

# Power Demand and Supply Analysis of Guwahati

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**ABSTRACT:** Power availability and power quality are two issues which are pivotal to power generation and distribution. Power quality primarily focuses on the fact that the power supplied to the consumers should be free from any sort of disturbances, whereas power availability guarantees the continuous delivery of power without interruption and outages. This is also to ensure proper functioning of equipments on the receiving end. With the advent of technology, power demand is on an ever-increase streak and thus the power supply and demand gap has always been one of the hurdles in the course of power distribution in a particular region. Guwahati is soon going to be a smart-city and with rapid expansion and development of the city power demand will increase manifold in the near future. A robust, uninterrupted power supply system the basic element of a smart-city. This project mainly aims at the analysis of the demand-supply pattern of Guwahati city of Assam. A brief work is presented by taking into account the financial year from April 2015 to March 2016. Various substations are visited in order to gather the data of the grid and the distribution levels and also as to provide an analysis of the cost of production. A decrease in the power supply and demand gap will be a major step towards meeting the national objective of 24x7 power to all through enhancement in access of consumers to grid-connected power supply by improving the availability and reliability, thereby facilitating inclusive growth of the region.

**KEYWORDS:** Affordable Power, Demand, Supply, Generation, Distribution, Substation, Grid, Cost, Smart-city, Single Line Diagram(SLD), Sub-station, Un-reserved Power(URP), Guwahati Electrical Circle(GEC).

## I. INTRODUCTION

The power-starved North-Eastern (N-E) Region, comprising Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura, is blessed with a huge hydro potential. The region also has abundant resource of coal, oil and gas for thermal power generation. With this reserve in the NE Region, approximately 240 MW/day can be generated for a period of 100 years. Assam also possesses immense potential for development of the power sector based on hydel power. However, despite being a storehouse of power, ranging from hydel to natural gas including oil and coal resources, the progress of this sector in Assam has not taken place on a scale commensurate with the possibilities. As a result, there exists a big gap between availability and demand for power in the state. On the contrary, consumption of power in the state has been increasing in the recent years. The power generation in the state has gradually declined from the year 1996-97 and this downward trend continued till 2002-2003. During the year 2001-2002, the generation of power has decreased by 10.1 per cent as compared to the previous year and it further declined by 11.2 per cent during the year 2002-2003. In order to meet the domestic demand, the state has been purchasing power from other sources. The power supply position in the state is expected to improve considerably in the coming years with the materialization of projects under the state sector.

The domestic generation, transmission and distribution activities in Assam are handled by the three companies; viz. Assam Power Generation Company Limited (APGCL), Assam Electricity Grid Corporation Limited (AEGCL) and Assam Power Distribution Company Limited (APDCL). The companies have made all out endeavour to improve the power supply position of the state and APDCL is now supplying power to the extent of 95% to 100% during Off- peak hours and to 90 to 95 % during Peak (evening) hours. It is a fact that there has been a steep increase of demand for power during the last 3-4 years in the state. In Guwahati alone in the past five years, there has been a threefold increase in demand for power. Until a couple of years back, only 16% rural households were electrified, which has now enhanced to about 50%; but as per the National Electricity Policy, steps have been undertaken to electrify every household of Assam

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by the year 2019. As such, there has been a great increase in demand for power in the rural as well as urban areas in recent times.

Also with the increased development and better economic activities during the last few years, this year, Assam has been experiencing an average peak demand for power to the tune of 1400 MW. This is approximately 2 (two) times what it was five years ago. It is a matter of cheer that the 726 MW OTPC power project located at Palatana in Tripura has now been commissioned to generate and Assam is getting its share to a tune of 200MW which has contributed in reducing demand supply gap. Further, to tide over this shortfall due to increasing demand APDCL is exploring different sources of power. In this endeavour, APDCL has managed to procure power from DVC and NTPC to avoid inconvenience of loads shading to the esteemed consumers. Till now, Assam is mainly dependent on hydro generations. This is about 60% of the total existing availability. Most of these hydro generators are sourced through Run of the River (RoR) which are solely dependent on the rainfall in the respective catchments areas. It was expected that these hydro generators would pick up to 100% of its capacity during this monsoon. Also, the gas based thermal power stations are generating far below their full capacity due to inadequate supply of gas etc. The much awaited NTPC, Bongaigaon has started its commercial operation from 2nd April, 2016. The share of Assam from this station is around 56%. With the synchronization of the first 250MW unit at Bongaigaon, the availability of power for APDCL has increased by around 130 MW. The total availability of power, at present, is around 1200 MW including State's own generations of about 260 MW. APDCL is making efforts to minimize this 200 MW deficit by procuring 100-150 MW from the open market. Efforts are also being made to enhance the percentage allocation of power to Assam from unallocated source in the Eastern Region.

