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Discussion Paper

# Assam

# Enabling State Level Climate Mitigation Actions in the Power Sector


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## Preface

I am delighted to present the Discussion Paper on "Enabling State-level Climate Mitigation actions in the power sector of Assam", carried out under the MacArthur Foundation-supported project titled "Enabling State Level Actions for India's NDC". For India to achieve its holistic NDC commitment target to UNFCCC, specific actions must be identified and implemented at the state level.

Each state has its own unique dynamics in the power sector, especially in the generation and distribution value chain. The state has a varied natural biodiversity of flora and fauna and has been endowed with rich mineral resources such as coal, petroleum, limestone, and natural gas. Despite having very good mineral resources, agriculture contributes the most to Assam's domestic sectors, accounting for over a third of the state's income while giving employment to roughly 70% of the population. Due to the small size of the local market and low income-level, hindrance geographical locations of the state, the chance of large-scale industries growth is intricate in the region.

Assam represents a model state having hilly terrain, ample rainfall and a growing economy. The GDP growth rate of Assam is very good not only among the north-eastern states but among the whole country, with a GDP growth rate of 8.35% in 2017-18. As of September 2020, Assam has a total installed power capacity of 1,761 MW. In addition, there is captive power generation capacity of around 499 MW (as on March 2019) in industries having demand of 1 MW and above. The state has a non-fossil cumulative capacity of 568 MW, contributing 32% of the total power generation capacity as compared to the NDC goal of 40%. Regarding renewables, state has solar, wind and biomass resources. Although the state has a significant solar potential, there is still a substantial quantum is yet to be harnessed with existing solar capacity.

This paper identifies and analyses low carbon growth strategic policy options in the power sector contributing to achieve India's NDC targets by deploying RE and increasing efficiency and suggests market friendly state policies contributing towards achieving NDC target.

Further, this discussion paper highlights IRADe's primary objective of promoting a wider consensus through research and analysis on effective policies among stakeholders and policy-makers. It integrates well with our previous studies across South Asia on identifying policy and market-based interventions for low carbon development. The output of this study is based on extensive primary and secondary research carried out through various stakeholder engagements and endeavours to provide a focal point to the efforts of policymakers in the state and Centre alike.

We are grateful to the MacArthur Foundation for supporting this study and I convey my gratitude to power sector officials in Gujarat in helping with requisite details in successfully carrying out this study. I also convey my best wishes to the readers.

**Professor Jyoti Parikh**
Executive Director, IRADe

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We thank state power sector officials from Department of Energy, Assam Electricity Regulation Corporation (AERC); Assam Energy Development Agency (AEDA),IIT Guwahati, State Climate Change Cell for their contribution to this Discussion paper. Their critical comments and presenting an expert's perspective on the power sector situation in Assam. We also extend our thanks to private sector RE developers for their comments in identifying ground-level realities which helped enrich this study.

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# Executive Summary

As part of Nationally Determined Contributions (NDCs), India has committed to reduce its emissions intensity of gross domestic product (GDP) by 33 percent to 35 percent over the 2005 level (NDC Goal 3) and achieve 40% of non-fossil fuel based electricity generation installed capacity by 2030 (NDC Goal 4). While the commitment has been at the national level, India, being a federation of 30 states, the state-level actions are required to achieve the national goals. Eventually state-level bottom-up actions would add-up to achieve national goals.

The power sector is the largest source of emissions in India. The electricity generation accounted for almost half of the total energy sector emissions in India and reducing the carbon footprint of the sector is essential. Electricity being part of the concurrent list in the Seventh Schedule to the Constitution of India (Article 246), policy and decision making responsibilities in some segments of the power sector, lie both with the state and the union governments. Each state faces unique challenges in its transformation of the power sector. State-level actions are required to transform the sector contributing to the Nationally Determined Contributions (NDC) Goals.

Assam, lying in the North-Eastern part of India, represents a model state having hilly terrain, ample rainfall and a growing economy. The GDP growth rate of Assam is very good not only among the north-eastern states but among the whole country, with a GDP growth rate of 8.35% in 2017-18. The $CO_2$ emissions due to various activities in the state in 2015 account for a total of 28.5 Million Tonnes[1] (Just over 1% of the total country emission) out of which contribution of the electricity generation (excluding required for captive use) is approximately 19%. Assam has a per capita emission of 0.9 tons[2] which is approximately half the national average of 2 tons. Furthermore, emission per GSDP in the state stands at 17.27 gCO2(e)/INR which is lower than the national emission intensity of 23.3 gCO2(e)/INR. While maintaining them at these levels is desirable, however, that would be challenging given aspirations of higher economic growth and life quality improvement in the state, unless measures are taken. This paper identifies and analyses low carbon growth strategic policy options in the power sector contributing to achieve India's NDC targets by deploying RE and increasing efficiency and suggests market friendly state policies contributing towards achieving NDC target.

As of September 2020, Assam has a total installed power capacity of 1,761 MW. In addition, there is captive power generation capacity of around 499 MW (as on March 2019) in industries having demand of 1 MW and above. The state has a non-fossil cumulative capacity of 568 MW, contributing 32% of the total power generation capacity as compared to the NDC goal of 40%. The state has 12% of total gas reserves in India and it is gas fired power stations which dominate the installed capacity mix. Because of the vintage capacities of gas stations, poor maintenance and utilisations, emissions of these power stations are on a higher side. Regarding renewables, state has solar, wind and biomass resources. Although the state has a significant solar potential, there is still a substantial quantum is yet to be harnessed with existing solar capacity in state a meagre 42 MW (as on 30 Sep 20).

[1] Source: GHG Platform Phase 3
[2] Source: IRADe Calculations

On consumption side, Assam has close to 59 lakh consumers with domestic consumers contributing 46% of the connected load while the industries and commercial consumers contributing 22% and 18% of the connected load. The state had poor demand and supply gap in 2019-20; the peak deficit was 10.8%, and the energy deficit was 5.3%, much higher than the national average. In 2018-19 the per capita electricity consumption of Assam was only 341 kWh, much lower than the national average, but state per capita consumption is expected to triple by 2030.

Higher share of LT consumers, low population densities in certain areas, poor quality T&D infrastructure, make Aggregate Transmission and Commercial (AT&C) losses high. AT&C Loss has slightly increased in FY 2018-19 because of drive to electrify all households under SAUBHAGYA scheme. Fifteen of the nineteen distribution circles are responsible for the most losses in the state. The reliability of Assam is also on a lower side primarily due to extended LT lines due to low population density.

Major recommendations emanating for Assam towards reducing emissions in the power sector include:

- Demand Side Interventions
- Revisiting of State Renewable Purchase Obligation (RPO) and improving RPO Compliance by all obligated entities
- Favourable policies and incentives towards rooftop solar
- Retiring old plants and improving technical performance of the inefficient thermal units
- Eliminate inhibitors in Regulations/Policies
- Better maintenance of the system, promoting decentralized RE generation are some measures of restricting AT&C loss

# 1. Study Objective and Justification

As per its commitment to the United Nations Framework Convention on Climate Change (UNFCCC), India has committed to reduce its emission intensity of gross domestic product (GDP) by 33 percent to 35 percent over the 2005 level (NDC Goal 3) and achieve 40% of non-fossil fuel based electricity generation installed capacity by 2030 (NDC Goal 4). While the commitment has been at the national level, the state-level actions are required to achieve the national goals on the ground. Eventually state-level bottom-up actions would add-up to achieve top down national goals.

The power sector is the largest source of emissions in India, and reducing the carbon footprint of the sector is essential. Electricity being part of the concurrent list in the Seventh Schedule to the Constitution of India (Article 246), policy and decision making responsibilities in some areas lie both with the state and the union government. Each state faces unique challenges in its transformation of the power sector. State-level actions are required to transform the sector and contribute to the Nationally Determined Contributions (NDC) Goals.

Some states in India are larger than many countries in terms of area, population as well as economy. Hence, technical interventions and modeling at the national level may not be aptly applicable for state level issues. Therefore, it is imperative to undertake state level analysis. Often, modelling or techno-economic analytical approaches do not address institutional constraints that involve modern and historic institutions, power plants and utilities. It is thus important to introduce reforms at that level given the role state, nation and the global community can play.

With this back ground, for the Indian state of Assam, this paper attempts

- To identify and analyse state-level low carbon growth strategic policy options in the power sector contributing to achieve India's NDC targets by deploying RE and increasing efficiency.
- To suggest market friendly state policies contributing towards achieving NDC target.

The selection of Assam as a model state representing hilly/ north-eastern state is based on various considerations. These considerations include the economic indicators, Greenhouse gas (GHG) emission, sectoral emissions and state willingness to initiate and adopt change. Data availability for the study has also been one of the major factors in the selection.

Paper is structured in this manner: Section 2 presents the over-view of the State in terms of geography, demography, economy etc., followed by Section 3 provides a review of the power sector of the state in terms of capacity, generation, fuel/technology mix, etc. Section 4 presents emissions, climate actions (with highlights on the power sector) and the state's current achievement contributing towards NDC goal 3 and 4. Section 5 provides an analysis of the power sector on mitigation options that could contribute in reaching targets of NDC goal 3 and 4. Finally, Section 6 presents the recommendations.

During the implementation of the study, project team also conducted various workshops, stakeholders' consultations to receive feedbacks, opinion of the stakeholders the state power sectors transformation towards environmental sustainability. Participants list, discussions, and findings, etc. are presented in the Appendices.

# 2. Assam State Profile

Assam is located in the north-eastern part of India and is the most populous state (3.5 Crores in 2021)[3] among the north-eastern states (Figure 1). Geographically, it is 2nd largest north-eastern state with an area of 78,438 sq.km sharing border with all north-eastern states and West Bengal while also sharing international borders with Bangladesh in the south and Bhutan in the north-east. The state is primarily set up along the banks of river Brahmaputra whose basin nurtures the state from Far East till it crosses the state and national boundary on to Bangladesh. According to the State Government website, Assam has population density of 398 per sq.km, higher than the national average of 382 per sq.km[4]. This has become an important indicator as transition of the energy system let say increasing the application of solar power depends on land availability.

Assam's GSDP at 3130 billion INR (2019/20 at current prices), is larger than many countries and is comparable to Serbia[5] when considered on the basis of purchasing power parity. According to the Assam Economic Survey[6], Assam GSDP accounts for 1.58% of the national GDP. The state has a varied natural biodiversity of flora and fauna and has been endowed with rich mineral resources such as coal, petroleum, limestone, and natural gas. Despite having very good mineral resources, agriculture contributes the most to Assam's domestic sectors, accounting for over a third of the state's income while giving employment to roughly 70% of the population[7]. Due to the small size of the local market and low income-level, hindrance geographical locations of the state, the chance of large-scale industries growth is intricate in the region. The GDP growth rate of Assam is very good not only among the north-eastern states but among the whole country, with a GDP growth rate of 8.35% in 2017-18, which is higher than the country's average of 7.17%. Assam's macroeconomic parameters have improved over the last decade. There


*Figure 1: Geographic location - Assam State*

[3] Estimated Population in 2021; Source: National Commission of Population, Population projection report published Nov'19
[4] https://assam.gov.in/about-s/393#:~:text=The%20total%20area%20of%20Assam,of%20382%20per%20square%20km.
[5] Source: Source: http://statisticstimes.com/economy/comparing-indian-states-and-countries-by-gdp.php (Accessed on 10 September 2021)
[6] https://des.assam.gov.in/information-services/economic-survey-assam
[7] Source: Assam State Portal (https://assam.gov.in/about-us/393) (Accessed on 8th April 2021)

are 194,379 Small-Scale Industrial (SSI) sector units (around 62% of total northeast SSI units) in Assam, which is a significant growth in numbers when compared to 8,290 units in 1998. The state of Assam is in a rapid economic growth transition, which is in immense need of access to quality and reliable power. Assam has one of the lowest per capita electricity consumption at 341 kWh in 2018/19 as against national average of 1181 kWh[8]. The $CO_2$ emissions due to various activities in the state in 2015 account for a total of 28.5 Million Tonnes[9] (Just over 1% of the total country emission) out of which contribution due to electricity generation (excluding required for captive use) is approximately 19%. Assam has a per capita emission of 0.9 tonnes[10] which is approximately half the national average of 2 tonnes. Furthermore, emissions per GSDP in the state stands at 17.27 gCO2 (e)/INR which is lower than the national emission intensity of 23.3 gCO2 (e)/INR (details provided in further sections).

[8] https://indianexpress.com/article/explained/telling-numbers-indians-use-1181-kwh-electricity-per-capita-wide-gap-among-states-6135082/
[9] Source: GHG Platform Phase 3
[10] Source: IRADe Calculations

# 3. State's Power Sector

Electricity is a key input in the core sectors of the economy viz; Agriculture, Industry, Irrigation, Transport & Communication which plays an important role in the economic up-liftment of the state. Hence, the growth of the Power sector is directly related to the development and growth of the economy of a state. The Assam State Electricity Board (ASEB) is a state government electricity regulation board of the state of Assam in India. It manages the generation, transmission and distribution of electricity in the state with its subsidiary companies namely,

- The Assam Power Generation Corporation Limited (APGCL)
- The Assam Electricity Grid Corporation Limited (AEGCL) and
- The Assam Power Distribution Company Limited (APGCL)

## 3.1. Power generation

Assam Power Generation Corporation Limited (APGCL) is responsible for development of both the Thermal and Hydro Power Projects - to generate electricity and meet the energy demands in the state to the greatest possible extent. The installed capacity of APGCL in the state was 376.155 MW in 2019-20. Power generation in Assam is insufficient to meet the rising demand, and this deficit is being met by purchasing of power from the Central Sector Generating Station like NEEPCO, NTPC and NHPC located in the state, or North Eastern and Eastern Region. Including these sources, as of September 2020, Assam has a total installed power capacity of 1,761 MW. The state has an additional capacity of around 499 MW (as on March 2019)[11] in the form of Captive Power Plants (CPPs) in industries having demand of 1 MW and above. Figure 2 depicts the sector-wise installed capacity of Assam (utilities only).

