ELECTRICAL POWER CONSUMPTION OF MYSURU CITY FROM 2015-16* TO 2018-19 AND SOLAR ROOFTOP PHOTOVOLTAIC SYSTEM GROWTH IN MYSURU CITY- A CASE STUDY

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Abstract: In this paper, a study of electrical power consumption of Mysuru city from 2015-16 to 2018-19 is carried out. The main electrical consumption sectors are residential, commercial, industrial and other sectors that include street lighting, water pumping, and education institutions. For the year ended 2018-2019, the electrical power consumption of Mysuru city stands at 1192.97 million units (MU). During this period, the customer base has increased to 5, 83,509 from 5,60,613 during the financial year 2017-18 showing a healthy increase of 4% Also, the paper provides information on the potential of solar energy in Mysuru city which can be tapped to supplement the traditional non-renewable electrical power being supplied by the Government-owned Chamundeshwari Electricity Supply Corporation Limited (CESC). It is found that at present, the total solar power production from rooftop photovoltaic systems in Mysuru stands at 3.36 MW. The solar potential over Mysuru as per the RET screen software is around 5.09 kWh/m^2/day.

I. Introduction

For the growth of any economy electrical power is the engine. The sustainability of any major economy depends upon the adequate and reliable supply of power. The challenge is getting tougher day by day in the context of expanding population and reducing resources. Though, "energy can neither be created nor be destroyed" seems to be simple we are all aware that sources of energy are limited and the non-renewable energy sources such as gas, coal, oil, etc, are fast depleting. So the need to conserve energy has now been universally acknowledged in order to save the scarce. Present scenario of Indian energy sector reveals that the demand is increasing at a rate of 5 to 6% [1] per annum and generating capacity is increasing at a rate of 4.5 to 5.5% [1] per annum. So the gap between demand and supply is increasing at the rate of 0.5 % per annum with peak demand shortage less than 1% [1].

As on August 21st 2019, India's installed generating capacity stood at 3,60,456 MW, consisting of 2,27,644 MW of installed generating capacity of the thermal power plants, 45,399 MW of hydro plants, 80,633 MW of renewable energy sources and 6,780 MW of nuclear energy [2]. The power sector has developed considerably over the years with demand rising at a faster pace. In our country, it is required to increase the power generating capacity as well as to ensure the availability of power to all to meet the growing needs and to sustain economic growth. The need of the hour is the development of clean energy technologies in order to meet the worldwide challenges of climate change, sustainable development and energy security. In the future, Solar Photovoltaic will be the most important technology to shift to a decarbonized energy and it will surely emerge as an effective alternate electricity source. As of July 31st 2019, the solar PV grid connected capacity in India stood at 30,071.35 MWp [3]. In India solar energy is a fast growing industry. India's solar-generation capacity expanded from 2,650 MW on 26th May 2014 to over 30,070 MW in July 31st 2019.

The 20,000 MW capacities were initially targeted for 2022, but the target achieved by the government four years ahead of schedule. The country added a solar capacity of 3,000 MW in 2015-2016, 6,000 MW in 2016-2017 and over 11,000 MW in 2017-2018 [4], with the current price of solar electricity normally dropping to 15% below the average price of coal-fired stations [4]. The growth of solar is very promising and will increase significantly in coming years.

II. Power Scenario of Mysuru

2.1 Mysuru Profile

Mysuru is one of the historical cities located in the Karnataka state and is one of the largest districts in Karnataka. Mysuru is also known as palace city. The city is at 763 m above sea level and is 135 km from the state capital, Bengaluru [5]. As of 2017, Mysuru city had an estimated population of 10,14,227 [6]. The population of Mysuru is growing rapidly due to industrialization and migration of people from rural areas and other cities which will have a direct bearing on power consumption.

