INR 1.4 billion (Figure 45). Designing of this program is expected to cost around 30 lakhs and will require 6-9 months to complete.

[43] www.saubhagya.gov.in

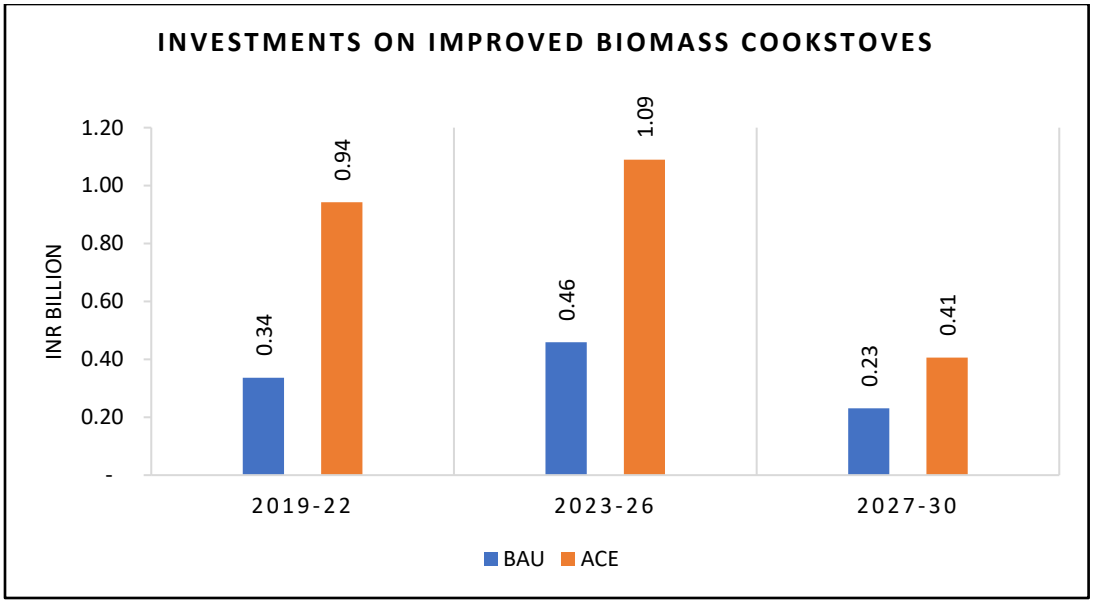


Figure 45: Investment required for Improved Biomass Cookstoves

Activity 40: Design a program to ensure higher cylinder refilling rate for PMUY beneficiaries

This activity is under Category 3: Project development and technology promotion

Under the Pradhan Mantri Ujjwala Yojana (PMUY), Assam has released over 28 lakh LPG connections by April 2019. Although no state-wise or district-wise data on PMUY beneficiaries is maintained, anecdotal evidence suggests that only a small share of the beneficiaries turn up for a second refill. The main reasons for low LPG cylinder refilling rates are:

- ✓ Long travel distances to refilling stations in rural areas
- ✓ Inability of households to afford refilling even after subsidy

To transition away from this situation, the state government should take steps to address these issues. It is recommended that AEDA should work with Oil Marketing Companies (OEMs) to undertake the following demonstration projects:

- ✓ Incentivize LPG dealers to set up small warehouses in cluster of villages to improve last mile connectivity.
- ✓ Incentivize LPG dealers to deliver cylinders at homes of PMUY beneficiaries. The cost of delivery to be borne by the state government
- ✓ Support village panchayats to aggregate LPG cylinder refilling demand and run a monthly or bi-monthly transport service for refilling. The scheme will have provision for village panchayats to keep stock of reserve cylinders as households have different consumption patterns and all cylinders may not require refilling simultaneously.

AEDA to organize a roundtable with OEMs, NGOs, Department of Food and Civil Supplies and other stakeholders to brainstorm on other similar schemes. AEDA will then identify five villages for each

demonstration project. The projects will be implemented for a duration of 12 months. A nodal officer appointed by AEDA will be responsible to collect all relevant data necessary to assess the impact of each project and determine the one which is most cost-effective and the most suitable for Assam. The nodal officer will assist policy makers to design a program for wider rollout of the strategy identified by comparing results of demonstration projects. The program design will cover number of PMUY beneficiaries to be covered, the duration for which government support will be provided and the level of incentives to be provided under the program.

To make LPG cylinder more affordable, Assam may consider a state level subsidy scheme on top of the central government's subsidy for PMUY beneficiaries. AEDA will undertake a study to determine the level of subsidy that may be given. The study will assess the economic-social-environmental impact of the program. The study will then be presented to policy makers to make an informed decision for rolling out the state level subsidy.

Designing of this program is expected to cost around 20 lakhs and will require 3-6 months for completion.

Activity 41: Design a program to promote use of pressure cookers

This activity is under Category 4: Financial and fiscal

The population of Assam is expected to rise from around 3.3 crores in 2015 to 4.2 crores by 2030. This will lead to proportional rise in energy demand for cooking. Transition to modern fuels like LPG and cookstoves will certainly help reduce the projected energy demand. Another important segment that will reduce energy consumption is the use of efficient cooking utensils like pressure cookers. Anecdotal evidence suggests that rice preparation in an open vessel takes around thirty minutes which reduces to around ten minutes with a pressure cooker.