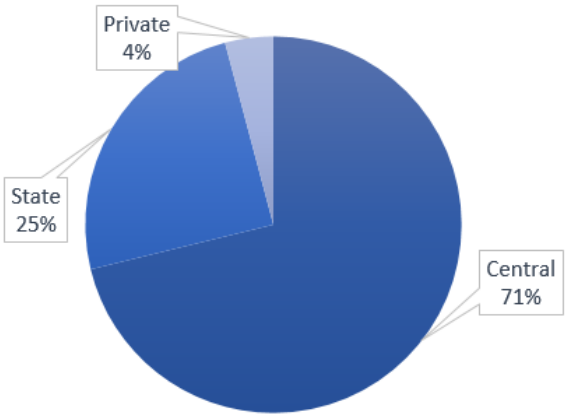


*Figure 2: Sector-wise Installed capacity in Assam (Utility Only)*

Source: CEA (as on September 2020)

The state has comparatively higher share of gas based power plants in its generation capacity mix when compared with most other Indian states. As on March 2018, Assam has a total natural gas reserves of 162 billion cubic metres which is roughly 12% of total gas reserves in India (including offshore gas fields). Out of a total of 1761 MW, gas based capacity accounts for 789 MW, coal based capacity accounts for 404 MW, and hydro based capacity accounts for 490 MW and RE capacity contributes 78 MW in the

[11] Source: CEA General Review 2020

generation capacity mix. **Figure 3** illustrates the source-wise installed capacity and generation of power (utilities only) in the state in FY 2018-19. The share of renewables in the state installed capacity is only 4 per cent which is much lower than the national average of 24 per cent. In terms of achieving the NDC Goal 4 target of 40% non-fossil fuel installed capacity at national level, the contribution of non-fossil generation capacity in the state stands at 32%. The total electricity generation by public generation utilities was 7245 MU in 2018-19 while that from captives accounted for approximately 1541 MU (CEA).

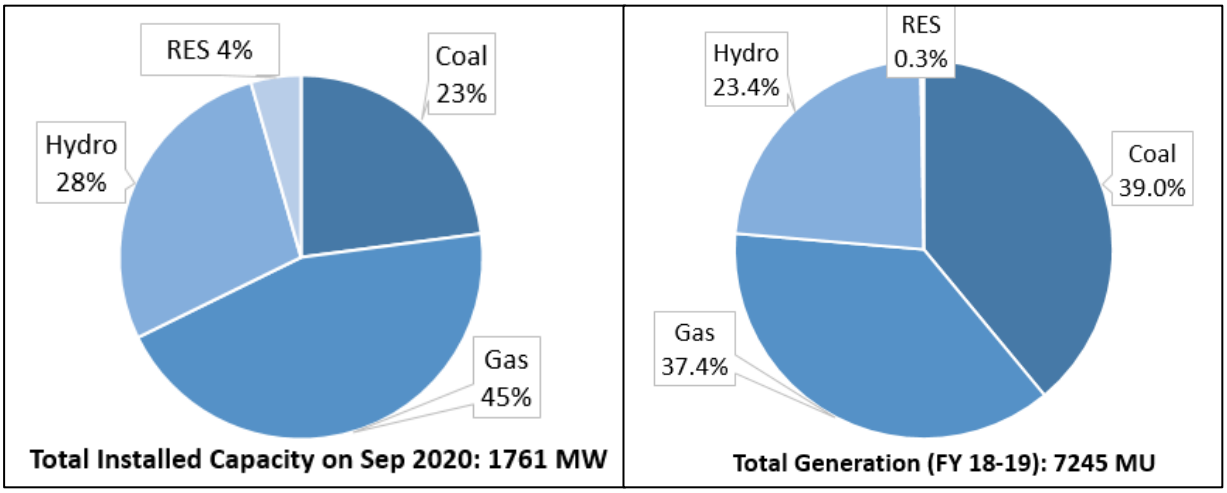


*Figure 3: Source-wise installed capacity and generation of electricity in Assam (utilities) in FY 2018-19*

*Source: CEA*

## 3.2. Transmission of Electricity

The Assam Electricity Grid Company Limited (AEGCL) is the state transmission utility in the state of Assam and is entrusted with the task to efficiently transport electrical power from electrical power bulk heads to the distribution company networks in the state. As of March 2020, AEGCL has a transmission capacity of 7124 MVA, line length of 5707 circuit kms and a total of 67 substations which include 54 nos. of 132 KV, 12 nos. of 220 KV and one 400 KV substation. AEGCL reported transmission losses of 3.40 per cent in its transmission system for the FY 2019-20, which has decreased progressively in the past few years and is significantly less than the decade ago loss level of 6.04%[12] in 2009-10.

## 3.3. Distribution of Electricity

The Assam Power Distribution Company Limited (APDCL) is the distribution company in Assam responsible for electricity distribution throughout the State. It is divided into 3 regions (Lower/Upper/Central Assam Region), 8 zones, 19 circles (shown in Figure 4), 45 divisions and 158 sub-divisions. As on March 2020, APDCL has close to 59 lakh consumers throughout the state. Furthermore, there are 422 nos. of 33/11 KV substations and a total of 88037 low tension distribution transformers (11/0.4 KV)[13].

[12] Source: AERC Annual Report FY 2019-20
[13] Source: AERC Annual Report FY 2019-20

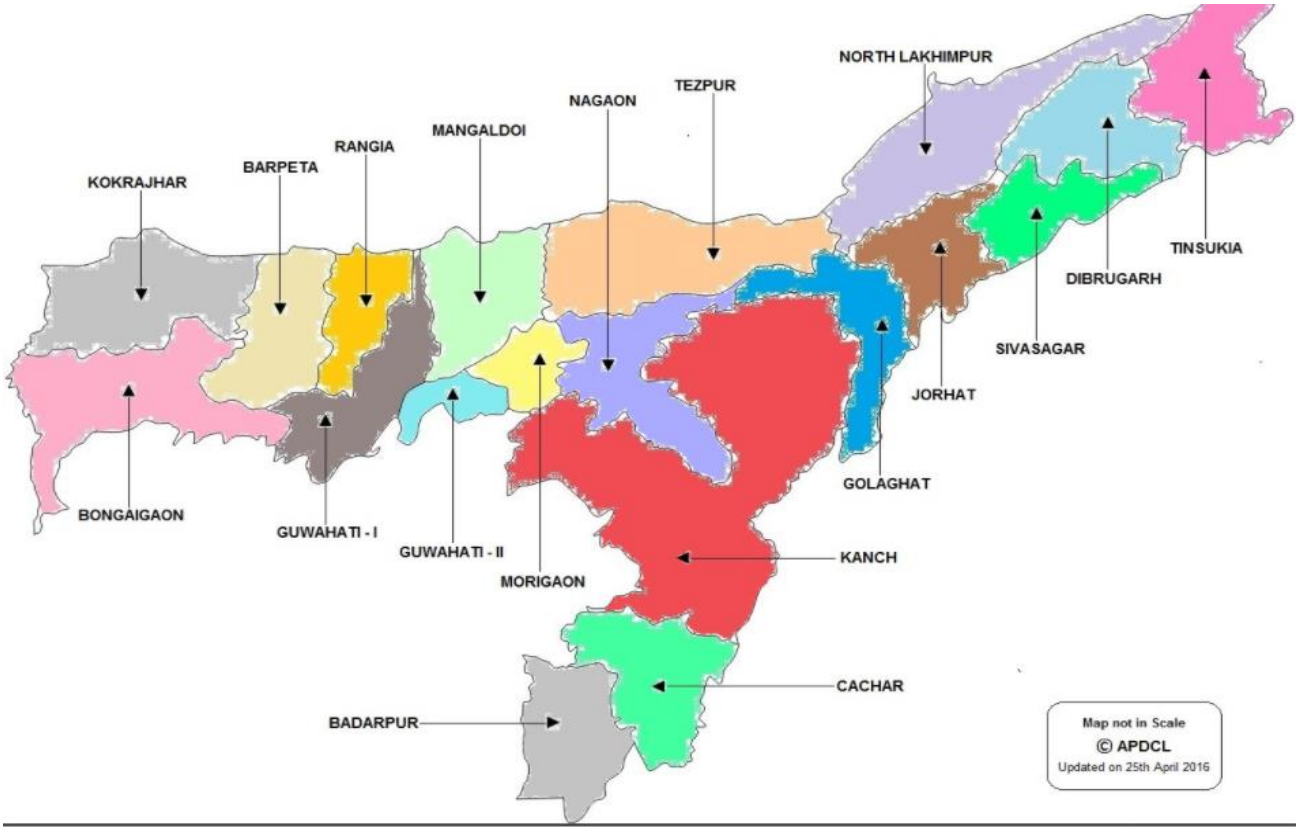


*Figure 4: Geographical map showing electrical circles in the state of Assam (Source: APDCL)*

## 3.4. Consumption of Electricity

Share of connections as well as consumption of electricity in Assam is dominated by LT consumers. In fact, LT domestic consumers alone comprised for more than 93% of total connected consumers while approximately 5% is attributed to LT commercial consumers. HT consumers in the state has a count of only 16868 (less than 0.3%) but has 22% of connected load attributed to them contributing 43% of the total revenue earned by APDCL.

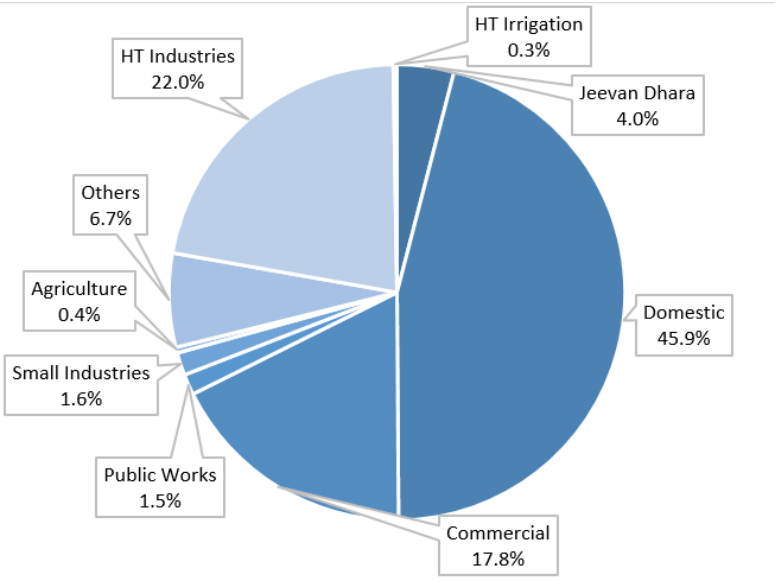


*Figure 5: Electricity Consumer sales mix - FY 2018-19*

As can be seen in Figure 5, maximum units are sold to domestic consumers, followed by sale to industrial and then commercial consumers. Assam being blessed with sufficient rainfall throughout the year with mean rainfall well in excess of 2000 mm, the electricity consumption for agricultural use is only 0.4%, as against national average of 18%.

The state had poor demand and supply gap in 2019-20 (Figure 6)– the peak deficit was 10.8%, and the energy deficit was 5.3%, whereas the all India average during that period was less than 1%. The electricity demand in Assam has been increasing over the years; as per the 19th Electric Power Survey by CEA, the electricity consumption in Assam is likely to reach 18,000 MU by 2027, which is twice the current consumption rate. In 2018-19 the per capita electricity consumption of Assam was 341 kWh which is less than a third of all India value of 1,181 kWh. Assam government data estimates that the per capita consumption is Assam is likely to reach 924 kWh by 2030, indicating the extent of expansion needed in the power supply system.

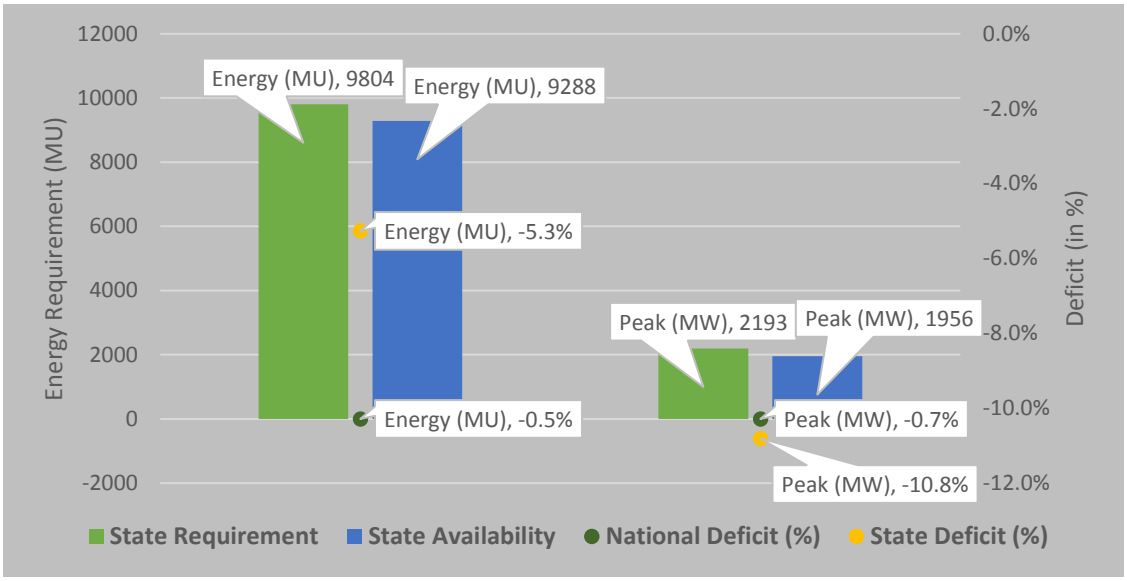


*Figure 6: Demand-Supply Gap for Assam in 2019-20 (Source: CEA, 2020)*

## 3.5. Power Sector Policies

As per the constitution of India, both the Centre and the States have jurisdiction over the electricity sector. By and large, large generation projects are with centre and the state; transmission and distribution are with state as far as management is concerned. However, through certain schemes, the centre guides the energy and development related policies through states via various enabling measures, which may be funds or capacity building for the purposes such as promotion of energy efficiency through LED bulbs or electricity for all villages and then households etc.