2.2 A study on Electrical Power Consumption of Mysuru City

Mysuru city is under the supervision of Chamundeshwari Electricity Supply Corporation (CESC) limited. CESC was established to manage the electric power distribution of five districts. CESC has been functional since 1st April 2005 and its headquarters at Mysuru itself. The various districts like Mysuru, Mandya, Hassan, Chamarajanagar, and Madikeri come under the CESC authority. The Mysuru city is divided into two divisions mainly N R Division and V V Mohalla. CESC supplies electricity to the famous industries like TVS, Nestle, Infosys, Asian Paints, JK Tyres, and Wipro etc.

***2015-16, 2017-18, 2018-19: Financial Year (April to March)**

The primary energy consuming sectors are commercial, residential, industrial and others which include street lighting, water pumping, and educational institutions.

Source: CESC Data

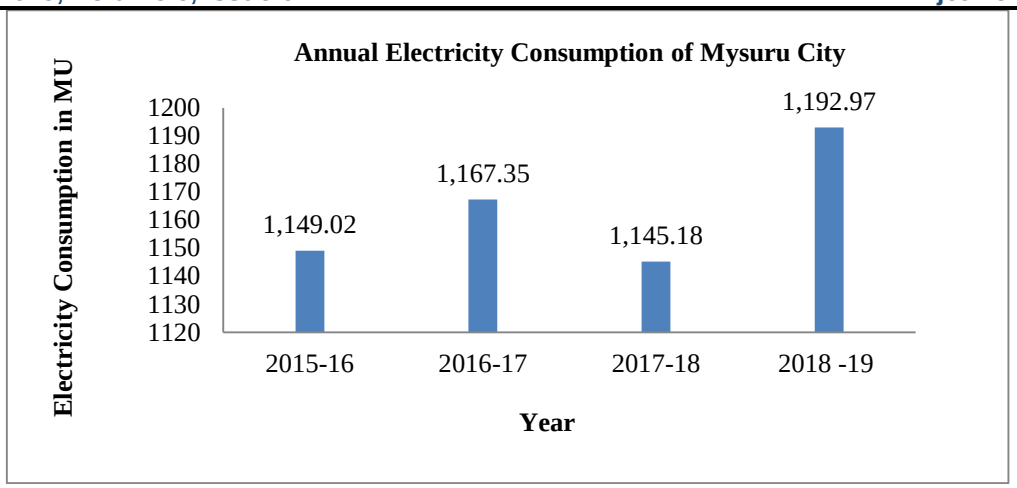

Figure 2. Annual Electricity Consumption of Mysuru city

It can be observed that the electricity consumption has steadily increased over the years except 2017-18. The dip in electricity consumption in 2017-18, according to CESC officials was due to slow down in the industrial, construction sectors, installation of solar rooftop PV system and some major industries drawing electricity directly from the power producing stations which CESC terms as wheeled energy. Therefore, it may be concluded that the total energy consumption continued to increase.