In this context, AEDA should design a program to promote use of pressure cookers in the state. The program will provide economic support for 5 lakh pressure cookers for poor families in rural areas. The beneficiaries may be selected from the below poverty line (BPL). This program will cost the state government around INR 25 crores over three years (Table 44).

Table 44: Timeline and fund requirement for program to promote pressure cookers

Fund requirement (INR lakh)	2019	2020	2021
Number of pressure cookers	75,000	1,50,000	2,75,000
Government support (@ INR 500 per cooker)	375	750	1375

Activity 42: Design a program to promote electric cooking

This activity is under Category 3: Project development and technology promotion

"Electricity and Clean Cooking Strategy for India" blog by the NITI Aayog highlights the absence of target year to achieve universal clean cooking. It is not long before electricity is added to the basket of fuels for cooking. Theoretically, if electric cookstoves are adopted, universal electrification could translate into universal clean cooking as well.[44]

In absence of a national strategy to promote electric cooking, it is prudent for Assam to take the lead and set an example for other states to follow. To promote electric cooking in the state, APDCL should undertake a pilot project to assess the network strengthening needs and the investment requirement and changes in electricity demand profile (load curve) for a large scale transition to electric cooking. The pilot project should be undertaken in urban sub-divisions like Guwahati.

The state government should consider preparing a notification directing all governmental departments and buildings like Secretariat and Assam Administrative Staff College to adopt electric cooking. Preparation of this notification is expected to take up to 3 months. This activity synergizes with the recommendation on strategic load growth of power sector.

Summary

The proposed activities require a budgetary support of INR 70 lakhs for preparatory phase. The proposed activities will have following impacts:

- Reduce the projected energy demand (23 TWh in 2030 in BAU) by 33%
- Increase number of households using electric (1.2 million in 2030 in BAU) by an additional 0.23 million by 2030 and improved cookstoves (0.5 million in 2030 in BAU) by additional 0.7 million by 2030

[44] http://niti.gov.in/writereaddata/files/document_publication/NITIBlog28_VC-AnilJain.pdf

5.7 Transport sector

Activity 43: Launch 'Assam e-mobility Program'

This activity is under Category 1: Policy and regulatory

The Transport Department is in process of drafting the electric vehicles policy for the state. To support this policy the Transport Department should prepare the 'Assam e-mobility Program'. The program will be a long-term comprehensive strategy for promotion of e-vehicles and development of charging infrastructure in the state. The program will include:

- ✓ Identify routes in major cities for introducing electric buses
- ✓ Identify of land for setting up charging stations based on solar/ grid.
- ✓ Undertake pilot project on electric buses
- ✓ Assist State Government Departments to consider e- vehicles in their future system planning
- ✓ Undertake skill development and enhancement program to develop trained workforce for repair and maintenance of electric vehicles

In the initial phase of the program, Assam should seek to maximize benefits it can draw from the central government schemes like the FAME II. With Assam having around 1% share in India's vehicles population, it is unlikely that Assam will receive a large share of the benefits. If benefits of the scheme are distributed in proportion of vehicles population, Assam will receive around 110 crores over three years. Therefore, Assam may consider submitting a proposal, to the central government, to designate Assam as a special state (for driving EV penetration in the NE) to draw higher benefits.

Scheme for Faster Adoption and Manufacturing of Electric Vehicles in India Phase II (FAME India Phase II) has pledged 10,000 crores to promote e-vehicles and develop the charging infrastructure in India. Under this scheme, Assam must offer bouquet of fiscal and non-fiscal incentives like waiver or concession on road tax, exemption from permit, waiver or concession on toll tax, concessional registration charges and others for entities dependent on state government support to be eligible for central assistance.

In the initial phase, Assam State Transport Corporation (ASTC) should undertake a study to Identify routes to introduce e-buses and set up charging stations in all major cities. The study will also assess the impact of electric vehicles growth on distribution network and suggest reinforcement measures if required. Based on findings of study, the corporation will then select five cities based on criterion like route length, ease of implementation, average occupancy rates, existing electricity infrastructure and upgrades required to introduce electric buses. ASTC will then roll out tenders for procurement. Preparation the tenders is expected to be completed in 3 months at a cost of 30 lakhs. The tender should be rolled out for at least ten e-buses and a charging station. In Guwahati, electric buses could be introduced on the Jhalukbari – Khanapara route with charging station being set up at ISBT, Khanapara. Procurement of electric buses for each city is expected to cost around INR 10 crores. The timeline for this activity is shown in Table 45.