### 3.5.1. Central Government Policies

Various policies and schemes have been launched by the Government of India (GoI) to strengthen the power sector in the country and make it more sustainable. A comparative table of national-level policies in the Indian power sector having an impact on NDC Goal 3 and 4 has been provided in **Table 1**.

**Table 1: Major central policies for the power sector in India**

| S. No. | Policy/Schemes | Description | Nodal Agency |
|---|---|---|---|
| 1 | 175 GW Renewable Energy by 2022 | To increase the total capacity of RE to 175 GW by 2022. | Ministry of New and Renewable Energy (MNRE) |
| 2 | Unnat Jyoti by Affordable LEDs for All (UJALA) | Promote replacing of ordinary bulbs with energy-efficient LED bulbs. | Energy Efficiency Services Limited (EESL) and DISCOMs of participating state |
| 3 | Perform Achieve Trade (PAT) | Reduction in Specific Energy Consumption (SEC) of energy-intensive industries. | Bureau of Energy Efficiency (BEE) |
| 4 | Clean Coal Technology (Super-critical Power Plants) | No new sub-critical power plant addition after 2017. | Central Electricity Authority (CEA) |
| 5 | Renovation and Modernization of Thermal power plants | Increasing energy efficiency of old power plants. | CEA |
| 6 | Integrated Power Development Scheme | AT&C loss reduction and strengthening of distribution networks in urban areas. | Power Finance Corporation (PFC) Limited |
| 7 | Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY) | Rural electrification, strengthening of sub-transmission and distribution system in rural areas, and separation of agricultural and non-agricultural feeders. | Rural Electrification Corporation |
| 8 | National Smart Grid Mission | Accelerate smart grid deployment in India. | Ministry of Power |
| 9 | Ujjwal DISCOM Assurance Yojana (UDAY) | Operational and financial turnaround of state-owned DISCOMs through revival package, linked to operational and financial improvements of the DISCOM. | Ministry of Power |
| 10 | Bachat Lamp Yojana | Promote replacing incandescent bulbs with efficient CFLs. | BEE |
| 11 | Street Light National Program | Replacement of conventional street lights with LEDs. | EESL |
| 12 | Smart Meter National Program | Replacement of conventional meters with advanced metering infrastructure (smart grids). | EESL |
| 13 | Municipal Energy Efficient Program | Retrofitting inefficient municipality pump sets. | EESL |
| 14 | Renovation& Modernization, Uprating and Life Extension (RMU&LE) of hydropower plants | Increasing energy efficiency of old hydel power projects. | CEA |
| 15 | National Wind-Solar Hybrid Policy | Promotion of large grid-connected wind-solar PV hybrid systems for effective utilization of land and transmission infrastructure. | MNRE |
| 16 | National Offshore Wind Energy Policy | Explore and promote the deployment of offshore wind farms in the Exclusive Economic Zones (EEZ) of the country. | National Institute of Wind Energy (NIWE) |
| 17 | Rajiv Gandhi Grameen Vidyutikaran Yojana | Programme for creation of Rural Electricity Infrastructure & Household Electrification, in April 2005 for providing access to electricity to rural households | Ministry of Power |

### 3.5.2.State Government Policies

The state is in a flux of energy policies with increased impetus on renewable energy, is expected more in coming years. Table 2 below shows the policies and regulations notified by the appropriate authorities in Assam for the development of the power sector in the state.

*Table 2: Major state-level policies for the power sector in Assam concerning NDC goals/climate change*

| Sl. No. | Initiative/Act | Year | Remarks |
|---|---|---|---|
| 1 | Small Hydropower (SHP) Development Policy | 2007 | The policy identifies the potential sites and encourages the private players in the SHP development in the state. Focus on improving the existing SHP projects. |
| 2 | AERC Renewable Purchase Obligation (RPO) Regulations | 2010 | Regulations are applicable to the obligated entities (OE). Upon failing RPO compliances, AERC direct OE to deposit amount equivalent to forbearance price of REC for target shortfall. |
| 3 | AERC Renewable Energy (RE) Tariff Regulation | 2012 | Regulations provide norms for determination of tariff for RETs. |
| 4 | Co-generation & Generation of Electricity from RE | 2015 | Promote grid-connected RETs, determination of intra-state open access charges, and wheeling and banking charges for RETs. |
| 5 | Grid-interactive Solar PV Regulations | 2015 | Provide framework for net-metering, energy generated and consumed by OE or eligible consumers by solar rooftop accounted towards RPO compliance. |
| 6 | State Action Plan on Climate Change | 2015-2020 | Investigates the strategies to make the state resilient against climate variability, climate change, and associated extreme events (explained later in details) |
| 7 | Power for All | 2015 | Aims to promote 24x7 power for all by 2019. |
| 8 | Smart Cities Mission | 2015 | Guwahati is selected as one of the 100 cities to be developed as a smart city. |
| 9 | State Renewable Action Plan | 2017 | Identify potential measures, policy, and regulatory framework to achieve the RE capacity addition target by 2022. |
| 10 | Assam Solar Energy Policy | 2017 | To create an enabling environment for businesses and developers to participate and invest in the process of targeted solar power capacity expansion of 590 MW by 2019-20. Encourage residential, commercial, industrial, and Government consumers for adoption of on-grid and off-grid solar installations, encourage solar park, and solar pump for irrigation. |
| 11 | Vision Assam 2030 | 2018 | Develop an energy roadmap to make the power sector of Assam as an economically sustainable, ecologically caring, and environmentally responsible sector by 2030. |
| 12 | Grid-connected Rooftop Solar Power Plant Programme | 2019 | Promote the grid-connected solar rooftop power plants among the residential, community, institutional, industrial, and commercial establishments. |

## Initiatives in the state for promotion of renewable energy

As the demand for electricity exceeds the supply in Assam, the state now has taken initiatives on solar power generation to complement the existing sources of supply. The government of India has sanctioned DPRs involving 288 crores for electrification of remote villages of Assam through Solar Standalone System and Solar Micro grids. The project will be implemented under DDUGJY. The total households to be covered under Standalone system & Micro grid is 41,822

Government of Assam has taken various steps to initiate renewable energy programmes in addition to the financial assistance received from the Ministry of New and Renewable Energy (MNRE). The government of Assam, has allocated budgetary support for the deployment of community based rural electrification model through mini and micro solar plants for providing basic lighting facilities to the inhabitants of un-electrified villages and widely dispersed un-electrified hamlets of electrified villages. Provisioning of solar power comes in handy for the remote Char (Riverine islands of Brahmaputra River) villages of the state.

The hill areas of the state are ideal for placing wind generated power stations. Different Wind Resource Assessments have been done in Assam with Collaborative Projects between The Assam Energy Development Agency and the National Institute of Wind Energy, Chennai under MNRE (GOI) have assessed the wind resources of the state. The state has already commissioned a few Wind Monitoring Stations. Solar Photovoltaic Power Plants (off-Grid) are also installed in Assam under Jawaharlal Nehru National Solar Mission (JNNSM) and Special Area Demonstration Project Programme.

It has been proposed to set up grid connected solar photovoltaic power plants on roof terrace of buildings or ground based projects with provisions of net-metering. The scheme targets large roofs or vacant land of government/ semi government offices, hospitals and educational institutions. Implementation of the projects would meet partial load of office buildings during working days and contribute the surplus power available to the Grids during weekends and holidays.

APGCL has also been taking initiatives to make use of solar energy and energy efficiency measures for public street lighting as a part of smart street lighting solutions. Various new projects were taken up in the State for the renewable power sector in recent past. In 2017-18, six new power projects with an installed capacity of 247 MW were allocated in the Budget. Moreover, Ministry of New and Renewable Energy (MNRE), Govt. of India has proposed 688 MW of Generating capacity from the renewable energy sources in Assam till 2021-22, out of which 663 MW will be from Solar and 25 MW will be from hydroelectric power projects.

Initiatives have been taken to reduce AT & C (Aggregate technical & commercial) losses in 67 towns with introduction of Supervisory Control and Data Acquisition system along with Smart Grid Pilot Project.

Source: Economic Survey Assam 2020-21, Directorate of Economics and Statistic, Government of Assam,

*Source: Power for All, 2015; SREAP for Assam, 2017; Assam Energy Vision, 2018*

# 4. State Emissions and Climate policies/actions

## 4.1. State emissions

Assam is rich in natural resources while a quarter of its area is designated as forest land i.e. carbon sink. Assam contributed 1.1 per cent {28.5 million tonnes of CO2 (e)} of the total emissions in the country {2498 million tonnes of $CO_2$ (e)} in 2015 (Source: GHG Platform[14]). In Assam, power generation for public use contributes approximately 19 per cent of the state energy sector emissions (Figure 7). Industry sector emissions, which include the Captive Power generation in the state has 29 per cent share in the state's energy emissions bucket. Assam has a per capita emission of 0.9 tons which is less than half of national average of 2 tons. Furthermore, emission per GSDP in the state stands at 17.3 gCO2(e)/INR which is lower than the national emission intensity of 23.3 gCO2(e)/INR (Source: IRADe Analysis & GHG Platform).

Agriculture, Forestry and Other Land Use emissions can be seen to be comparatively high (35%) for Assam [national average is approx. 15% (GHG Platform India, 2019)], second only to energy sector emissions. Among energy sector, Industries and public electricity generation were the highest emitting sectors in 2015. As state above and seen in Figure 7, industries alone accounted for 29 per cent of energy sector emissions and 16.5 per cent of total emissions in the state in 2015.

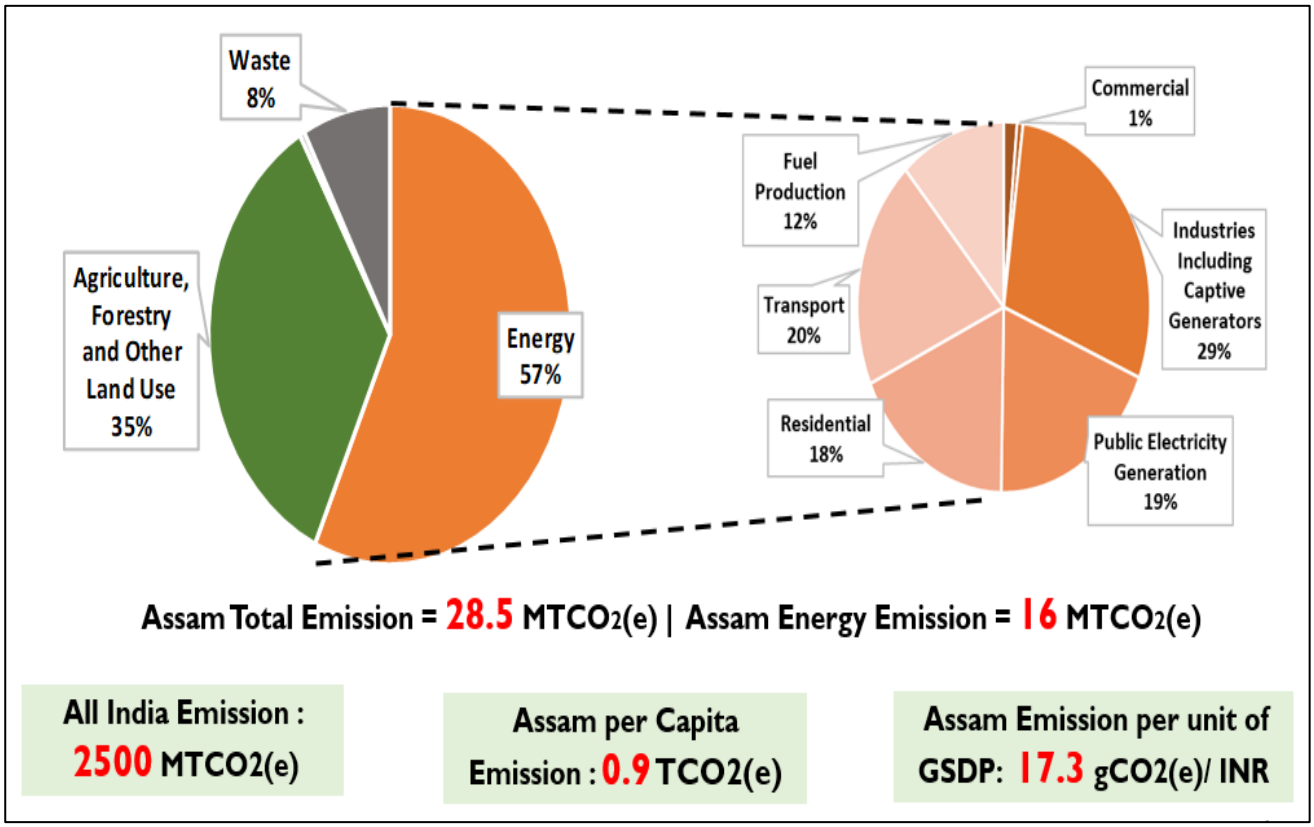


*Figure 7: Sectoral GHG emissions of Assam in 2015 (Source: GHG Platform India)*

AFOLU- Agriculture, Forestry & Other Land Uses; IPPU - Industrial Product & Process Use

*$CO_2$ equivalence data is considered on the basis of global warming potential of gases as per IPCC AR5 synthesis report

Note: IPPU emissions are very less; Agriculture & Fisheries sector emission contributions in the energy domain are very limited

[14] http://www.ghgplatform-india.org/

## 4.2. Assam State Climate Change Action Plan 2015 – Power Sector Snapshots

SAPCC of Assam notes that the energy generation capacity in Assam is not enough to meet the electricity demand in the state, especially in remote areas. It estimates that demand is likely to go up substantially. It identifies

- RE as an additional source of energy to be promoted for disaggregated generation of electricity restricting the emissions.
- Energy efficiency in conventionally produced fossil fuel based energy as another area where large potential of energy saving exists, thus reducing existing levels of associated GHG emissions.