Paper is organized as follows. Section II describes the Data Acquisition part that we have collected day wise by visiting different sub-stations in Guwahati. After that, the collected power data has been analysed in Section III. Section IV presents the economic analysis of power. Finally, Section V presents conclusion.

## II. DATA ACQUISITION

Guwahati city is divided into 2 electrical circles: GEC-I and GEC-II. We have visited the following substation inside Guwahati electrical circle for data acquisition:

### 1. 132 kV/ 33kV Kahilipara substation:

Transformation Capacity: 3x30 MVA, 132/33 kV, 2x10 MVA, 132/33/11 kV.

The **incoming feeders** are – Sarusajai-1, Sarusajai-2, Sarusajai-3, Sarusajai-4, Sishugram, Meghalaya-1, Meghalaya-2, Rangia, Narengi, and Dispur

The **outgoing feeders** are-Jalukbari, Nabard, Jwaharnagar-1, Jwaharnagar-2, Narengi, Paltanbazar-1, Paltanbazar-2, Medical-1, Medical-2, Barsapara, Ulubari-1, Ulubari -2, APDCL SS, Fatasil

### 2. 132 kV Sarusajai 1 &2:

The Sarusajai substation was completed by the year 1986 under AEGCL. The substation has a capacity of 220/132kV using three input lines through the **incoming feeders** namely- AGIA-1, AGIA-2, SAMAGURI-1, SAMAGURI-2, MIRZA-1, and MIRZA-2. The substation has another substation under it - **Sarusajai- 2**. The capacity of the substations is 132/33Kv. This substation was completed by the year 1997 under AEGCL. The **outgoing feeders** of the 132/33kV Sarusajai station are- Jwaharnagar, Mirza, Garbhanga, Paltanbazar and Kahilipara station.

### 3. 440 kV Mirza substation:

The Mirza substation is the only 400kV substation of AEGCL and it is one of the largest substations in North- East. It is situated approximately 27 kms away from Guwahati city. It consists of 2\*315 MVA transformer units. The **incoming feeders** to the substations are- 220 kV Bongaigaon, 440 kV OTPC Tripura via Silchar.

The **outgoing lines** are- 132kV line to Sarusajai-1, 132kV line to Sarusajai-2

### 4. 33 kV Jalukbari substation:

**Incoming lines** are from Sarusajai at 33kV.

The **outgoing lines** are- Gauhati University, Assam engineering College, Azara, and Boraogaon at 11kV.

### 5. 33 kV Garigaon substation: Specification of the substation- 33/11kV.

### 6. State Load Dispatch Centre, Kahilipara:

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It was established in the year 1983 is located at Kahilipara, Guwahati. SLDC, Assam is presently being operated by the state transmission utility Assam Electricity Grid Corporation Ltd. (AEGCL). It monitors & operates the state grid of Assam on real time basis through optimum scheduling & dispatch in secure and economic ways, and in accordance with the provisions of Indian Electricity Grid Code (IEGC) and State Grid Code, SLDC, Kahilipara, keeps account of the quantity of electricity transmitted through the state grid including the energy exchanged through Power Exchange entities, and bi-lateral trading through Open Access system and complies with the operational guide-lines of NERLDC and NLDC for overall system stability and security.

## 7. Bijuli Bhawan, Paltanbazar, Guwahati:

It is the Head Quarters of Assam State Electricity Board and its successor Companies- APGCL, AEGCL and APGCL. Bi-lateral trading through open access system is handled by commercial wing of APDCL based at Bijuli Bhawan.