Table 45: Timeline and fund requirement for introducing e-buses in five cities

Fund requirement (INR lakh)	2021	2022	2023	2024
Cost of study	25			
Cost of tender preparation		30		
Cost of e-buses procurement (@ 10 crores per city)		10	20	20

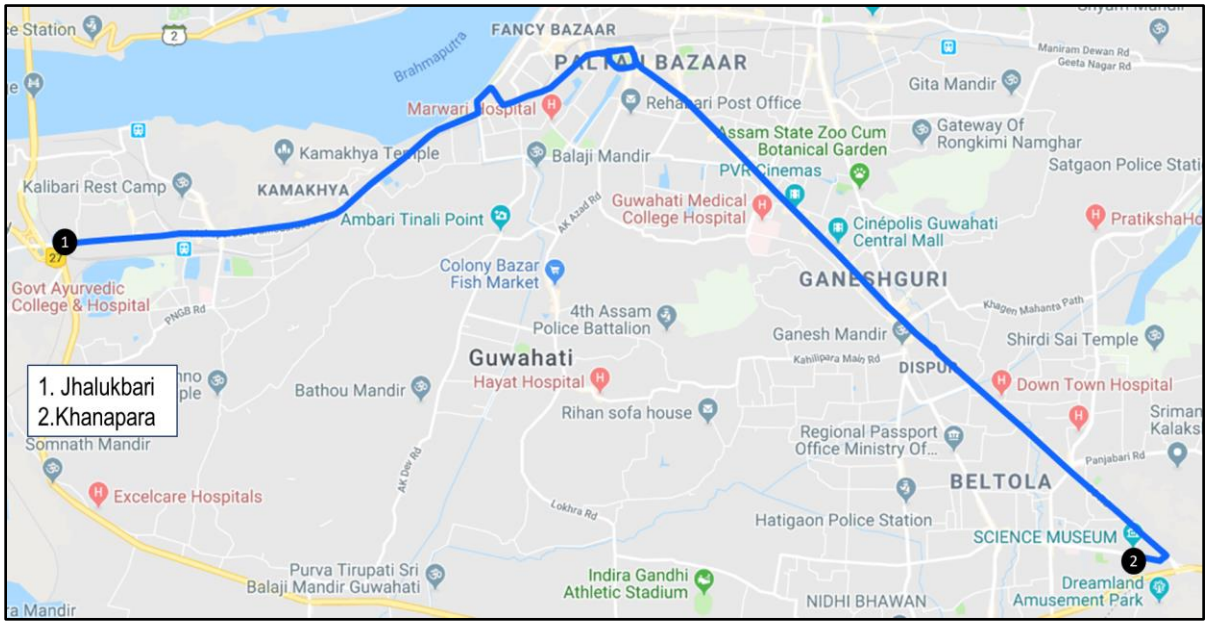


Figure 46: Jhalukbari - Khanapara route in Guwahati

A proposal to formulate a state level inter-departmental steering committee to coordinate amongst various departments like Transport Department, Public Works Department, Power Department, Department of Finance, Planning Department, Urban Development Department, SITA and others should be prepared. This proposal preparation process is expected to take up to 3 months.

APDCL could be appointed as the nodal agency to coordinate development of electric vehicles charging infrastructure and set the ceiling for the service stations. The steering committee and the nodal agency will evaluate providing incentives to set up charging stations in the initial phase of e-mobility program. This will pave the way to scale up efforts.

AERC in line with the Ministry of Power guidelines should create and notify electric vehicles charging as a separate tariff category. In addition, ULBs should amend building bye-laws in line with the Ministry of Urban Development's guidelines to include charging infrastructure in all types of buildings. Assam may also consider amending its open access regulation to facilitate charging stations in sourcing power from renewable plants. Delhi has allowed open access to charging station providers, if the aggregated demand is greater than 1 MW.

To ensure sustenance of e-vehicles related progress in the state it is necessary to develop a skilled domestic workforce. In this regard, Power Department and Transport Department should work with institutions like IIT-Guwahati, Assam University, Tezpur University, ITIs, polytechnics and other technical training institutes to design and run certification courses on e-vehicles. The courses will cover O&M, repair and other aspects.

Assam should then consider launching a state level subsidy with special focus on two-wheelers and three-wheelers segment. The subsidy program is going to cost the state government around INR 140 crores over seven years (Table 46).

Table 46: Timeline and fund requirement for EV subsidy program

Fund requirement (INR lakh)	2024	2025	2026	2027	2028	2029	2030
Subsidy for two-wheelers	500	750	1,000	1,250	1,500	2,000	2,750
Subsidy for three-wheelers	100	150	250	500	750	1,000	1,500

Assam should also consider attracting the manufacturers of electric vehicles and its components in the state by providing manufacturing incentives which also provides employment opportunities for the local youth.

Activity 44: Undertake demonstration projects on solar boats

This activity is under Category 3: Project development and technology promotion

Renewable energy resources especially solar energy has high potential to reduce the carbon footprint of the sector. Integrating solar energy in the water transport segment is much simpler than road, air or rail transport. To tap this freely available resource Inland Water Transport (IWT) Department should consider undertaking five demonstration projects on solar powered boats. The demonstration projects will determine the economic feasibility of solar powered boats. The projects may be undertaken for Guwahati – North Guwahati route (Figure 47) and the Chandubi lake. The demonstration projects are expected to cost the state government around 10 crores (Table 47).