The strategies suggested by the State to achieve the above mentioned objectives are as follows.

*Table 3: SAPCC Strategies to energy capacity addition*

| Sl. No. | Strategies- Energy Capacity Addition | Implementing Agency | Cost (INR Cr) | Priority |
|---|---|---|---|---|
| 1 | Setting up of 60 MW SPV Power Plant at Amguri, Assam | APDCL | 491.8 | H |
| 2 | Setting up of 2 MW SPV Power Plant at Namrup | APDCL | 18.25 | VH |
| 3 | Setting up of 2 MW SPV Power Plant at Lakwa | APDCL | 18.25 | VH |
| 4 | Capacity Building in APDCL | APDCL | 0.15 | H |
| 5 | Protection of Erosion of river bank for water intake pump at Desang river for Lakwa TPS | APDCL | 0.98 | VH |
| 6 | Master drain system of Lakwa Thermal Power Station with Effluent Treatment Plant | APDCL | 0.24 | VH |
| 7 | Crude oil drain pit development for gas intake station at Lakwa TPS & accumulator tank for Gas compressor lubrication drain | APDCL | 0.04 | VH |
| 8 | Lower Kopili Hydroelectric Project (120 MW), Dima Hasao and Karbi Anglong Districts, Assam | APDCL | 0.28 | VH |
| 9 | Development of Small Hydro Electric Projects | APDCL | 0.6 | H |
| 10 | Switchyard illumination at Namrup TPS-LED | APDCL | 0.2 | H |
| 11 | Street lighting at Namrup TPS- LED | APDCL | 0.2 | H |
| 12 | Additional thermal Insulation on GT Unit #1, #2, #3 & #4 at Namrup TPS | APDCL | 0.14 | H |
| 13 | Anti-erosion measure at Dillighat Intake of Namrup TPS | APDCL | 1 | VH |
| 14 | Renovation / Repairing of cooling system of APDCL Steam Turbine unit-5, splash bar changing at Namrup TPS | APDCL | 1 | VH |
| 15 | Research and Development | APDCL | 0.75 | H |
| | **SUB TOTAL - APDCL** | | **533.9** | |
| 16 | Development of State Renewable Energy Policy | AEDA | 0.25 | |
| 17 | Installation & Promotion of 25 MW aggregate capacity of Grid Connected Solar Power Plant at different vacant land of APDCL with capacity ranging from 1 MW to 5 MW | AEDA | 15.3 | VH |
| 18 | Installation of Grid Interactive Rooftop/Ground mounted Solar Power Plant (with battery backup) at important Govt. Building of Assam with capacity ranging from 5 kW to 50 kW | AEDA | 73.89 | VH |
| 19 | Illumination of important towns/historical locations of Assam through Solar Street lighting system | AEDA | 22.5 | VH |

| | | | | |
|---|---|---|---|---|
| 20 | Installation of 1 MW aggregate capacity of Solar Wind Hybrid System with capacity ranging from 600 W to 10 kW | AEDA | 23.33 | M |
| 21 | Installation & Promotion of 150 nos. of Solar Water Pumping systems for irrigation purpose | AEDA | 9 | H |
| 22 | Electrification of 75 nos. of remote villages through Solar PV based power plant under DDG | AEDA | 52.5 | VH |
| 23 | Setting up 80 MW Grid Connected Solar Power Plant through IPP in BOO Mode | AEDA | 800 | M |
| | **SUB TOTAL -AEDA** | | **996.8** | |
| | **GRAND TOTAL - Energy generation** | | **1531** | |

## 4.3. Contributing to NDC Goals

Assam, as discussed earlier, has varied physiography with hills dominating its terrain while plains along the river Brahmaputra and Barak in south-east also comprising a significant portion. We examine here state of NDC goal 3 and 4 in Assam:

Goal 3: Reducing Emission intensity of Gross Domestic Product (GDP) - To reduce the emissions intensity of its GDP by 33 to 35 percent by 2030 from 2005 level.

Goal 4. Increasing the Share of Non Fossil Fuel Based Electricity - To achieve about 40 % cumulative electric power installed capacity from non-fossil fuel based energy resources by 2030.

In terms of NDC Goal 3, the state emission intensity reduction as on end of 2015 stands at 37% compared to its 2005 levels meaning it is overachieving the NDC target at state level. It is important to maintain and in fact further improve this emission intensity reduction in the wake of a developing economy, impetus on upcoming industries in the state and improving life quality of its people.

As discussed earlier, out of a total installed capacity of 1761 MW (as on Sep 2020), the state has a non-fossil cumulative capacity of 568 MW. This means that the state has 32% non-fossil fuel based installed capacity. With increased impetus on RE based generation, one can expect that the share of non-fossil is only going to increase by 2030. While higher use of renewables contributing both in Goal 3 and 4, efficiency improvement in power sector contributes in Goal 3 and will be examined in details in the next section.

# 5. Decarbonisation options in the Power Sector

Three decarbonisation options are analysed here:

1) Improving efficiency of the thermal power plants,
2) Increasing renewables in the energy mix and
3) Reducing transmission and distribution losses.

The following section will examine the current status, hurdles faced, and opportunities of transformation in different segments of the Assam power supply system.

## 5.1. Thermal Power Stations

Assam energy mix has two types of thermal power stations- gas based and coal based. Gas based power stations in the state has the dominant share in terms of the installed capacity (45%) while the coal (installed capacity share of 23%) has a higher share in terms of units generated (39% in FY 2018-19). NTPC Bongaigaon remain the only coal based power station in the state which is run under the central sector. Gas based power stations namely Lakwa Thermal Power Station (LTPS) (including Lakwa Replacement Power Project) and Namrup Thermal Power Station (NTPS) are operated by APGCL (state entity) while another gas based station Kathalguri TPS is operated under North Eastern Electric Power Corporation Limited (NEEPCO) - central sector ownership.

Figure 8 shows the plant-wise specific emissions of thermal power plants in Assam. The per-unit emissions are dependent on various plant characteristics such as load factor, technology, and vintage, and operational maintenance.

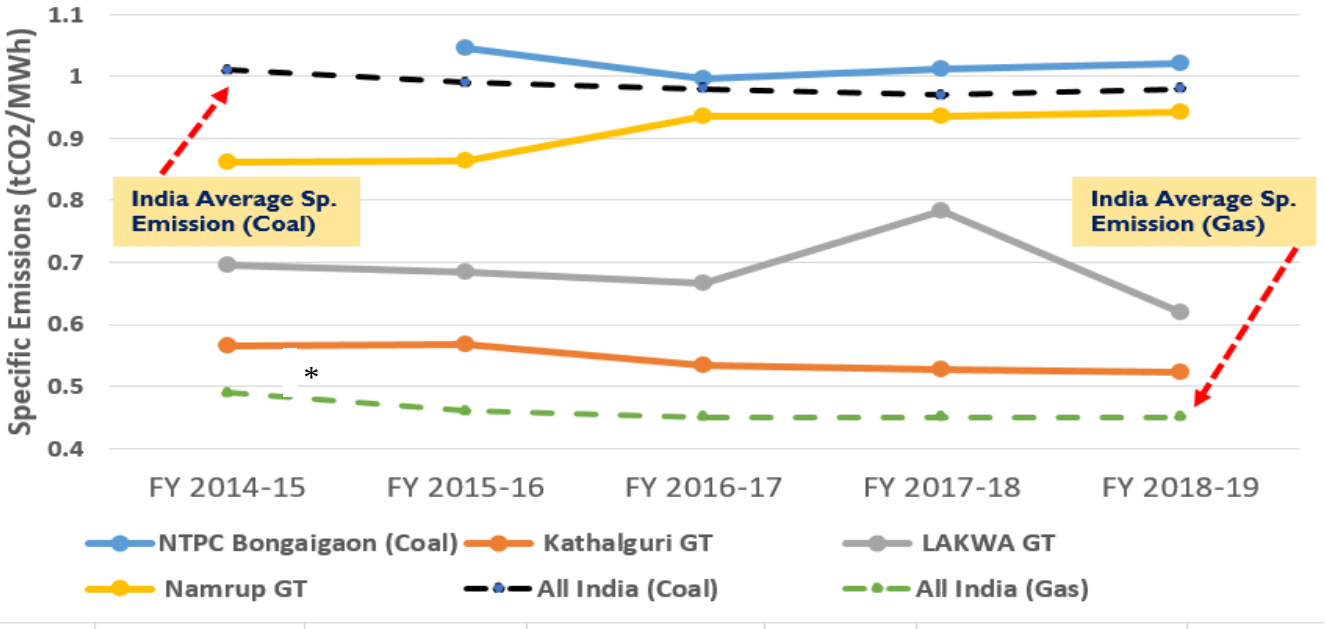


*Figure 8: Plant-wise specific emissions of thermal power plants in Assam*
***Source:*** *CEA and IRADe Analysis;* ***Note*:*** *1st* unit of NTPC Bongaigaon came on-line on June'15

As can be seen in Figure 8, the specific emission of NTPC Bongaigaon (only coal based TPS in the state) which has been recently commissioned (3rd unit of the station has been brought online on March 2019) is comparable to average specific emission of India. However, the specific emission of Namrup Gas

Thermal Power Station is significantly high as compared to other gas power stations in the state as well as the all India average specific emission of gas thermal power station of approx. 0.45 $tCO_2$/MWhr. The same is true for Lakwa TPS (LTPS) although in a moderate extent.

As mentioned earlier, specific emission is dependent on various factors including the vintage capacity of units in operation. Few of the units of Namrup TPS (NTPS) are close to 50 years old while that of Lakwa TPS are close to 35 years old. Lakwa TPS has seen capacity addition lately with newer capacity being added and called Lakwa Replacement Power Project (LRPP). Vintage technologies that have been employed in these TPSs arguably leads to higher emissions while power load factors of such inefficient plants are also difficult to maintain, both because of economic and technical limitations.

The station heat rate of Namrup TPS is also quite high (4323 Kcal/kWhr)[15] as compared to other gas stations in the state (around 2500 Kcal/Kwhr). Thus, Namrup TPS essentially burns more than 70% extra fuel compared to others. Figure 9 shows the power load factors (PLF) of the thermal power stations in Assam.

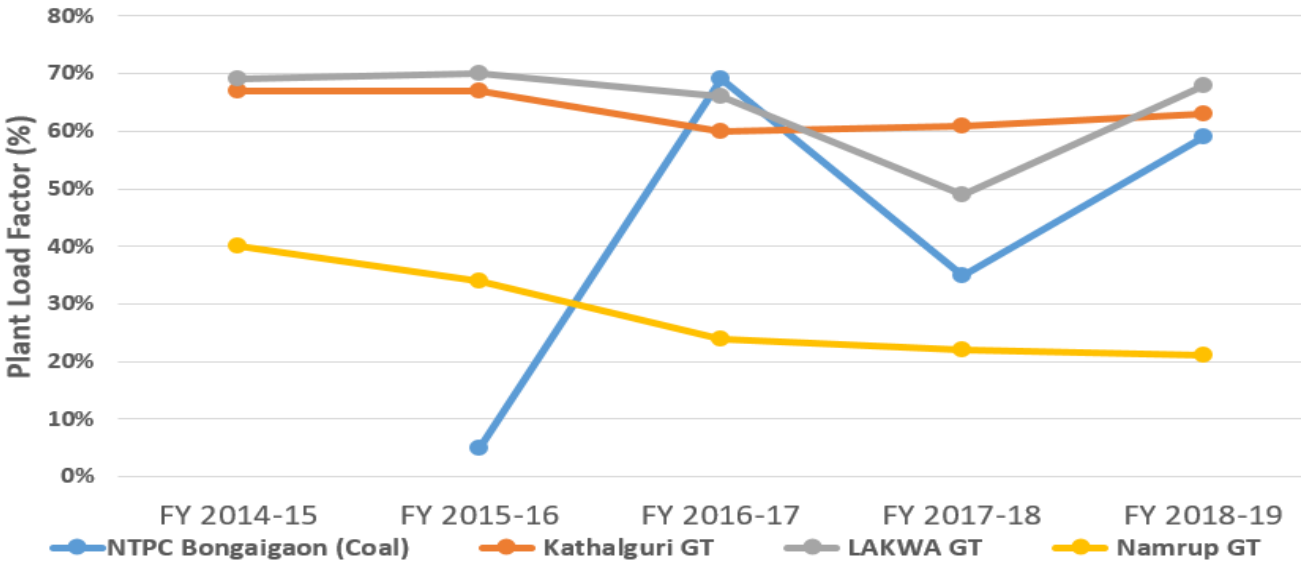


*Figure 9: Power Load Factor of thermal power plants in Assam over last 5 years*
*Source: CEA*

As shown in Figure 9, the PLF of Namrup Gas Thermal Power Station is on a lower side compared to other stations partly caused by limited gas availability. Assam Power Generation Company Limited (APGCL), mentioned in its tariff order dated 7th March 2020 that during FY 2018-19, 0.42 million standard cubic meters per day (MMSCMD) out of allotted 0.46 MMSCMD gas received for NTPS resulting in a generation loss of 71.50 MU. Similarly, for LTPS+LRPP during 2018-19, 0.69 MMSCMD out of allotted 0.72 MMSCMD gas received resulting to a generation loss of 68.23 MU. This, of course, cumulative with other factors leads to higher specific emission by Namrup TPS.