### III. DATA ANALYSIS

We have considered the time period from April 2015- March 2016 which has been divide into 4 quarters. All the feeders feeding the state are dispatched from SLDC Kahilipara. Out of all the feeders we have considered only those feeders which feed Guwahati. We have considered hour wise power carried by those feeders for each month and taken the monthly average for analysis

Tools Used: Microsoft Office excel 2007.

**3.1: Grid map:** The figures below show the electricity grid network of Assam and Single Line Diagram of Kahilipara SS. We have considered electrical area of Guwahati which is marked by a red circle on the above map.

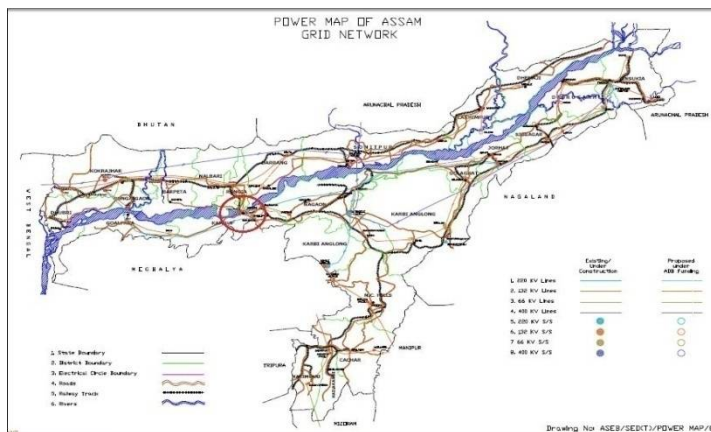


Figure 3.1: Assam Grid map

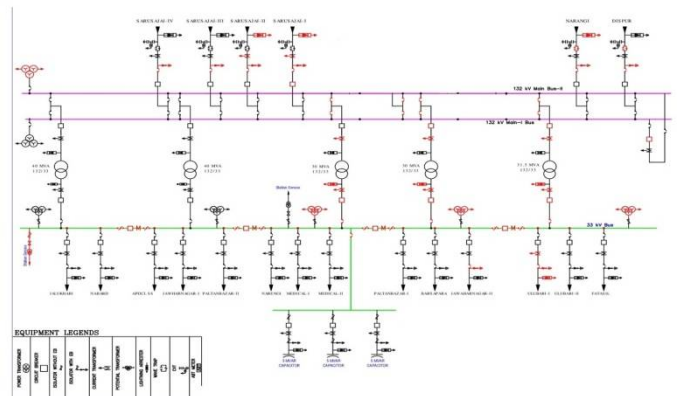


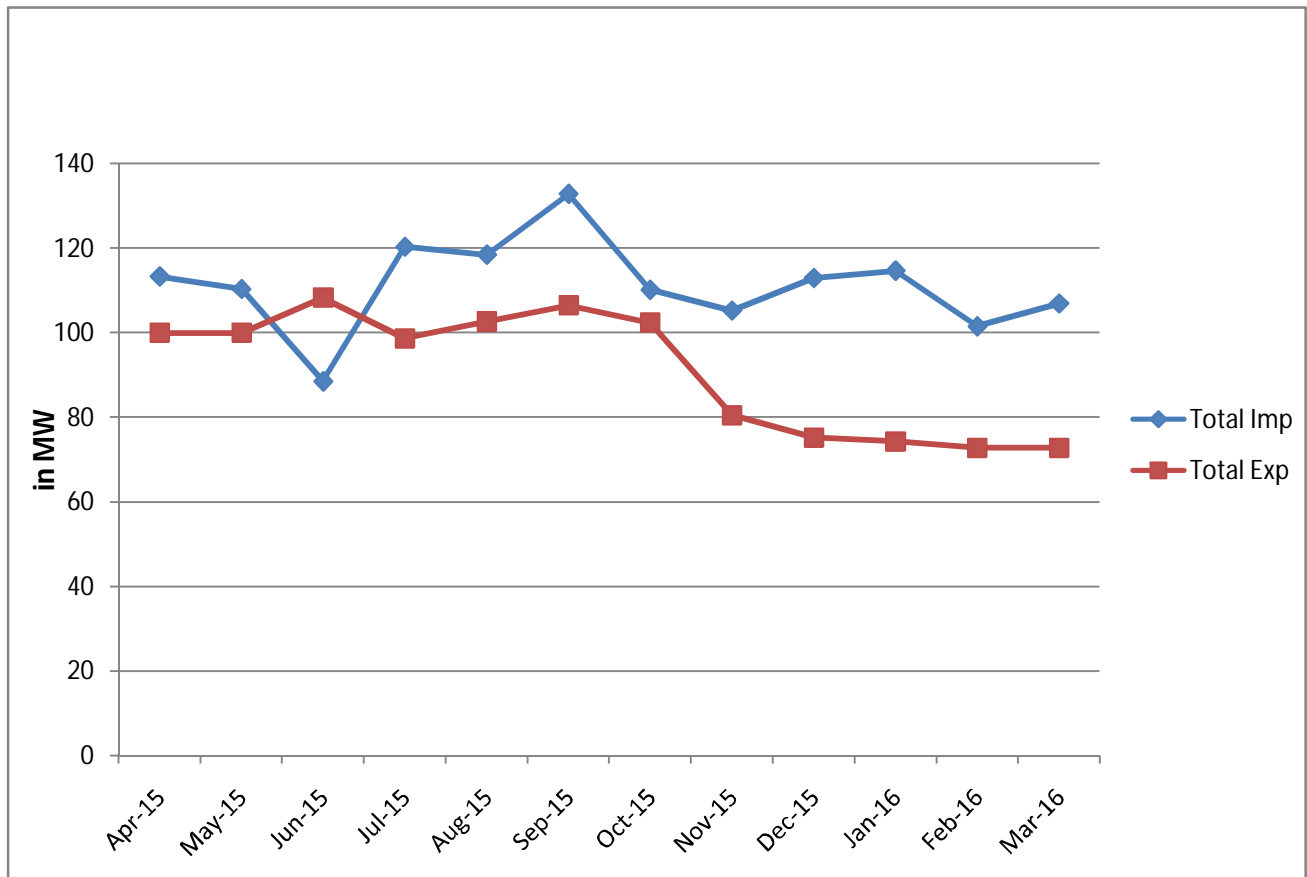
Figure 3.2: SLD of Kahilipara SS

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### 3.2: Average Demand-Availability analysis of Guwahati:



**Figure 3.3: Total Load-Supply analysis for FY 15**

Fig-3.3 shows the average import-export analysis of power in Guwahati city for the period April, 2015 to March, 2016. The square dots represent the monthly averages of demand and supply (i.e. blue dots for import/supply and the red one for the export/demand). We have seen that in the month of June, 2015 the demand exceeds the supply. The reasons for such a situation might be due to the high demand of power in the summer season and maintenance activities that were going on at LTPS and NTPS. Here Rangia and Bongaingaon feeders have not been taken into account since they are out of the locality of Guwahati. So the supply here is more than the demand in the graph.

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### 3.3: Analysis for summer season:

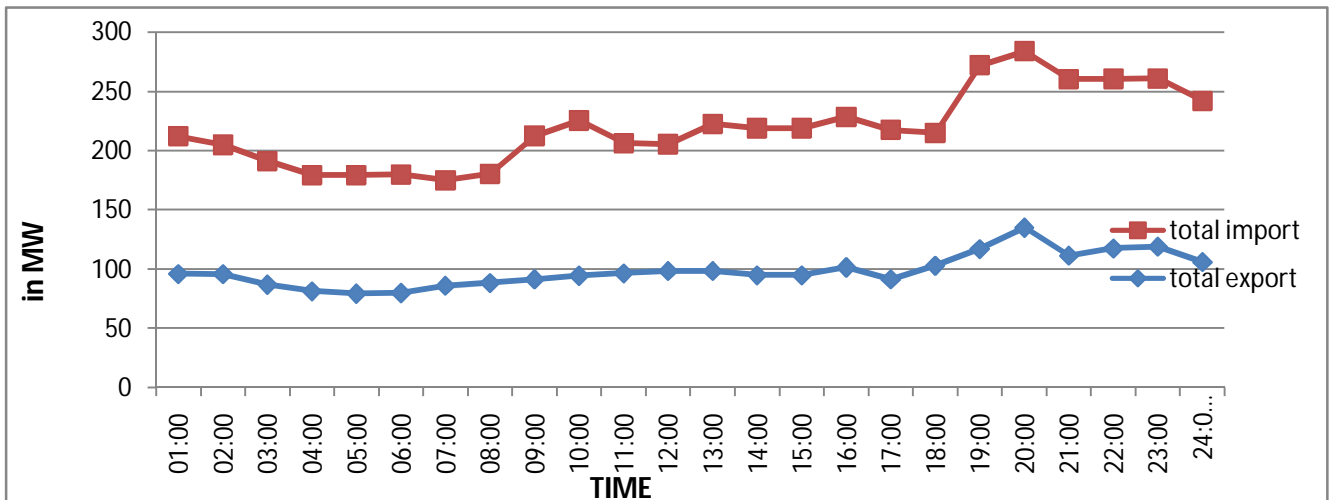


Figure 3.4: Export-Import during summer

Here, the graph shows that the average demand in a day is nearly 100 MW in the summer season of the year. This is obvious due to the fact that in the summer season various power consuming appliances run in households (e.g. fans, AC, cooler, cold storage, deep refrigeration etc.) as well as increased agricultural activities (irrigation etc.). During the season, the generation (especially Hydro) also reaches peak because of the ample water reserve due to adequate rainfall.

### 3.4: Analysis for winter season:

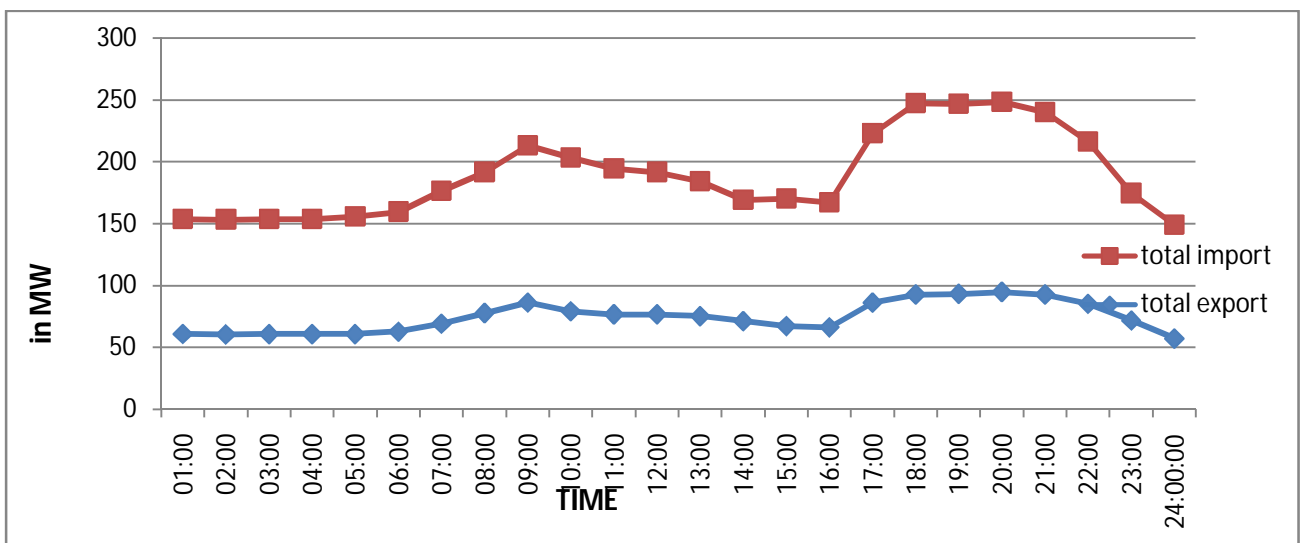


Figure 3.5: Export-Import during winter

Here, the graph shows that the demand lowers to the range of 50-100 MW in the winter season of the year. Because application of energy consuming appliances (Both household as well as agricultural) reduces as compared to

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the summer, though demand reaches nearly 100 MW during peak hours. The hydro generation also reduces due to lack of sufficient water head.