Table 47: Timeline and fund requirement for demonstration projects on solar boats

Fund requirement (INR lakh)	2020	2021	2022
Cost of projects (@100 lakh per project)	200	400	400

Figure 47: Guwahati-North Guwahati waterway

Case study: Aditya Solar Ferry, Kerala

The Kerala State Water Transport Department started operating the solar powered vessel 'Aditya' in January 2017. The boat has capacity of 75 passengers and ferries passengers between Vaikom and Thavanakadavu.

The boat operates completely on power generated by solar panels on sunny days and its batteries are charged by grid electricity on cloudy days. The boat saves over 30,000 liters of diesel annually and has significantly lower O&M cost compared to other boats.

Figure 48: Solar powered ferry 'Aditya' [45]

[45] https://www.swtd.kerala.gov.in/pages-en-IN/solar-boat.php

Activity 45: Design a program to promote use of natural gas

This activity is under Category 3: Project development and technology promotion

There have been continuous discussions about opening Assam's first CNG station in Dibrugarh and Tinsukia since 2012. However, the discussions have failed to materialize, and the state is still waiting for its first CNG station. 51 CNG stations will be set up in the two geographical areas identified under 9th round of CGD bidding, which is expected to be completed by 2027 (Figure 49).

The Transport Department should work with Assam Gas Company Ltd. (AGCL) to undertake a study to identify the barriers that's have prevented establishment of CNG station in Dibrugarh. This study is expected to be completed in 3 months at a cost of 15 lakhs.

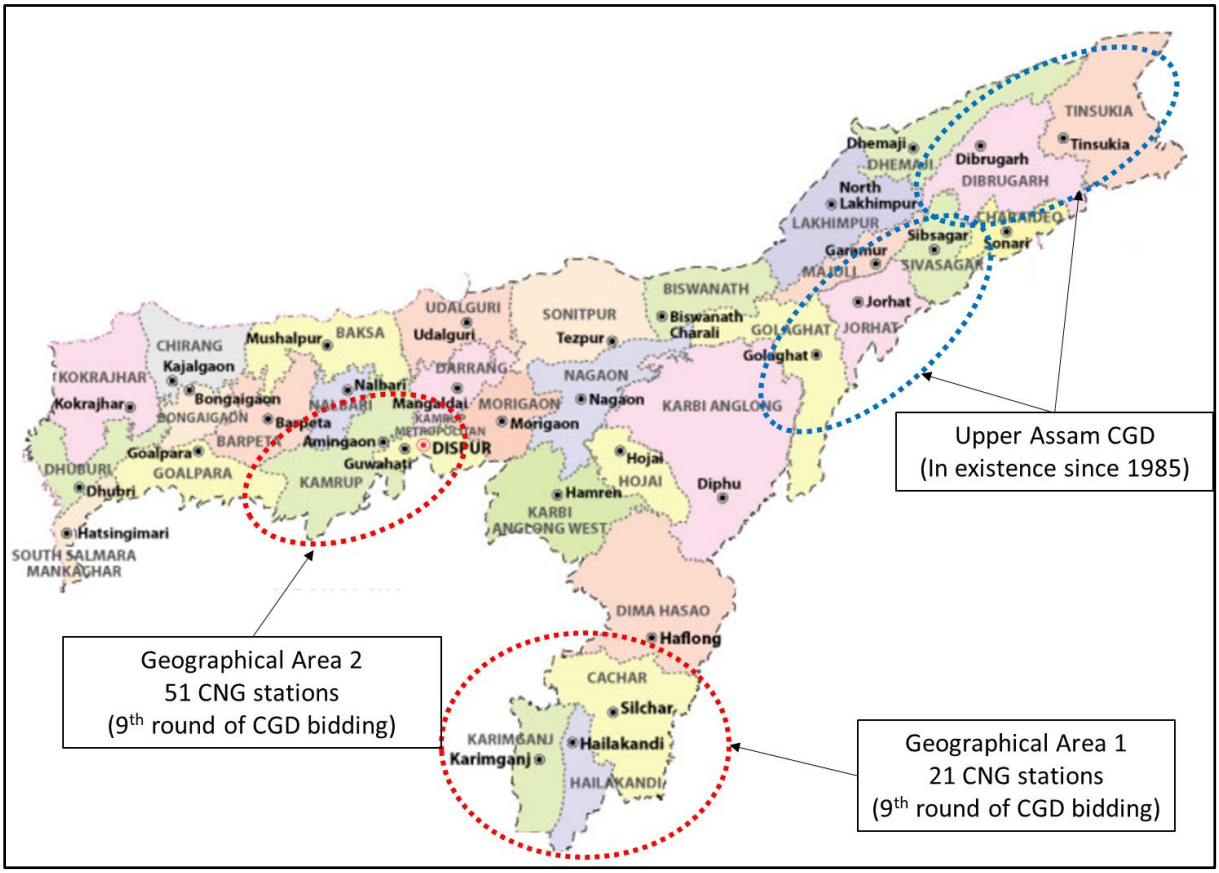


Figure 49: Existing and upcoming CGD networks in Assam

Summary

The proposed activities require a budgetary support of INR 60 lakhs for preparatory phase. The proposed activities will have following impacts:

- Reduce the projected energy demand (18 TWh in 2030 in BAU) by 18.5%
- Increase the projected share of non-diesel and non-petrol vehicles in road transport (10% in 2030 in BAU) by 38%

5.8 Residential sector

Activity 46: Prohibit manufacturing, distribution, imports and sale of incandescent bulbs

This activity is under Category 1: Policy and regulatory

The objective of this initiative is to prohibit or discourage the sale of outdated and inefficient products in the market thereby promoting new and efficient technologies. Incandescent bulbs are the least efficient type electric lighting and tend to have short operational life. To enhance energy efficiency of the residential sector a legal proposal to prohibit manufacturing, distribution, import and sale of incandescent bulbs will be prepared. To ensure the compliance of this notification, a robust monitoring and verification process should be established.

In this context the ASDA should prepare a notification banning use of incandescent bulbs. The proposal may also consider banning of electromagnetic ballast in the state. The energy loss in electronic ballasts for tube lights are about 3 W compared to 15 W in standard electromagnetic ballast. By imposing a ban on electromagnetic ballast and promoting use of electronic ballasts, energy savings in the order of 20-25 % of lighting energy demand could be realized (Table 48).

Table 48: Energy savings potential by using electromagnetic ballast

Type of Lamp	With Conventional Electromagnetic ballast (Watt)	With Electronic Ballast (Watt)	Power Savings (Watts)	Energy Savings in a year (5 hours a day for 350 days) (kWh)
34W Tube light	49	37	12	21

The draft notification may be sent to the state government for approval and a lead period of 12 months may be provided for the implementation of the notification. The ASDA should consider appointing independent inspectors or verifiers for monitoring the implementation of notification. The notification should include provision for levying penalties on defaulters. This activity is expected to cost the state government around 35 lakhs over three years (Table 49).

Table 49: Timeline and fund requirement for preparing a notification banning incandescent bulbs

Fund requirement (INR lakh)	2020	2021	2022
Cost of notification preparation	5		
Cost of publicizing the notification	15	10	5

Activity 47: Strengthen mechanism to ensure compliance with BEE star label program

This activity is under Category 2: Institutional strengthening and awareness

To ensure compliance of proper star labeled products in the market, it is necessary that random checking to be carried out as per BEE's guidelines. It may be noted that BEE has been undertaking this activity across the country for these products. However, the efficacy of this check testing is observed to be limited for which BEE is planning to involve various SDAs to support this activity. In order to ensure that the products sold are bonafide, ASDA will have to play an important role in increasing the credibility of the Standards and Labeling Program.

The ASDA should appoint two independent label verifiers to take up this activity. All necessary trainings may be imparted to these verifiers as per BEE's guidelines. This activity is expected to cost the state government around INR 50 lakhs over five years (Table 50).

Table 50: Fund requirement for appointment of independent BEE star label verifiers

Fund Requirement (lakh)	2019	2020	2023	2024	2025
Cost to appoint independent label verifiers	10	10	10	10	10

Activity 48: DSM program to promote BEE star labeled appliances in new sales and replacements

This activity is under Category 3: Project development and technology promotion

APDCL may launch DSM schemes to increase the penetration of 4/5 star rated appliances in the total product mix. The schemes will be aimed at achieving the following:

- ✓ Market transformation - increasing market share and penetration of 4/5-star labeled appliances and reduction of market barriers
- ✓ Changing consumer purchasing behavior - encouraging customers to choose 4/ 5-star labeled appliances over inefficient appliances, by overcoming the cost barrier
- ✓ Increasing energy efficiency awareness in consumers

The schemes should focus on ceiling fans which are a major contributor in the residential electricity demand. The scheme will be implemented by APDCL. Depending on the fund availability, a fixed quantum of rebate/ discount vouchers will be generated to decide vintage and capacity of old ceiling fans to be replaced and recycled under the scheme. The scheme may engage a contractor for carrying out the replacement and recycling process. All rebate vouchers will be given to the hired contractor (recycler). The contractor can be a private firm engaged in recycling and disposal of consumer appliances.

APDCL will create awareness about this scheme and communicate benefits of saving energy and importance of energy efficiency to its consumers. Consumers residing in APDCL's service territory after learning about the scheme will call a helpline number advertised by the APDCL. The consumers will register themselves for the program and schedule a pickup of their old ceiling fans. The contractor will cater to the registered consumers on a first-come-first serve basis, visit households, verify the working condition of the

units, collect the old units and give a rebate voucher to consumers entitling them to a flat discount on the Market Operating Price (MOP) of ceiling fans. The quantity of rebate offered on the new 5-star or super-efficient fan should be fixed for a pre decided capacity of the appliance.

APDCL should partner with retailers in their service territory that will provide energy efficient fans to consumers at rebate prescribed in the rebate voucher. Consumer can avail discount on purchase of fans by visiting any participating retail outlet. Retailer collects the rebate voucher and offers ceiling fans at the discounted price. Retailers will record details of the appliance sold and the beneficiary consumer in a web based database.