**Emissions reduction from thermal power plants can take place with phasing out/retrofitting the old plants, improving plant load factor and fuel efficiency, installing new power plants with latest technology.**

[15] Source: APGCL Tariff order

Capacity addition of 660 MW super-thermal unit at Margherita, eastern Assam by NEEPCO was planned under the National Electricity Plan published by CEA in January 2018 but no development has happened till now.

## 5.2. Renewables in Assam Energy Mix

### Current status

Assam has varied potential in terms of RE capacity in the state strongly dominated by solar. As shown in Figure 10, the state also has biomass power and small hydro-power potential but easily lag behind 14 GW solar (MNRE) which accounts for almost 97% of the total RE potential. MNRE estimates the small hydro power potential at 202 MW while Assam SHP policy estimates the same at 541 MW.

Although the state has a significant solar potential, a substantial quantum is yet to be harnessed with existing solar capacity in state a meagre 42 MW (as on 30 Sep 20). Figure 11 shows the source-wise RE capacity in Assam.

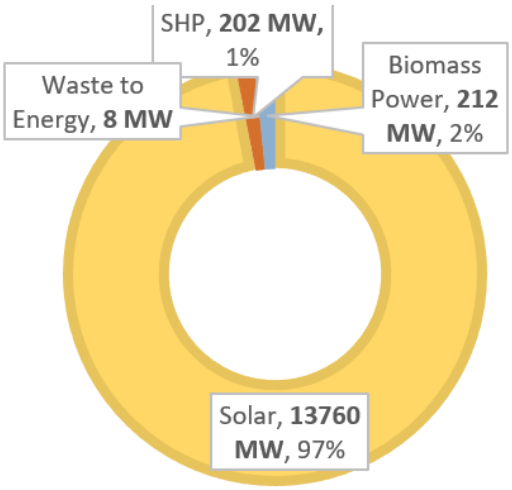


*Figure 10: RE potential in Assam (MNRE)*

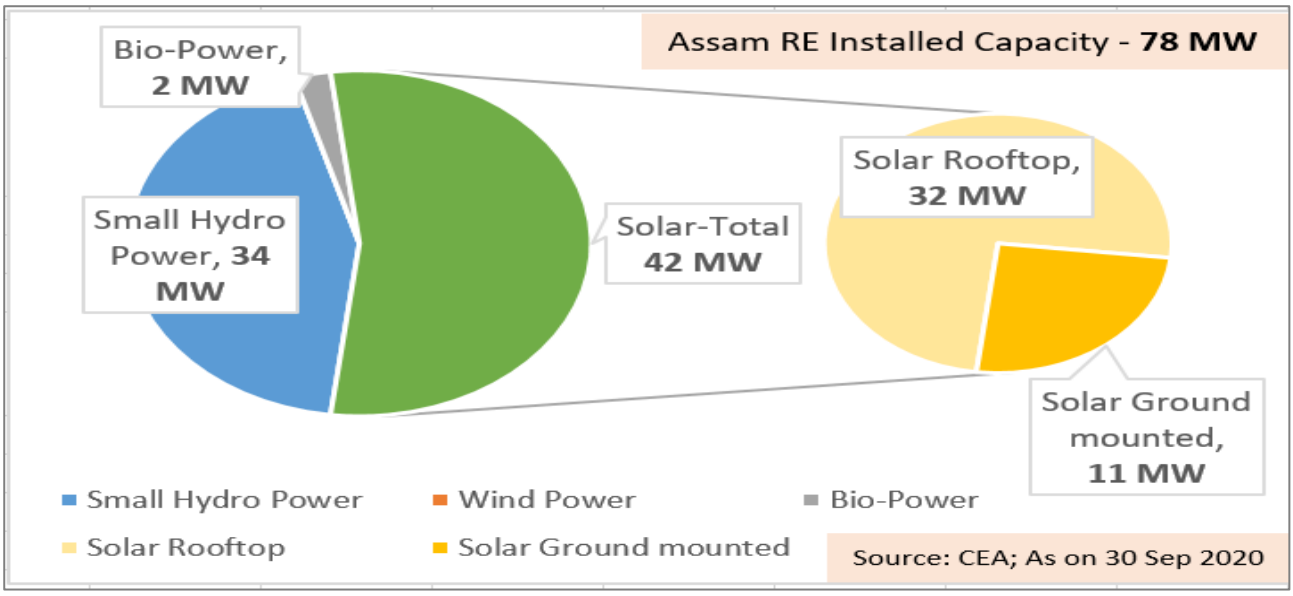


*Figure 11: Source-wise RE capacity in Assam (As on 30.09.2020)*

As can be seen in Figure 11, the RE capacity is mostly based on solar, biomass, and small hydro capacities. Assam has also wind power potential of 246 MW[16], as of now, no wind power capacities are installed in the state. There is significant immediate potential of RE capacity addition in terms of solar with solar parks and various grid-connected solar projects already been bid out for installation. The government of Assam had notified Assam Solar Policy in January 2018 and prescribed specific targets. The target to be achieved by FY 2019-20 in terms of grid connected solar was 465 MW while for grid connected rooftop

[16] https://energy.economictimes.indiatimes.com/news/renewable/renewable-energy-potential-of-assam-stands-at-14487-mw-solar-takes-largest-share/81430856

solar, it was 110 MW. By 2019-20, capacity for off-grid solar applications which included mini/micro grid solar as well as solar home and street light was 12 MW. As shown in Figure 11, as on 30 September 2020, neither solar ground-mount nor the solar rooftop capacity addition target could be achieved. In fact, as per Assam Energy Development Agency (AEDA), as on November 2020, no commercial or industrial rooftop solar has yet been installed throughout the state despite specific target of 22 MW and 25 MW were given for the same respectively. More initiatives are needed from the government as well as also from the stakeholders.

Figure 12 below shows the cumulative RE installed capacity growth in the state. The graph also shows the electricity generated from RE in the last four years.

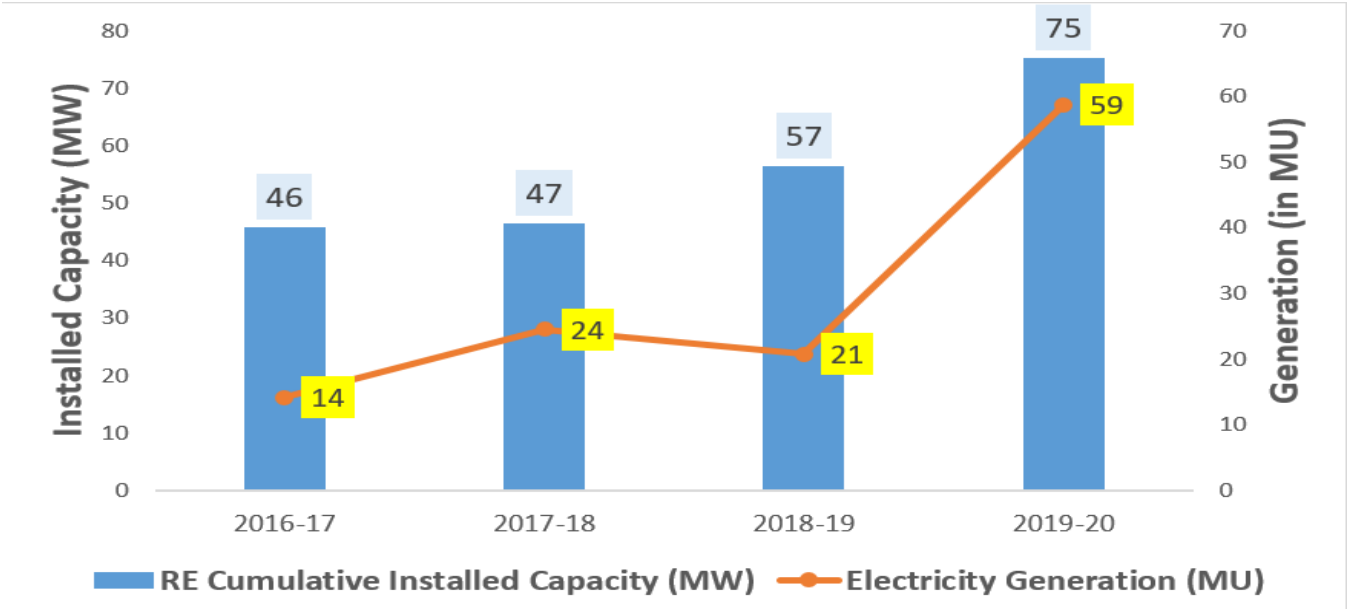


*Figure 12: Cumulative RE installed capacity in Assam over years and generation from RE*
Source: CEA Monthly Executive Summary; CEA RE Generation Report

The graph above shows that the capacity growth has been slow in the state and huge potential remains to make significant strides in terms of RE capacity addition. For FY 2019-20, the capacity utilization factor (CUF) of RE generators stood at lowly 9%. As stated earlier, the state receives significant rainfall and hence sunny days are on a lower side compared to other parts of the country. This impacts the generation from solar panels and same was confirmed by local solar developers. **Low availability of solar capacity is a key issue.** In terms of Small Hydro Power (SHP), a total of 7 prospective sites were awarded through competitive bidding but only a single project is operational. Most of the other projects are facing issues related to forest clearance[17] while one of them is now closed due to rejection of forest clearance by appropriate authorities. This brings forth an important question whether the forest clearance for the projects could have been sought before the bidding process?

[17] Source: AERC Annual Report

# Off-grid Solar and Mini-Grids

Mini grids were conceptualized to provide uninterrupted power supply to remote villages that were otherwise un-electrified. The power supply through the mini-grids was costlier, but they provided quality power supply to the people. The electricity access lightened the lives of these villagers. Soon, it introduced the people to new livelihood avenues that uplifted them.
Assam has a very diversified land distribution with hilly regions as well river islands a prominent feature of its geography. Mini-grid and off-grid provides an implementable solution for Assam electricity sector and minimizes few conventional problems viz. transmission and distribution loss problems, which is otherwise one-fifth of generation, as the electricity produced are locally consumed.
The specific targets identified in Assam Solar Policy 2017 proves the importance of this measure and extension of central subsidy scheme for north-eastern states is poised to help proliferation of off-grid RE across the state. The support for North-eastern council is expected to boost investment and ideas needs to be brainstormed to inspire private players to invest as it will make the development more organic and sustainable in long term.

### 5.2.1. Renewable Purchase Obligation

The Renewable Purchase Obligation (RPO) mechanism was first envisaged under Section 86 (1) (e) of the Electricity Act 2003. The RPO is imposed on the obligated entities[18] to ensure that a fixed portion of energy, as specified by the State Electricity Regulatory Commission, be procured from an RE generating station. Separate obligations are prescribed for the procurement of solar and non-solar power.

The state of Assam started initially with exceeding solar RPO compliance; however, it has not been able to keep up with the rising targets. The solar and non-solar RPO status of Assam state DISCOM (Assam State Power Distribution Limited) is shown in Figure 13 and Figure 14 respectively.

[18]- Entities who are obliged to have a portion of their electricity consumption generated from RE based generators- Distribution Companies, Consumers consuming electricity from its conventional Captive Generating plant of 5 MW and above capacity, consumers procuring electricity from conventional generation through open access and third-party sale

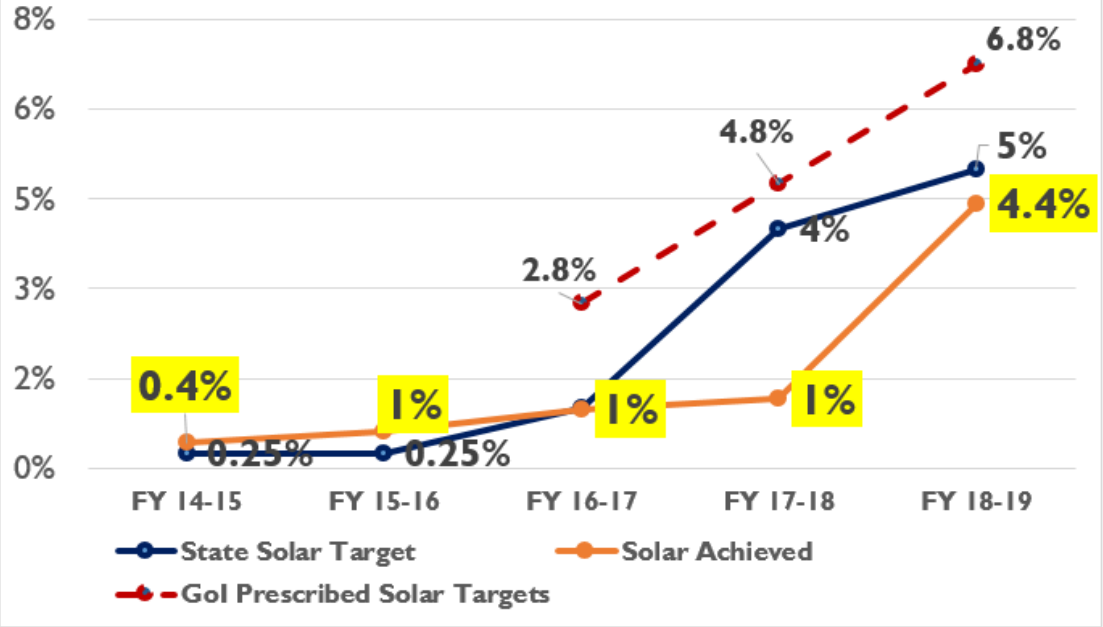


*Figure 13: Solar RPO target and achievement by APDCL*

Source: AERC

As seen in Figure 13, the compliance of solar RPO targets were done for FY 14-15 FY 15-16 and FY 16-17 but the same could not be maintained with increasing targets. While the state has purchased Renewable Energy Certificates (RECs) from the markets, it has still fell short for the targets. In case of non-solar, APDCL has been able to achieve targets for FY 16-17 and FY 17-18 but fell short of target in FY 18-19 (Figure 14).