Source: CESC Data

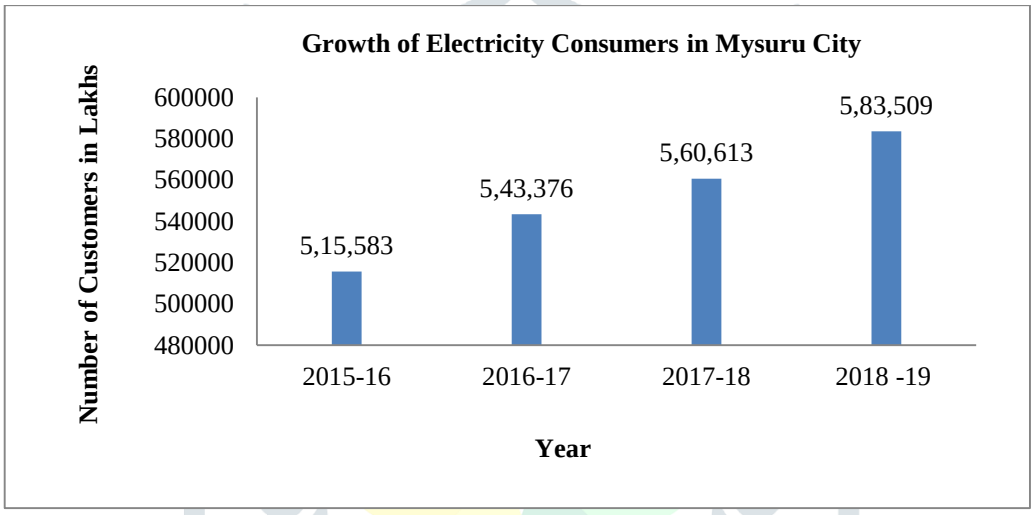

Figure 3. Consumer Growth from the year 2015-16 to 2018-19

It can be seen from Fig. 3, the number of customers is increasing year on year. The number of customers drawing electricity from CESC, Mysuru is steadily increasing and around 17,000 new customers are added each year. It is evident that the demand is increasing which is a positive thing.

2.2.1 Residential Sector

The households of Mysuru comprise of low, medium and high-income levels. As of 2018-19 there are 4,66,850 households with electricity connection from CESC Mysuru. In residential sector of Mysuru, the electricity consumption is increasing rapidly as shown in Fig. 4.

Source: CESC Data

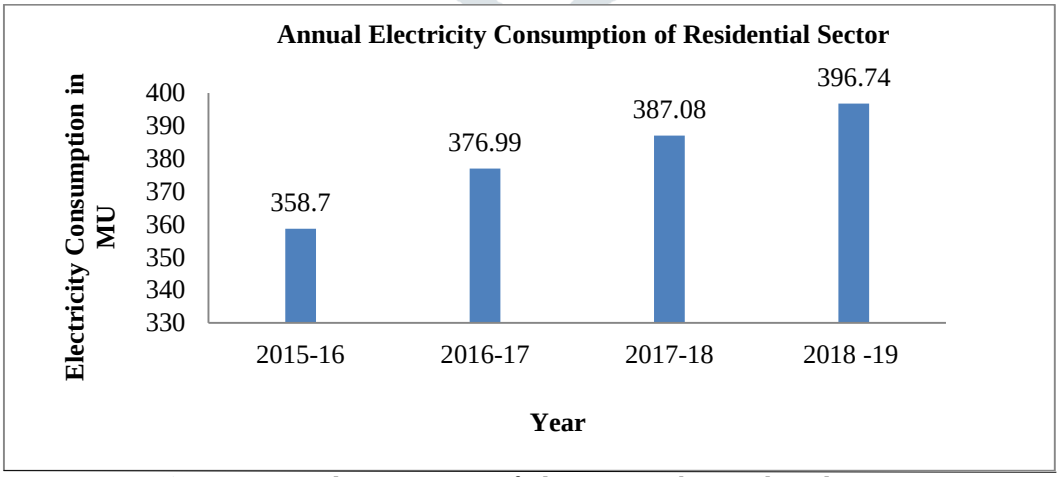

Figure 4. Annual Consumption of Electricity in the Residential Sector

2.2.2 Commercial Sector

The commercial sector accounts for 15% of the total connections from CESC. The total numbers of commercial consumers in 2018-19 are 72,714 while there were only 64,031 in 2015-16. The Fig. 5 presents the annual electricity consumption of commercial consumers in Mysuru from 2015-16 to 2018-19.