M&V team, an intermediary agency appointed by the APDCL, will collect rebate vouchers from retailers, determine payments due to retailers and carry out survey of sample beneficiary households to verify replacement of old unit with new energy efficient fans. Old fans collected under the program will be recycled by the contractor in an environment friendly manner. The M&V team will also conduct regular inspections if the recycling facilities to ensure that the contractor is abides by the rules and regulations in relation to recycling of appliances. APDCL after receiving reports from the M&V team will compensate the retailers directly.

APDCL will issue an RfP for hiring contractors for implementing the replacement and recycling processes, an intermediary agency collects rebate vouchers from retailers, verifies distribution of rebates to beneficiaries. The web based system will be used by participating retailers to enter voucher number and other beneficiary details, so that monitoring, verification and evaluation of the program can be carried out in a smooth manner. The program structure for this activity is shown in Figure 50.

Consumers can apply only for rebate on one appliance per household (for refrigerators) and the appliance must be purchased within the rebate period. The program cost for refrigerators/ceiling fans/TFLs for replacement pilot project is illustrated in Table 51.

Table 51: Program cost for replacement of inefficient appliances

Type of cost (INR)	Ceiling Fans	Details
Rebate Provided per Appliance	300	Rebate given to consumers in the form of rebate vouchers
Units to be Replaced of an appliance in 3 years	10,00,000	Number of Units to be provided rebate under the Replacement Program
Cost of Rebate	30 crores	Will be used to offer a discount of INR 300 at purchase of new super-efficient fan
Costs of Program implementation	50 lakh/ year (for 3 years)	This is spent on overall implementation of the Program and communicating the Program, monitoring and impact assessment

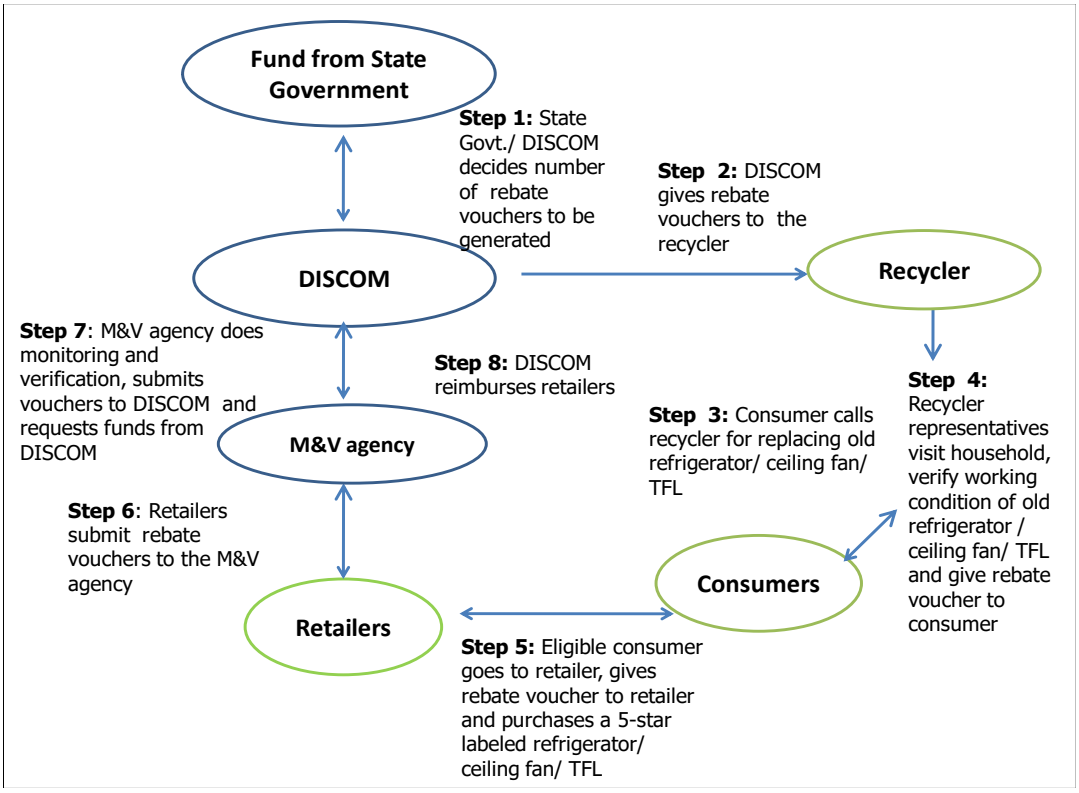


Figure 50: Program structure for low efficiency fans replacement (Source: ICF)

This project may be undertaken in areas which contribute to the peak demand. APDCL will identify substations and distribution transformers contributing to peak demand. An Independent Monitoring & Verification Agency will be appointed to ensure transparent handling of the funds and reporting of the funds disbursed in relation to the replacement of appliances. APDCL will put in place a web based system for transparent information sharing and reporting. An impact assessment study at the end of the pilot will be undertaken to analyze the actual savings achieved through this scheme. This activity is expected to cost the state government around INR 33 crores over five years (Table 52).