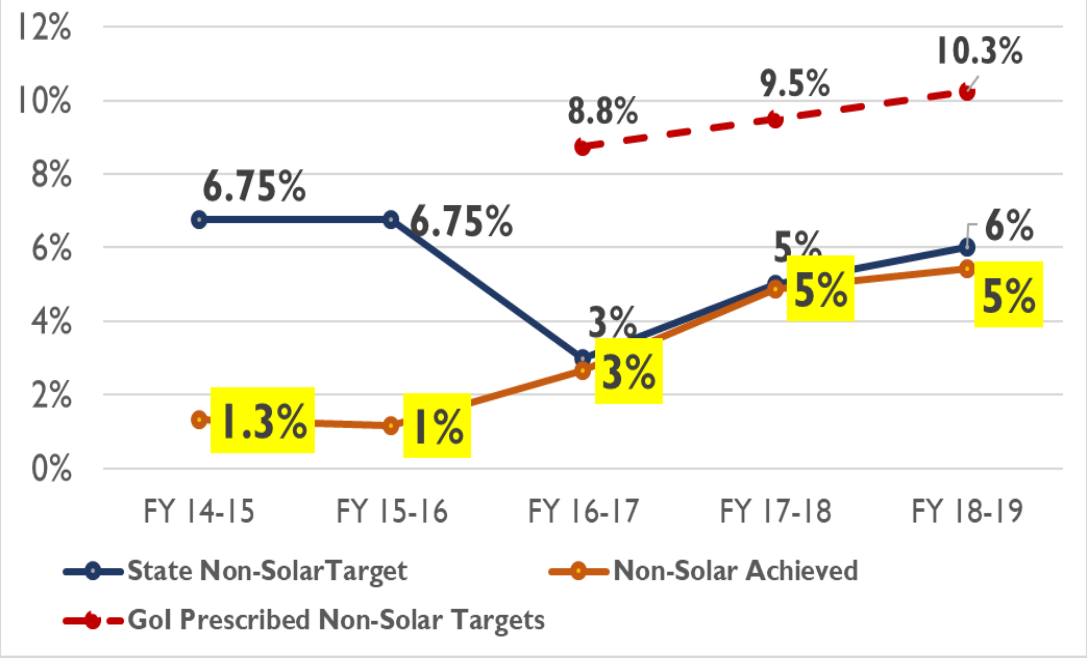


*Figure 14: Non-solar RPO target and achievement by APDCL*

It is to be noted that the state RPO targets are on a lower side than the targets suggested by Ministry of Power(MoP). **Hence, improvement is desired in terms of the compliance in coming years. This is ought to be boosted by more impetus by the state government in installing RE based projects across the state.**

The other obligated entities in the state i.e. open Access (OA) consumers and Captive Power Plants (CPP) had a mixed compliance ratio in FY 2018-19. Cumulatively, the CPPs had a solar RPO shortfall of 3.9% while for non-solar RPO, the shortfall was 2.7%. The OA consumers cumulatively exceeded their solar target in FY 2018-19 by 0.4% while fell short of their non-solar RPO by 1.4%. **Raising the RPO target and its strict compliance would result into emissions reduction contributing to achieving NDC goals.**

### 5.2.2. Major Hurdles in RE Growth in Assam

Assam, as discussed earlier, has a significant RE potential dominated by solar. It, although, has few challenges which are both attributable to its geography, as well as implementation.

Few of the challenges are identified below.

1. Assam receives significant rainfall during monsoon season which is dampener for maximum possible capacity utilization of solar. As pointed by a solar developer, the CUF of solar generators easily takes a hit of as low as 4% compared to other sunshine blessed states. Incessant rainfall also makes it mandatory to have a foundation which is strong and gives sufficient to the panels, especially for ground mount solar projects. This adds to the cost of the installation.
2. Cost of RE equipment is typically on a higher side because of transportation challenges owing to its *chicken neck* geography[19] as well as difficulty in access to south eastern part of the state that Assam is subjected to.
3. Availability of skilled labour remains one of the challenge for RE developers in Assam. Expert availability too in case of maintenance or quality inspection is scarce.
4. As pointed by few stakeholders, hooliganism, local mafia and degrading unionism is a challenge in Assam which the developers face while execution of the project. This leads to cost overrun as well as delay in the project execution while being forced to have the work executed by labour who are not efficient.
5. Although recent bids have resulted in projects being won by private players, the involvement of large pool of private developer's remains mooted to stimulate faster development in the state.
6. Policy push needs to be complemented by implementable actions viz. minimum clearance needed once a project is bid out ought to be ensured by implementing agency which has been bane in case of SHP as well as solar park projects
7. Before a project is identified, local Autonomous Councils should be involved in the process to eliminate political issues popping up at a later time. Land acquisition and forest clearance has been delayed for various projects across Assam due to this issue.
8. RE developers have highlighted the lack of strong implementation of single window clearance has led to plans of many projects being delayed.
9. Weak financial health of industrial consumers who have roofs available with them has made it unfeasible (or too risky) for a willing CAPEX/RESCO rooftop solar developer to make a business case. This is happening despite a high tariff for industrial/commercial consumers in Assam.

[19] The 60-kilometre long and 22-kilometre wide Siliguri Corridor in the Indian state of West Bengal, also known as the "Chicken's Neck", connects India's north-eastern states with the rest of the country.

## 5.3. Transmission and Distribution in Assam

### 5.3.1. Aggregate Technical and Commercial (AT&C) Losses

Due to its topography, climate vulnerabilities – which include flash floods and long distance between the east and west border, Assam's distribution sector deals with a variety of issues while catering to its consumers. The state has AT&C losses comparable to the national average (which is already high), with around a fifth of its energy purchased lost due to system inefficiencies.

As discussed earlier, distribution business in whole of Assam is the responsibility of state utility- APDCL. Figure 15 shows the trajectory of the AT&C loss of APDCL over the years.

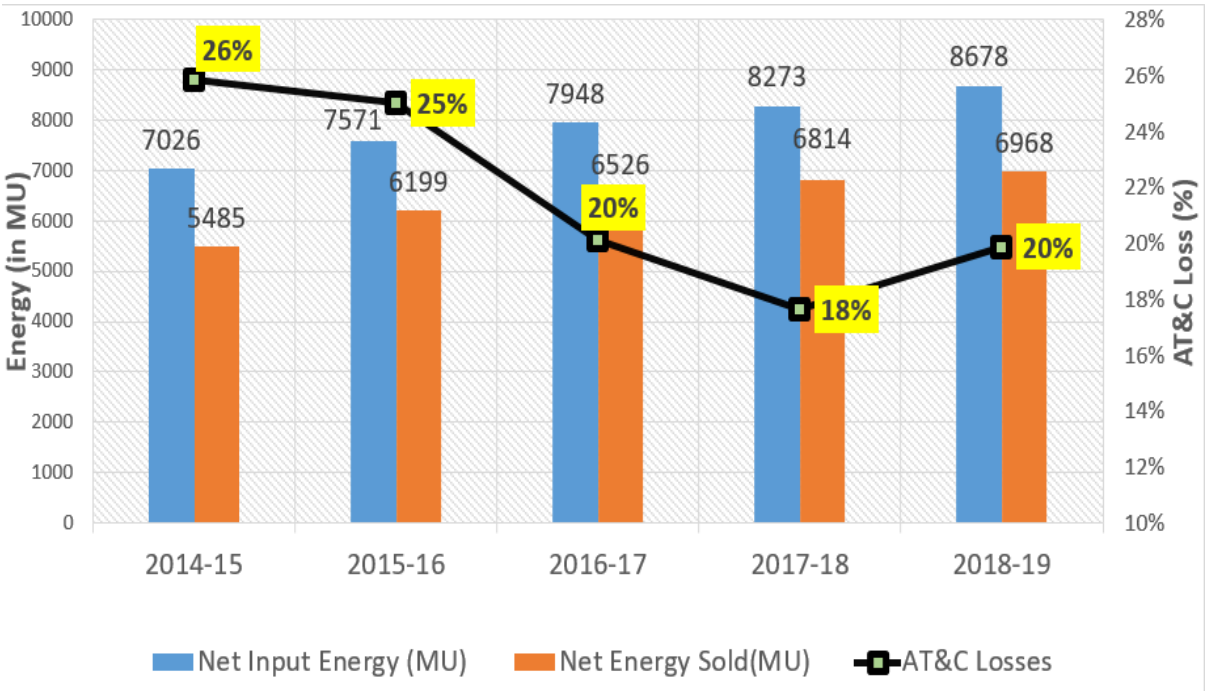


*Figure 15: AT&C Loss trajectory of APDCL*
Source: PFC Report for State Utilities performance

In a state such as Assam, there are twin challenges to control the distribution losses. The first being the challenge to manage commercial losses (as is seen in almost all the DISCOMs in India), and the other being the difficult terrain of the state. The hilly terrain and low population density in some areas make it more vulnerable to higher losses.

It can be seen in Figure 15 that there has been improvement in loss levels of the state DISCOM over the years with 26% loss level in FY 2014-15 being brought down to 18% in FY 2017-18 before a marginal increase to 20% in FY 2018-19. The trend in decrease in losses can be attributed to the steps taken up by the DISCOM such as GIS mapping and systematic augmentation of the distribution network (UDAY Newsletter, 2019[20]).

Documents available with state commission shows that distribution loss levels are higher than 17% in all 15 circles barring the 4 circles namely Guwahati – I, Guwahati – II, Dibrugarh, and Tezpur. An average of loss levels in these 15 circles aggregates to 25% with few circles like Badarpur (39%) and Kokrajhar (34%) losing more than a third of its input electricity.

[20] https://www.uday.gov.in/images/newsletter_jan_2019.pdf

### 5.3.2. Reasons for increase in AT&C loss in FY 2018-19:

There are various reasons that can be attributed to loss level increase as mentioned below.

- Rapid household electrification: The state's household electrification status stood at 37% as per census 2011, which increased to 61% in 2016-17 and reached 100% in 2019. A total of 16.1 lakh households across Assam were electrified between October 2017 and January 2019 (SAUBHAGYA Dashboard).
- Enhancement of Low Tension (LT) networks under RGGVY/DDUGJY without adequate High Tension (HT) infrastructure[21] . Large scale rural electrification programme has resulted in considerable expansion of LT distribution network leading to increase in technical losses.
- The LT-HT ratio of APDCL in terms of distribution infrastructure is 3.24:1, against the desired ratio of 1:1.2.
- Length of LT lines/circuits has increased resulting in high losses in LT lines, excessive voltage drops, frequent faults on LT network and higher rate of failure of distribution transformers.
- APDCL also claims that deferred implementation of various schemes as per the approved Capital Investment Plan and restricted allowance of Repair & Maintenance (R&M) expenses have contributed in its inability to maintain/improve loss level.

[21] APDCL tariff order dated 7 March 2020,

### 5.3.3. Distribution System Health:

It is extremely vital to ensure that the distribution system is healthy to have power supply system suffers less failures and remain healthy. This not only warrant consumer confidence but maintain steady flow of income for the DISCOM.

#### Metering at Distribution transformer (DT) and Feeder level:

It is imperative to determine the load pattern of the distribution system at DT and feeder level. Metering of the distribution system is paramount to determine the exact load patterns at a DT and feeder level. It also helps in identifying the loss making pockets enabling quick resolution of problem. As a part of the UDAY scheme, a Memorandum of Understanding was signed between MoP, Government of Assam and APDCL to reduce the losses of the APDCL. As a part of the agreement, a target was set for the APDCL to achieve 100% feeder metering by June, 2017 and 100% DT metering by June, 2018. While 100% Urban DT metering has been reached, feeder metering and rural DT metering target has been missed by a considerable margin. Table 4 shows the progress of metering at feeder and DT level.

*Table 4: Targets and progress of metering at feeder and DT level in Assam*

| Parameter | Target | Achievement (March, 2020) |
|---|---|---|
| **Feeder Metering** | 376 | 196 |
| | 100% | 52% |
| **DT Metering (Urban)** | 1019 | 1019 |
| | 100% | 100% |
| **DT Metering (Rural)** | 4700 | 1430 |
| | 100% | 30% |

Source: (Source: UDAY health card, Assam, March 2020)

#### Reliability of Assam's distribution network:

Reliable power supply is paramount to overall development of a region. Lack of reliable power supply causes the consumers to shift to other options including the highly polluting diesel gensets.

Assam is one of the few states which faces a power deficit in the country. In 2019-20, the state faced a shortfall of 5.2% in power supply; the number increases to 10.2% for the peak load deficit (CEA LGBR, 2020). This is much higher than the national average of 0.5% shortfall.