Source: CESC Data

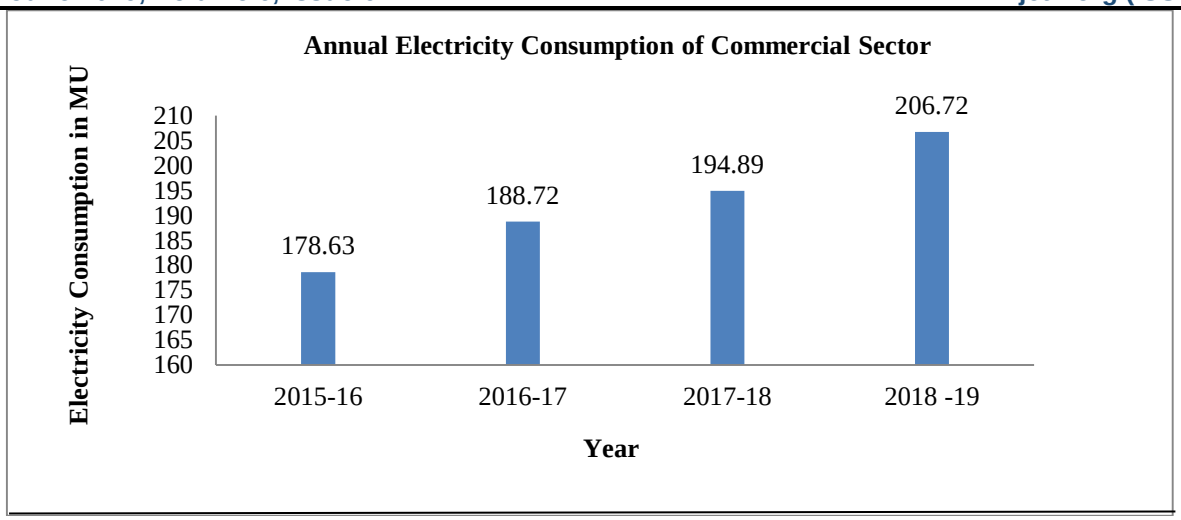

Figure 5. Annual Electricity Consumption of Commercial Sector

It can be seen that the electrical consumption in this sector is increasing, resulting in increased revenues to the CESC.

2.2.3 Industrial Sector

From the past several years, the growth of industries in Mysore city is gradually increased. Mysuru has become an excellent industrial hub after Bengaluru due to good infrastructure, good weather throughout the year and policies of the corporation. As of present, there are 8,651 industrial connections connected to CESC Mysuru. The following graph shows the electrical consumption of industries in Mysuru.

Source: CESC Data

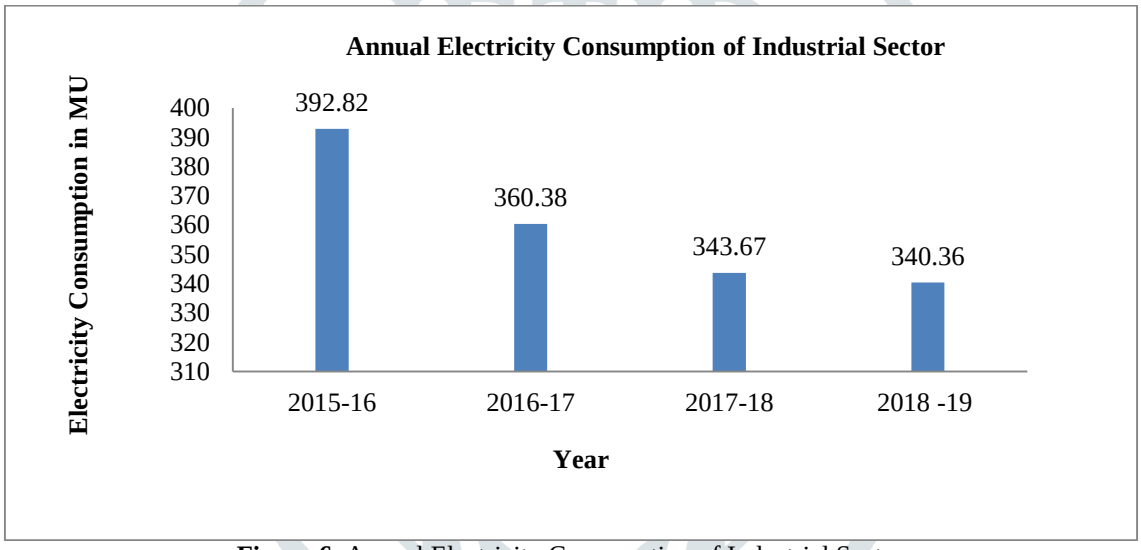

Figure 6. Annual Electricity Consumption of Industrial Sector

It can be seen that the electrical consumption was high in 2015-16 with 392.82 MU but the consumption has seen a dip in 2016-17, 2017-18 and 2018-19. The reason according to the CESC official is that due to muted growth in industries, industries were generating their own energy by installing solar rooftop photovoltaic systems and also drawing electricity directly from the power producing stations which is referred as wheeled energy.