Table 52: Timeline and fund requirement for program to replace inefficient ceiling fans

Fund Requirement (lakh)	2019	2020	2021	2022	2023
Cost of rebate on replacement of ceiling fan		1,000	1,000	1,000	
Administration cost		50	50	50	
M&V Agency cost			30	30	30
Cost of designing web based system	5				
Cost of impact assessment study					20

Activity 49: Project for promotion of energy efficient storage water heater and gas based water heaters

This activity is under Category 3: Project development and technology promotion

The demand for water heaters in Assam is expected to grow significantly from 5 lakh water heater in 2015 to around 1.2 crores by 2030. It has been observed that instant water heaters are becoming popular in the state most of which have rated input power of 3kW to 4.5 kW. Most of these water heaters are from unorganized players and they don't even have ISI safety mark on it. Use of instant water heaters contribute to the peak demand and cause voltage fluctuation or flickering of lights as typical connected load for a household is about 2 kW. Sometimes the electric demand of a tank-less water heater can exceed the electric demand of the rest of your home by 2 or 3 times. This not only contributes to sudden peak during winters, but also results in tripping of MCBs. Assam to reduce its peak demand should focus on water heaters that contribute to peak load, through the following ways:

- ✓ State government to issue a guideline for APDCL to discourage the use of Instant water heater especially 3 kW and above in households. Due to the detrimental impact on the power supply system due to instant water heaters of bigger size, Assam state may come out with a guideline for APDCL to restrict:
  - Use of non-ISI certified, local made instant water heaters
  - Discourage the use of higher size instant water heaters (2 kW and above) to be sold in the state.
- ✓ State government to launch a scheme for promotion of water heaters run on Piped Natural Gas (in cities where CGD is available and planned in future) by providing subsidies/incentives. This scheme proposes to extend the solar water heater subsidy scheme to geysers/ water heaters that run on Piped Natural Gas. It also proposes the conversion of the electric water heaters to PNG based geysers/ water heaters in cities where CGD network exists or is planned. Tinsukia, Dibrugarh, Sibasagar, Jorhat and Golaghat have CGD network and this scheme can be initially piloted in these circles where real estate development is happening at a very fast pace. Depending on the success, the scheme can be conceptualized to be extended to other circles where CGD is planned in future (Kamrup (Metropolitan), Kamrup (Rural), Karimganj, Hailakandi and Cachar). Such an initiative will help in reduction of electricity bills for domestic consumers and will reduce the load on APDCL during winters. Also, this scheme will provide consumers with water heating facilities at a much lower cost.

In this context, AEDA will prepare a guidebook/ document (with support of an independent consultant) for APDCL to disseminate disadvantages of high capacity instant water heaters along with ways to discourage its usage among domestic consumers. This guidebook will then be disseminated through suitable channels such as AEDA and APDCLs websites, energy awards functions, school competitions, street plays, NGOs etc.

AEDA will conduct a feasibility study on the availability of piped natural gas in cities and conduct a cost benefit analysis of gas heaters viz-a-viz electric heaters and accordingly plan for an incentive scheme and a pilot project. Based on the findings of the feasibility study, AEDA will implement an incentive based

scheme for PNG based water heaters in identified districts. This activity is expected to cost the state government around INR 17.5 crores over five years (Table 53).

Table 53: Timeline and fund requirement for program to promote energy efficient and gas water heaters

Fund requirement (INR lakhs)	2020	2021	2022	2023	2024
Cost of guidebook preparation	0.5				
Cost of distribution of guidebook	1	1	1	1	1
Cost of feasibility study for designing the incentive scheme for PNG water heaters	20				
Cost of pilot project in one of the circles from (Tinsukia, Dibrugarh, Sibasagar, Jorhat or Golaghat) (50 lakh per project)		50	50	50	

Summary

The proposed activities require a budgetary support of INR 25 lakhs for preparatory phase. The proposed activities will have following impacts:

- Reduce the projected energy demand (9 TWh in 2030 in BAU) by 28%

6. Way forward

The estimated expenditure required for operationalizing the action plan is illustrated in Table 54. This expenditure covers the cost of undertaking policy studies and program design, preparation of proposals, DPRs and tenders, undertaking demonstration projects, and other related activities. The expenditure shown here does not include the cost of subsidies and the investment required for scaling up of implementation activities. Also, the estimates are based on certain assumptions and examples from other states. This would require refinement at the time of implementation through a detailed study.