The power deficit translates to power cuts at the consumer level. They are measured through the Consumer Average Interruption Frequency Index (CAIFI) and Consumer Average Interruption Duration Index (CAIDI), where,

CAIFI = No. of interruptions faced by a consumer per month

CAIDI = Duration of total interruptions per month

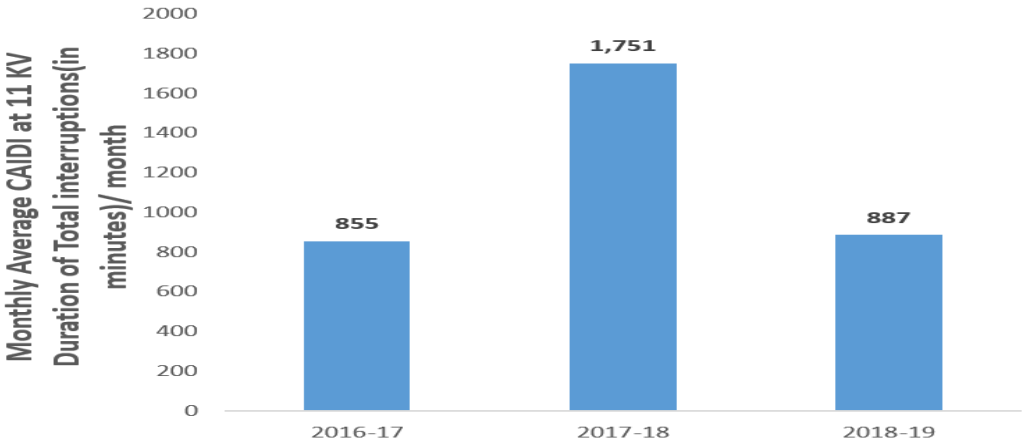


Figure *16: Monthly average CAIDI at 11KV in Assam*

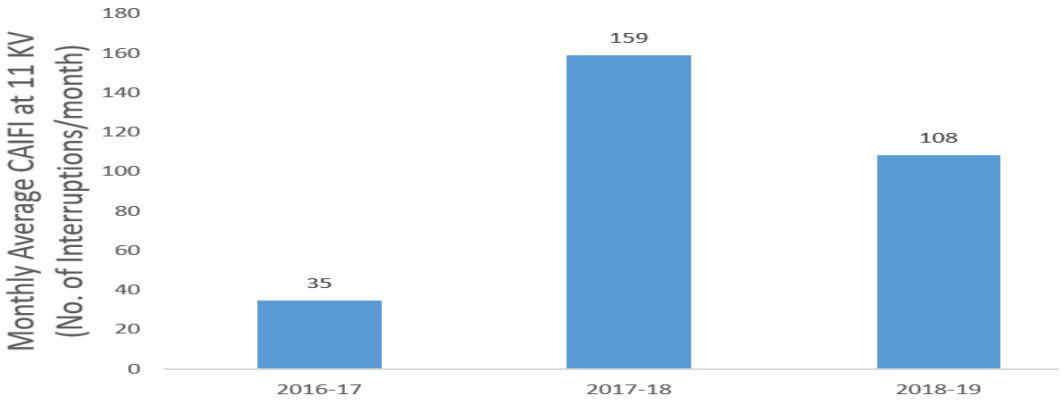


*Figure 17: Monthly average CAIFI at 11KV in Assam (For interruptions exceeding 10 minutes at a time)*

From Figure 16, it can be seen that an average Assamese CAIDI translated to more than 14 hours of power interruption in a month in 2018-19. Similarly, from Figure 17, it can be seen that an average Assamese faced 108 interruptions per month.

Circle-wise monthly average CAIFI data in 2017-18 data depicts a wide variation between various geographical regions, as shown in Figure 18.

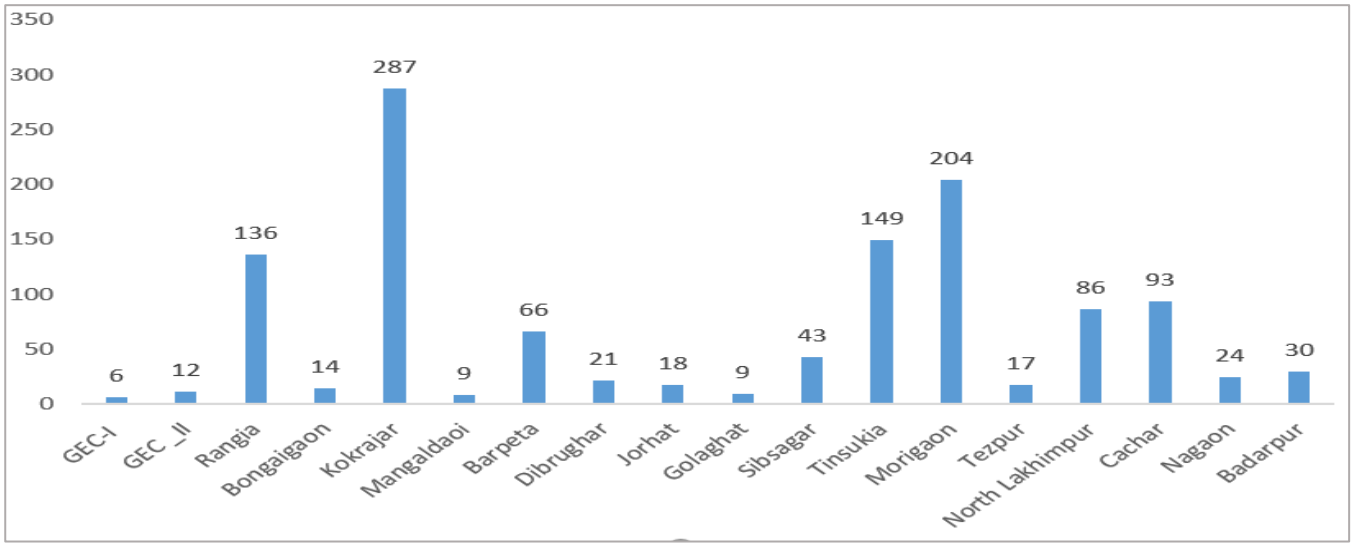


*Figure 18: Circle-wise Monthly average CAIFI at 11KV in Assam*

(Not including the Kanch circle due to its abnormally high number of interruptions)

# 6. Recommendations and the Way Forward

Assam is the largest state in the north-east and has a developing economy. The government of Assam estimates that its electricity consumption is going to substantially increase by 2030. It is always wise and easier to plan for something which is yet to happen rather than change something which has already happened. As discussed earlier, Assam's emission intensity reduction in 2015 compared to its 2005 level brings optimism for climate enthusiasts but it's equally important to at least maintain such levels in the wake of a growing state economy, growing cities and expanding disposable income for middle class (per capita income at constant prices grew from INR 21,146 in 2010-11 to INR 51,040 in 2016-17[22]). The state has non-fossil capacity 32% in total power generation capacity as against the NDC goal 4 of the target 40%, as state needs to increase its capacity by manifold to keep pace with growing electricity demand, considering renewables as key option for expansion will contribute in achieving NDC goal 4 at the national level. However, as explained earlier, renewables in the state has its own challenges, for example low availability factor of solar, should be given adequate consideration while designing expansion of the state power sector with renewables.

Below mentioned recommendations can be explored to have a power sector growth that is less carbon intensive.

## 6.1. Demand Side Interventions

Given demand growth potential in the state is very high, Demand Side Management (DSM) interventions can help in controlling customer behaviour and flattening the demand curve. It not only bodes well for the system's health but helps in financial savings for the DISCOMs as the need for the inherently costly peak load power can be reduced.

DSM also leads to emission abatement as such interventions help in reducing the power requirement as a result of which systems become more efficient and power losses are reduced. Other distribution utilities across the country are in discussions to implement Demand Response system as well with few pilots across the country also in various stages of implementation. APDCL can think on similar terms to save on electricity purchased. As electricity saved is equivalent to 3 times the electricity generated, this intervention is beneficial to everyone involved and bodes well for the environment as well.

## 6.2. Increase Penetration of Renewable Generation - Improve RPO Compliance

Some stakeholders in Assam argue that it should have a lower RPO compared to what MoP prescribes as it has a renewable potential which has its own harnessing challenges coupled with moderate DISCOM finances. However, since no transmission charges are levied on renewable power and renewable certificates can be purchased on the exchange, this argument is not valid.

RPO targets in India have been categorized into two categories – solar and non-solar. Initially, the cost of solar energy was higher than wind energy (the most common non-solar RE technology). Thus, separate targets were proposed so that investments could be encouraged in both RE technologies. However, now that the costs of the two technologies are comparable, it makes little sense for categorization of the targets. In states such as Assam, which have more potential in solar technology as compared to others, it creates an added burden.

[22] Source: Assam Economic Survey 2017-18

## 6.3. Decentralized RE generation

Assam shares about 2.4% of the country's total geographical area and provides shelter to 2.6% population of the country as per 2011 census. The geographical area of the State is 78,438 sq. km. of which 98.4 per cent[23] area is rural. Due to the varied terrain, river islands and places which have difficulty in access, off-grid decentralized RE generation makes sense to ensure availability minimum electricity to its population which are spread across the state. Assam Solar Policy 2017 identified separate target for off-grid solar and although the policy control period is now over, the state government will do good if they identify more ambitious targets for off-grid and make necessary requirements institutionally and financially to enable such targets to be achieved on ground.

Decentralized RE minimizes otherwise conventional losses like line losses, voltage issues, maintenance delay in case of fault as everything is localized. It is important to note that financial viability of such projects in the long term needs to be guaranteed if the state intend to promote private participation in such projects.

## 6.4. Eliminate inhibitors in Regulations/Policies

Assam needs to careful visit some of its policies and regulations related to RE which might be inhibiting the growth of these technologies in the state and may be keeping interested private developers at bay when it comes to investing in the state. One such provision is to not include "Solar generating plants with capacity of 5 MW and above" under the MUST RUN status while scheduling its power[24].

## 6.5. Improve technical performance in conventional generation/ retire inefficient units

As discussed above, gas fired power plants in the state, especially Namrup TPS and Lakwa TPS are quite old. Vintage units in these power plants leads to high station heat rate (Namrup SHR - 4323 Kcal/kg) as well as high auxiliary power consumption (Lakwa TPS (excluding LRPP) -10.3%)[25] (It is to be noted that the recommended auxiliary consumption by CERC for gas TPS is around 3% and SHR for most of the power stations across country are around 2000 Kcal/Kwhr)[26]. Hence, for generating a unit of electricity they are burning more fuel. Thus, renovation or outright decommissioning of older inefficient plants makes more sense for the state in long term economically as well as environmentally.

## 6.6. Opportunity to integrate more RE in the energy mix

Assam has a largely gas and hydro based power mix which are both highly flexible. A large amount of solar capacity, which is technically infirm, can be added in the state by using the gas/hydro as balancing power. However, this will require a highly sophisticated Load Dispatch Centre. This however can be done in a short period of time and result in rapid reduction in emission intensity of the state.

[23] Assam Economic Survey 2017-18
[24] Source: AERC Cogeneration and Generation of Electricity from Renewable sources of Energy Regulations 2015
[25] APGCL Tariff Order dated 7 March 2020
[26] Source: https://cercind.gov.in/2013/whatsnew/Sop.pdf (accessed on 23Sep21)

# Appendix A

During the course of the study, the researchers interacted with stakeholders on multiple occasions to understand the ground realities and their perspective on the improvement avenues. These interactions include as part of focus group discussions, interviews, telephonic conversations, etc. through inception workshop, local stakeholder consultations and output disseminating webinar.

## A. Inception Workshop

Inception workshop was conducted in IIT Guwahati, Assam on 9 May 2019. The stakeholders were sensitized about the project's objectives along with a brief general profile of power sector in the state. Dignitaries and representatives included Shri. Debajyoti Choudhury. Director Planning, Irrigation Department, Govt. of Assam; Kaushal Saikia, Chief Engineer, PWD Assam; Prof. Gopal Das, Dean, Research & Development, IIT Guwahati; Shri. R. R. Ukirde, Director, NPTI Guwahati; Mr. Subrata Chakrabarty, WRI India and others. Few of the major points highlighted by the state stakeholders are mentioned below.

1. RPO trajectory set by the Central government is too high for any state to meet.
2. At times, PPA signed by the DISCOM does not allow them to meet their RPO obligations
3. Meeting RPO obligation by purchasing REC certificates put extra burden on the DISCOM and it is difficult for them to pass it to consumer, which puts an extra burden on their financials.
4. Separate RPO targets for solar and non-solar should make way for a unified RPO obligation especially as states have different RE potential
5. Assam's dependency is high on central sector plants to meet its power deficit
6. Due to the demand uncertainty in the state and supply and storage scenarios of renewables at this stage, replacing conventional with RE would be immediately difficult.