### 3.5: Breakdown of External vs APGCL import for Guwahati (Generation wise):

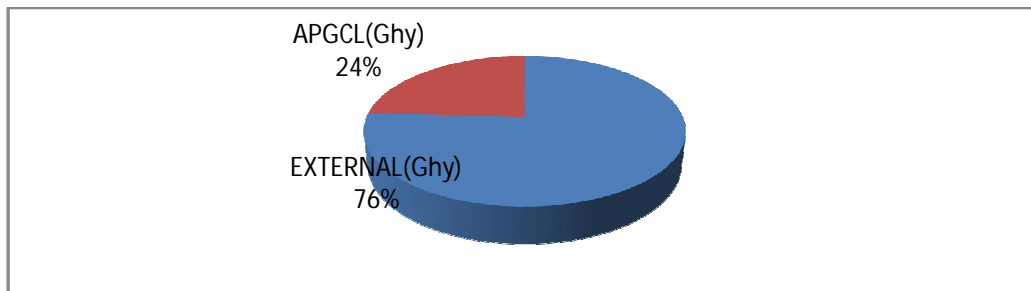


Figure 3.6: AEGCL generation vs. External generation

Feeders in Guwahati are fed mainly from two sources: one being our own generation by APGCL and the other is external sources (like NEEPCO, OTPC, NTPC etc.) as per contract signed. As we can see the contribution made by APGCL is very low. Hence there is a scope for improvement in the domestic generation.

### 3.6: Allocation of Total Generation to Guwahati vs Rest of Assam:

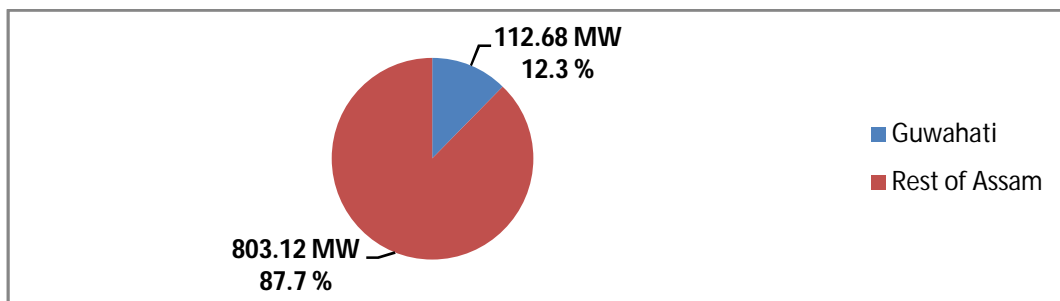


Figure 3.7: Allocation of total generation in state to Guwahati

Average daily generation of our state is around 1000 MW. Which includes generation by own APGCL and share from other central govt. generation companies. As shown by the above pie-chart, Guwahati draws around 120 MW daily which is 13% of the total generation. In the years to come, the share of Guwahati will increase considerably because the city is expanding at a rapid pace. Also the implementation of Smart city project will considerably increase the demand for electricity.

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### 3.7: Electricity purchased by Assam from different sources in Million Unit (MU):

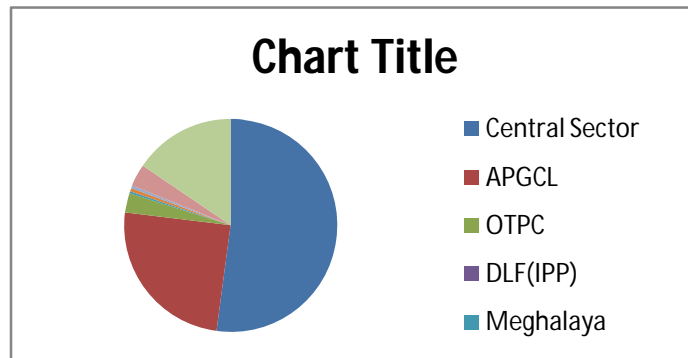


Figure 3.8: Breakdown of energy sources

Above diagram shown the distribution of own generation (APGCL), share of Assam from other CPSU generation and purchase from open market. As shown by the above chart, central sector contributes the most. Generation of state-owned APGCL stands at 2nd position. Bilateral purchase contributes significantly, as it is the 3rd most crucial contributor. Remaining portion is contributed by OTPC, Non-conventional sources, IOCL (AOD), Meghalaya, DLF etc.