Table 54: Expenditure requirement for operationalizing Assam Energy Action Plan

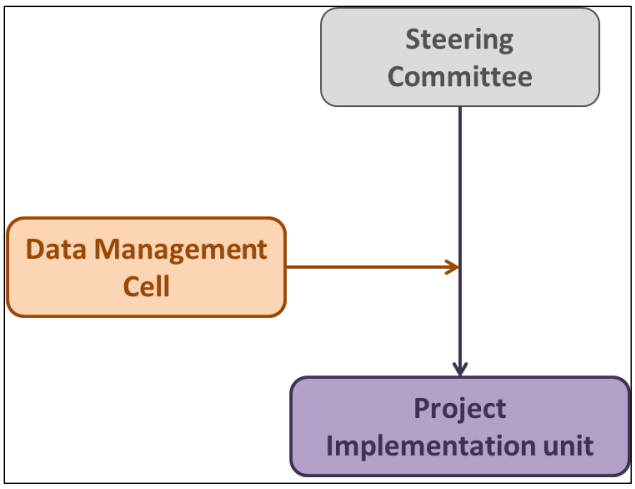
Category	Short-term (2019-2020)	Medium-term (2021-23)	Long-term (2024-30)
Category 1	7.6	31.8	35
Category 2	7	17.8	2
Category 3	21.2	65.3	40.1
Category 4	5		
General	1.7	0.9	2.1

The Assam Energy Action Plan is heavily linked to several state and national initiatives, like the Sustainable Development Goals adopted by Government of Assam, Assam Solar Policy (2017), KUSUM scheme, SAUBHAGYA, IPDS, Power for All and Assam Action Plan on Climate Change, which are under the aegis of different governmental departments at regional, state and national level. Therefore, it is essential to have a high level coordination structure and follow-up mechanism in terms of reporting and monitoring arrangement to drive action plan implementation.

A high level steering committee with representatives from veto players identified in the Assam Energy Vision - 2030 document (Forest and Environment Department, Transport Department, Power Department, Department of Industries and Commerce, Agriculture Department, Urban Development Department and the Transformation and Development Department) will be formed. The committee will also have representation from research and academic institutes, technical training institutes and finance organizations. The committee will play a high level advisory role and will guide implementation of action plan. The committee will monitor the progress of action plan implementation and suggest corrective actions as and when the activities fall behind schedule or fail to achieve desired outcomes. A list of monitoring indicators will be prepared for each activity, which may further be linked to the SDGs.

The steering committee will be supported by a working level Project Implementation Unit. Each stakeholder department will be represented by a nodal officer in this unit. The nodal officer will be responsible for coordinating activities relating to their departments. The unit will be responsible for seeking timely approvals and input from concerned authorities including the Steering Committee and managing day to day activities related to action plan implementation. The Project Implementation Unit will be supported by technical advisors, consultants and subject matter experts on technical details and project management.

A Data Management Cell will collect energy related data and update and calibrate the Assam Energy Model. The cell will undertake energy modeling activities and disseminate findings necessary to change course of action plan as and when needed. The cell will provide analytical base for decision making during project implementation.



The Assam Energy Action Plan recommends strengthening and expansion of the already existing initiatives in the state and launch of new initiatives. In the short term, the action plan focuses more on policies and institutional strengthening. The recommendations on financial schemes with potentially high social impact are suggested for immediate uptake. Key action items with high impact potential in terms of local economic growth, jobs creation and rural livelihood improvement can be launched as flagship schemes.

Annexure

For projecting base-year energy demand four scenarios are considered for modeling. Each scenario represents a different self-consistent storyline of how the energy sector in Assam might evolve over time. Four scenarios are considered, each representing a different set of socio-economic setting under different set of policies. The four scenarios considered are:

Business-as-usual Scenario

The Business-as-usual (BAU) scenario is premised on historical trends under the existing policy framework. The efforts made on energy demand and supply segments will continue at historical and present pace.

Business-as-usual high growth Scenario

The Business-as-usual High Growth scenario (BAU-HG) is premised on the BAU scenario. It is an aggressive BAU scenario with higher GSDP growth rate and higher urbanization (as compared to BAU scenario).

Assam SDG Scenario

The Centre for Sustainable Development Goals (SDG Cell) under the guidance of Transformation and Development (T&D) Department, Government of Assam has prepared Assam-specific SDG document "*Assam Agenda: 2030*".[46] This document highlights strategies and actions for realizing SDGs by 2030. This scenario (also called as SDG scenario) builds upon the macro-economic targets, energy-climate indicators and several other key performance indicators (KPIs) set forth in this document.

Assam Clean Energy Scenario

This scenario is built upon the Assam Energy Vision – 2030. This scenario is oriented towards higher penetration of Renewable Energy, improvements in Energy Efficiency and promotion of Clean Energy in the overall energy mix. "Assam Clean Energy (ACE)" Scenario considers macro-economic assumptions as per the SDG document 'Assam Agenda: 2030' and energy and climate indicators as per Assam Energy Vision – 2030. In addition, KPIs on energy efficiency, renewable share, waste to energy and fuel shift have also been considered.

Assam Energy Security Scenario

The "Assam Energy Security (AES)" scenario is built around promotion of local energy resources. The scenario therefore synergizes the economic growth in Assam by reducing its energy dependence on other states. Macro-economic assumptions and KPIs of energy sector considered in this scenario are outlined in the SDG document "Assam Agenda: 2030". The energy and climate indicators considered in the scenario are based on Assam Energy Vision – 2030. A few targets of this scenario will be influenced by the modeling outputs of the SDG and ACE scenario.

[46] The document is not available in public domain yet