2.2.4 Other Sectors

The other sectors consist of hospitals, educational institutions, street lightings, water supply stations and lift irrigation. Fig. 7 shows the electrical consumption in these sectors year-wise.

Source: CESC Data

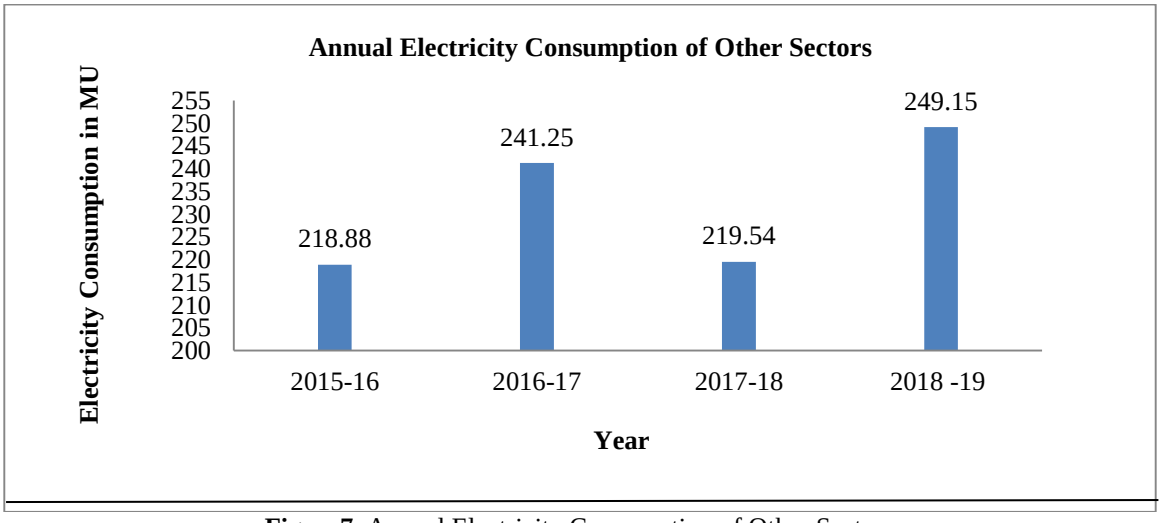

Figure7. Annual Electricity Consumption of Other Sectors

It can be concluded from the graph the electrical consumption in other sectors showed a decreasing trend in 2017-18 due to slow down in infrastructure constructions around Mysuru, good rainfall which reduced the load on the pump set, installation of solar street lightings in Mysuru but for 2018-19 the electrical consumption increased due to turnaround in infrastructure constructions and poor rainfall.

III. Solar Energy as a Potential Renewable Energy Strategy for Mysuru

This topic gives the detail on availability of solar energy in Mysuru, tariff rate for various kilowatts and installation data from 2015-16 to 2017-18.

3.1 Geography of Mysuru

Mysuru is situated in the region of modest environment zone and obtains a good quantity of solar radiation throughout the year. The range of solar radiation is from 3.88 to 6.39 kWh/m^2/day. The longitude and latitude of Mysuru city are 76.7^0 E and 12.3^0 N. The climate of Mysuru comes under a tropical savanna climate. The summer periods are from February to May, the monsoon periods are from July to October and the winters are from December to January. The recorded highest temperature in Mysuru was 39.4 °C on 4th April 1917 and the lowest was 7.7 °C on 16th January 2012. Mysuru receives an average yearly rainfall of 804.2 mm [5].

As per the RET screen software, the annual solar radiation for Mysuru is about 5.09 kWh/m^2/day. The Fig. 8 shows the monthly values of solar radiation on horizontal surface at Mysuru.