## IV. ECONOMIC ANALYSIS

The net demand at present scenario is approximately 1400 MW in Assam. To meet the required demand power is imported from the following areas:

### 4.1: Own generation (Assam Power Generation Company Limited)

- Namrup Thermal Power Station (Installed generation capacity- 111 MW)
  - Lakwa Thermal Power Station (Installed generation capacity- 157 MW)
  - Karbi Langpi Hydro Electric Power Station (Installed generation capacity- 100 MW)
- Total expected generation- 368 MW

### 4.2: Central Sector (NER region)

- National Thermal Power Corporation (NTPC)
  - North Eastern Electrical Power Corporation Limited (NEEPCO)
  - OTPC (ONGC Tripura Power Corporation)
- ER region: Through North-Eastern grid via Siliguri.

### 4.3: Bilateral (Bidding and trading)

- TATA (Private)
- DLF (PPP Mode)
- UR
  - Power obtained from own generation- 200 MW approx. (at present) and rest of the demand is fulfilled through the central grid.
  - Total revenue earned from own generation (APGCL) was 63,309.07 lakhs and total expenditure was 64,902.11 lakhs in 2015.

### 4.4 Per unit cost:

A detailed study was made for evaluating the difference between own generation (power generated by APGCL) and buying of power from the national power market and the following conclusions were obtained in terms of per unit cost. Per unit cost is calculated considering the fixed, variable and transmission cost.

- ❖ For own generation per unit cost - Rs. 4.00-4.73
- ❖ For Palatana (Tripura), per unit cost- Rs. 2.93

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- ❖ For Kopili, per unit cost- Rs. 0.50( initially), Rs. 0.95( present)
- ❖ From the central sector, power is purchased at the rate of Rs. 3.00- 4.00

### 4.5: Comparative Analysis of cost:

After proper evaluation we have concluded that buying power from the national power market is more profitable than generating power on our own as the own generation includes expenditures like scheduled maintenance, O&M cost, replacement, Human resource cost, fuel cost , depreciation cost etc. Moreover, the plants sometimes suffer from fuel deficit (for e.g., in Lakwa gas based plant, there is deficit of gas for which the generation has come down at present) which in turn can cause a sudden drop in supply. Though buying power from open exchange is more profitable, but we cannot fulfil the present requirement through purchase only because we are not supposed to cross a power drawn limit as set by CERC as there is only one corridor for north eastern region for power exchange and capacity which is limited to 290 MW only.

The power obtained from various sources to meet the required demand is shown in the graph below:

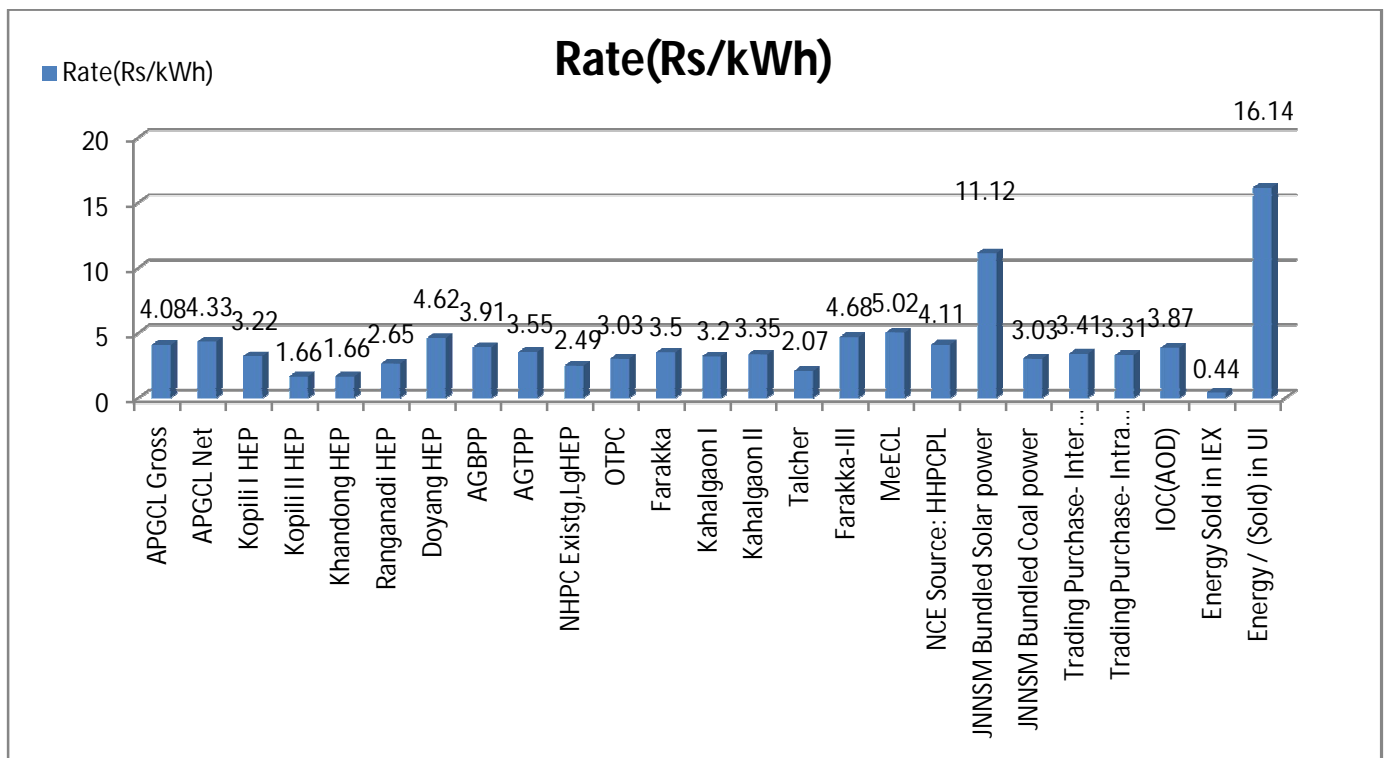


Figure 4.1: Per unit cost for different source

### V. CONCLUSION

As Guwahati endeavors to be a smart city soon , it needs to have a robust electricity supply network to provide 24x7 electricity to the urban dwellers. But from our study we have found that **APDCL** still faces a considerable **T&D losses** of **23.19%**. Our own generation is not sufficient enough to meet the peak electricity demand of state. This gap is bridged by the allocated power from Central Sector Generating Stations (NTPC, NEEPCO & NHPC) and purchase through bilateral transactions. Many projects are currently underway to increase our own generation. Huge efforts have been made by APDCL to reduce the transmission and distribution losses by modernizing our T&D network and energy auditing. Revenue loss has also been mitigated through installation of smart energy meters at all the households of the city in a phased manner. As per as the merit rate, it is profitable to purchase power from the zone which provides power



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with the cheapest price than to generate on our own. Currently North-Eastern grid is connected to National grid (Eastern region) through only one corridor that passes through Siliguri. The corridor capacity is restricted by NLDC. As only one corridor is available for power exchange, so it is feasible to follow the merit rate and we have to rely on our own generation. Currently our state purchases nearly 400 MW of power daily to meet the peak hours demand. Recently state's power sector has been severely hit by reduction of transmission capacity of chicken-neck corridor of the NER grid from 520MW to 290MW by NLDC. Two types of measures should be taken to tackle the power crisis in Assam in particular and North-East in general.

### ❖ Long term measures:

1. Utilize the enormous hydroelectric potential of north-east by constructing mega-hydel project (more than 1000MW) with central govt. support after duly considering all possible socio-economic-geographical aspects and downstream effect. Also state govt. can construct economically more viable Small Hydel Plants(SHPs)(less than 20MW) on various rivers of the state.
2. Assam is also blessed with huge reserves of natural gas and limited source of coal. These natural resources can be properly utilized in thermal power plants with help from financial institutions.
3. Explore different renewable energy sources and add the renewable energy produced to the main grid.
4. Leverage cutting-edge technology to minimize T&D losses and to improve overall system efficiency.

### ❖ Short-term measures:

1. Promoting the use of energy efficient lighting solutions such as LED , energy efficient home appliances etc.
2. Promoting the use of roof-top solar panels in govt. institutions, public installations and even on individual scale also.
3. Increase awareness on energy conservation.
4. Ensuring 100% smart energy metering throughout the state and putting into place an effective and corruption free revenue collection system.

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