## B. Agenda of the Workshop:

15 Integrated Research and IRADe Action for Development

MacArthur Foundation

**Agenda**

**Policy Dialogue on Energy & Climate Change**

**| Assam Chapter|**

**On**

**09th May, 2019 at IIT Guwahati**

| | | |
|---|---|---|
| **09:45 - 10:15 AM** | **Registration** | |
| **10:15 - 11:15 AM** | **Session I – Inaugural** | |
| **10:15 - 10:30 AM** | **Welcome Address** | **Prof. C. Mahanta**, Head, Department of Civil Engineering, IIT Guwahati |
| **10:30 - 10:45 AM** | **Welcome Remarks** | **Prof. Gopal Das**, Dean, Research & Development, IIT Guwahati |
| **10:45 - 11:00 AM** | **Inaugural Remarks** | **Prof. Kirit Parikh,** Chairman, Chairman, Integrated Research and Action for Development (IRADe) |
| **11:00 - 11:15 AM** | **Inaugural Address** | **Prof. Jyoti K Parikh**, Executive Director, IRADe |
| | **Group Photograph & Tea Break** | |
| **11:15 - 12:45 PM** | **Session II- Adapting Energy and Power sector to meet NDC's target** | |
| | **Session Chair** | **Shri. R. R. Ukirde**<br>*Director, National Power Training Institute (NPTI), Guwahati* |
| | **Theme Context ( 10-15 Minutes)** | IRADe presentation on "**Adapting Energy and Power sector to meet NDC's target**" by **Mr. Kumar Abhishek, Research Analyst, IRADe** |
| | **Remarks by Panelists (About 7-10 Minutes Each)** | • **Shri. N. K. Deka,** Deputy Director (PP), Assam Electricity Regulatory Commission (AERC)<br>• **Shri. Sanjeeb Tamuli,** Assistant Director (T), Assam Electricity Regulatory Commission |
| **12:45 - 13:45 PM** | **Lunch** | |
| **13:45 - 15:15 PM** | **Session III- Promoting use of solar water pump in agriculture sector** | |
| | **Theme Context (10-15 min)** | IRADe presentation on "**Promoting use of solar water pump in agriculture sector**" by **Mr. Chandrashekhar Singh, Sr. Research Analyst, IRADe** |
| | **Remarks by Panelist (7-10 minutes each)** | **Tentative List**<br>• **Prof. M. K. Dutta**, Head, Department of Humanities and Social Sciences, IIT Guwahati<br>• **Shri. Debajyoti Choudhury,** Director Planning, Irrigation Department, Govt of Assam<br>• **Prof. D. C. Baruah**, Professor, Tezpur University (Central University), Assam |
| **15:15 - 15:30 PM** | **Tea Break** | |
| **15:30 - 17:00 PM** | **Session IV- Energy efficient transport systems to reduce emissions** | |
| | **Session Chair** | ***Prof. Praveen Kumar***<br>*Department of EEE & E-Mobility Laboratory, IIT Guwahati* |
| | **Theme Context ( 10-15 Minutes)** | IRADe presentation on "**Energy efficient transport systems to reduce emissions**" by **Dr. Probal Ghosh, Head (Modelling) IRADe** |
| | **Remarks by Panelists ( About 7-10 minutes each)** | • **Mr. Subrata Chakrabarty**, Manager, Climate Program, WRI India<br>• **Shri. Kushal Kumar Saikia**, Chief Engineer, Public Works Department (EAP), Guwahati, Assam |
| **17:00 – 17:30 PM** | **Closing Address** | **Prof. C. Mahanta, Head**<br>Department of Civil Engineering, IIT Guwahati |

## Stakeholder Consultations

Initial stakeholder consultations were conducted in May 2019. The interviews were conducted throughout the study with stakeholders which included people from organizations including, but not limited to, AERC, APDCL, AEDA, private RE developers, academia, etc.

### AERC

1. Most of the obligated entities in Assam are almost complying with their RPO obligations.
2. The discom is purchasing RECs from the exchanges to mitigate their shortfall.
3. 800 KW out of 2.4 MW of Biogas plant has been commissioned in Tezpur while rest is stranded due to evacuation issues.
4. 50 MW of solar tender through SECI has been conducted while efforts have been made to tie 50 MW of wind power through PTC.
5. Many rooftop plants have been installed in and around Assam and efforts are being made to connect them to grid in accordance with the upcoming net metering regulations.
6. Close to 100 MW of PPA has been signed by discom as an output of solar bids conducted in Assam last year.
7. 14 MW of rooftop solar is being developed by Assam Energy Development Agency while 16 MW is being developed by APDCL.
8. Solar Park in Amguri is having developments but the completion will take some time.

### AEDA

1. Close to 197 rooftop projects (capacity ranging from 1 KW – 500 KW) have been implemented in various parts of the state and currently net metering of those projects are being carried out.
2. As directed by MNRE, out of 14 MW of rooftop solar to be developed by AEDA. 6 MW (2.6 MW – CAPEX and 3.4 MW – RESCO) has already been developed while the rest 8 MW (for Residential rooftops) will be developed in next few months.
3. A pilot floating solar power plant of 10 KW has been successfully developed. The project is used for lighting close to 20 households.
4. SHP potential at small pockets exists across but same is still to be harnessed.
5. 50 meter and 80-meter wind masts has been installed across the state to understand the potential of wind power in the state.

### RE Developer

1. Foremost hurdle faced by developers in Assam (and North-East) is lack of barren land in state. He told that agriculture and forests are major land use sectors thus, land availability is an issue. He further explained that there are some jurisdiction issues for land availability for large solar plants.
2. Assam is a large state with relatively low loads, thus very large plants may not always be available. A plant may have to be connected to different substations to ensure evacuation, which leads to higher losses.
3. Decentralized systems may be better for states like Assam. On enquiring about viability of off-grid solutions in the wake of 100% household electrification in Assam, it was told that MNRE subsidy for off-grid projects has been discontinued.
4. Large industries in Assam are limited. Thus, large loads are not there which can be supported by large solar plants. tea is a seasonal industry and solar plants are thus not viable for them.

5. About solar plants in small industries, it was mentioned that small industries do not have enough capital to get solar plants in the CAPEX model. Developers are not confident about payment security by industries through RESCO model. DISCOM permission is required for industries to sign an RE PPA, which is also a lengthy process.
6. On being asked if mechanisms like single window clearance would help, it was said that such mechanisms already exist, however there are implementation problems with these mechanisms in Assam.
7. With regard to delay in subsidy payments, subsidy delays can range from anywhere between 3 month – 1.5 year.
8. There is a lack of skilled manpower in Assam (and rest of the NE), which causes delay in the projects.
9. Local contractor issues governing manpower deployment is a major hurdle with additional cost in paying off hooligans a constant menace until the completion of the project
10. Waterlogging issues is a permanent annual challenge with torrential downpour during monsoon season (June till September end) creating project execution challenge coupled with an additional cost in elevating the structure to mount the panels). Due to monsoon, the annual generation is on a lower side and hence the guaranteed generation needs to be carefully arrived to eliminate LD and similar charges
11. Labor cost is high
12. Connectivity is to be borne by the developer from the site to the connectivity point (unless the project is under the ambit of SOLAR PARK in which the government does the work). This entails separate cost.
13. In a separate development in the Solar Rooftop industry, one of the developer rued the fact that NET-METRING is now only allowed up to 10kW (as per recent MoP directive) which is a deterrent for developers.

## C. Research Output disseminating Webinar

In order to disseminate the outputs of the study and seek final stakeholder comments from various organizations and individuals, webinar was conducted on 14 December 2020. The invitees of the webinar included eminent power sector people including Mr. Niraj Verma - IAS, Principal Secretary, Department of Energy, Government of Assam; Mr. Satyendra Nath Kalita, Member (Technical), Assam Electricity Regulation Corporation (AERC); Mr. Akhil Chandra Khatoniar, Engineer-in-Chief cum Principal Chief Electrical Inspector, Assam; Mr. Pankaj Batra, Project Director IRADe- SARI/EI, Ex-Chairperson (I/c) & Member (Planning), CEA ;Mr. Mrinal Choudhury, Additional Director, Assam Energy Development Agency (AEDA) and others. Key discussions from the webinar is discussed below.

1. Assam's major power procurement comes from central sector plants and the state's current state-owned generation capacity is around 10% of the requirement. Thus, solar energy for Assam is an opportunity to not only expand but also become more self-reliant.
2. Assam do not plan to add any Coal Thermal Power Plant
3. The state currently has 200 MW of solar energy in various stages and is also building a hydro power plant in Lower Kopili region.
4. The Principal Secretary, Energy, GoA mentioned that Assam has signed an MoU with GIZ, as a result of which a modelling study was conducted using the LEAP (Long-range Energy Alternative Planning)

model. The study resulted in four pathways based on the interventions required. The state decided to go with the Assam Energy Security Scenario (AES), which is the most ambitious scenario and will result in 47% Renewable Energy generation in Assam by 2030 and drastically bring down emissions.

5. The state plans to roll out a new solar policy and biomass policy soon
6. It was informed that the State Designated Agency (SDA) in Assam which takes care of the demand side interventions has formulated the Energy Conservation Building Code (ECBC) for Assam and the same will be notified soon.
7. Member (Technical), AERC highlighted that total electric system loss for Assam (including distribution, state transmission and central transmission losses) in FY 2019-20 was 23.04%. He further stated that only 1% of reduction in losses will save 21.71 MU which may result in emission abatement of 16,473 tonnes of CO2(e).
8. It was discussed that the technical losses in Assam are also high; Some parts of the network at 11 KV run for 100-140 kms of length. Thus, there is a need to refurbish the network and improve HT-LT ratio.
9. It was mentioned that since Assam is predominated by domestic consumers, load shifting may not be a viable solution; a better solution would be to reduce the demand wherever possible. Towards this step, Assam govt. and the distribution utility has distributed 4 LED bulbs to each family, and consequently the power consumption has come down from previous year.
10. It was proposed by Member (Technical), AERC that Assam's emissions are very low as compared to other states and the Govt. of India should come up with a policy on the lines of the Kyoto Protocol, wherein, the non-polluters are incentivized. This would help the underdeveloped states to catch up with rest of India and further increase their electricity consumption.
11. It was suggested that since Assam faces land availability issues for solar plants, the state should go ahead with procuring RE capacity in other states through Solar Energy Corporation of India (SECI), since there is a total waiver of transmission charges.
12. Availability of waste land in Assam is very low and of what is available falls under the floodplains. About 30-40% of total land available in Assam is in floodplains.
13. It was highlighted that off-grid RE can be a solution to increase RE in the state, especially in the far-flung hilly areas. The newly available battery technology can further help these decentralized applications.
14. Solar Policy for Assam is being reviewed and industrial demand for solar is being looked upon and will be addressed in the newer version of the policy. AEDA as the state nodal agency is working with govt. and APDCL to promote solar rooftop plants in RESCO mode in institutional sectors.
15. On biomass energy prospects, it was mentioned that newer estimations are required especially for the rice growing areas. On being asked about any movement in the compressed biogas plants in state, AEDA informed that currently there is no such plant planned however, potential is high. He informed that Numaligarh Refinery Limited is putting up a plant to harness ethanol from Bamboo wastes.
16. Older power plants can be refurbished to achieve better efficiency in the sector
17. It was concluded that since Assam is a largely gas and hydro based power sector which are both highly flexible, a large amount of solar capacity can be added in the state. However, this will require a highly sophisticated Load Dispatch Centre. This however can be done in a short period of time and result in rapid reduction in emission intensity of the state.

## Agenda of the Webinar:

Integrated Research and Action for Development (IRADe)

Supported by MacArthur Foundation

# Agenda

### Enabling State Level Strategic Actions for India's NDC
**|Assam Chapter|**
**Date: 14th December, 2020**

| **Webinar cum Policy Dialogue on Energy & Climate Change** | | |
|---|---|---|
| **3:15 - 3:55 PM** | **Session I – Inaugural Session** | |
| | **Welcome Address** | ***Dr. Jyoti K. Parikh***<br>*Executive Director, Integrated Research and Action for Development (IRADe)* |
| | **Special Remarks** | ***Ms. Moutushi Sengupta***<br>*Director, India Office, MacArthur Foundation* |
| | **Special Address** | ***Shri S. N. Kalita***<br>Member (Technical), Assam Electricity Regulatory Commission (AERC) |
| | **Inaugural Note** | ***Shri. Niraj Verma, IAS,*** *Principal Secretary, Power Department, Principal Secretary, Urban Development Department, Personnel and A.R. Training Department Government of Assam* |
| **3:55 - 5:00 PM** | **Session II- Adapting Energy and Power Sector to meet NDC's Target** | |
| **3:55 - 4:10 PM** | Context setting presentation based on Sectoral Discussion Paper for Assam prepared by IRADe researchers; delivered by **Mr. Kumar Abhishek, Research Analyst, IRADe** | |
| **4:10 – 5:00** | **Session Chair** | ***Prof. Kirit Parikh***<br>*Chairman, Integrated Research and Action for Development (IRADe)* |
| | **Remarks by Panelists** | ▪ ***Shri Akhil Chandra Khataniar,*** Chief Electrical Inspector -cum- Adviser, (i/c), Govt. of Assam<br>▪ ***Shri Mrinal K. Choudhury,*** Additional Director, Assam Energy Development Agency (AEDA)<br>▪ ***Shri V. K. Agrawal***, Technical Director, SARI/EI, IRADe Ex-Executive Director, Power System Operation Corporation<br>▪ ***Dr. Chandra Kiran B Krishnamurthy***, Consultant - Power Sector, MacArthur Project; Assistant Professor, Department of Forest Economics, Swedish Univ. of Agricultural Sciences, UMEA, Sweden |
| | **Chair and Panelists remarks followed by open discussion** | |

| | | |
|---|---|---|
| **5:00 – 5:55 PM** | **Session III - Promoting the Use of Solar Water Pump in the Agriculture Sector** | |
| **5:00 - 5:15 PM** | Context setting presentation based on Sectoral Discussion Paper for Assam prepared by IRADe researchers; delivered by **Mr. Chandrashekhar Singh, Sr. Research Analyst, IRADe** | |
| **5:15 – 5:55** | **Session Chair** | ***Dr. Tushaar Shah,*** *Senior Fellow, International Institute of Water Management India* |
| | **Remarks by Panelists** | ▪ ***Ms. Mina Deka,*** Senior Research Officer, Irrigation Department, Government of Assam<br>▪ ***Mr. Ashok Kr. Sarma,*** Executive Engineer, Agriculture Department, Government of Assam (tbc)<br>▪ ***Mr. Jyotiska Barua,*** Assistant General Manager (NRE), Assam Power Distribution Company Limited (APDCL)<br>▪ ***Mr. Ashok Thakuria,*** Director, Planning, Irrigation Department, GoA |
| | **Chair and Panelists remarks followed by an open discussion** | |
| **5:55 – 6:00 PM** | **Closing Address** & *Vote of Thanks* | ***Shri. Pankaj Batra, Project Director IRADe- SARI/EI***<br>*Ex-Chairperson (I/c) & Member (Planning), Central Electricity Authority* |