Source: RET Screen

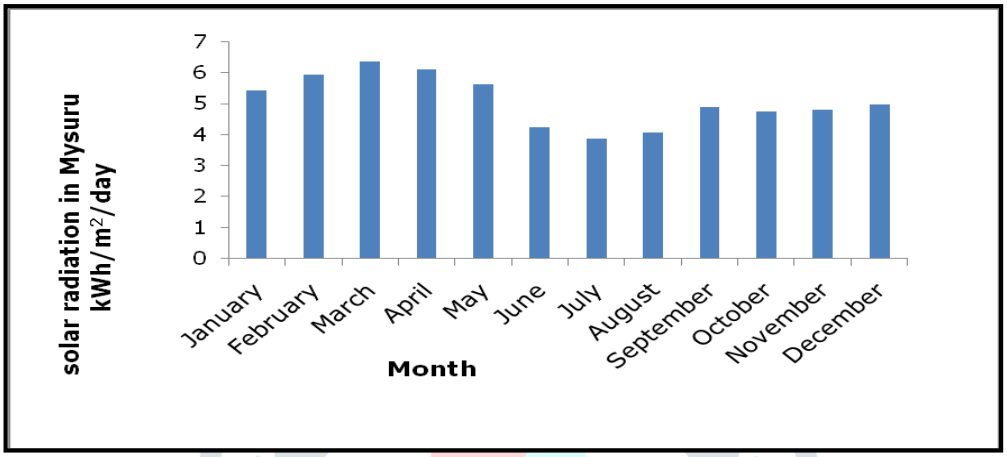

Figure 8. Solar radiation pattern over Mysuru

It can be seen that the solar radiation increases from January to May and reduces during the rainy season from June to October.

3.2 Solar Rooftop PV System

The cost of land in Mysuru is increasing as a result; it might be difficult to obtain a separate portion of land around Mysuru. The best alternative to this problem is the solar rooftop PV system.

It is seen that commercial sectors and municipal covers a significant area in Mysuru out of the entire city. Rooftop solar PV system is very much feasible in the city. It is seen a majority of commercial buildings, government buildings, have sufficient amount of roof area which is not being utilized. The solar rooftop PV systems of 100-500 kW are quite possible in commercial and other sectors while systems with capacities of 20-30 kW are achievable in the residential buildings [7].

3.3 Current Tariff with and without Subsidy

The tariff set for Solar Rooftop PV plants for the year 2018-19 is shown in detail [8].

Table 2. Solar Rooftop PV Tariffs for 2018-19

Solar Rooftop PV systems capacity	**Tariff approved in Rs/unit without Capital Subsidy**	**Tariff approved in Rs/unit with Capital Subsidy of 30%**
1 MW and Below	3.56	2.67
<5MW the tariff is Rs 3.05/unit		
Duration: 25 years		

The tariff rate of the year 2017-18 is shown in the table 3. [9]

Table 3. Solar Rooftop PV Tariffs for 2017-18

Solar Rooftop PV systems capacity	**Approved tariff in Rs/unit without Capital Subsidy**	**Approved tariff in Rs/unit with Capital Subsidy of 30%**
1 to 10 KW	7.08	6.03
>10 kW upto 50 kW	6.61	5.63
>50 kW upto 100 kW	6.14	5.23
>100 kW upto 500 kW	5.67	4.83
Above 500 kW upto 1 MW	5.2	4.43

By comparing both the table, conclusion can be drawn that the tariff rate has been slashed almost 50% compared to 2017-18. The main reason for the drastic reduction is attributed to two factors mainly

i. Progressively falling of solar panel prices i.e., it costs around Rs 30 to 50 per watt of power generated. [10][11]

ii. Power produced by coal and hydroelectric plants have become cheaper, hence, it is cheaper for CESC to buy power from neighbouring states than getting it from household. [12][13]

3.4 Collection of Solar Rooftop PV Data

The author visited the CSEC corporate office frequently to collect the data pertaining to solar roof top PV system. The data was collected in the form of excel sheets which contained the number of installations, customer name, and kW installed. It is shown in the Table 4 and 5.

Table 4. Installed Capacities in Mysuru

Year	Number of Connections	Installed Capacity, kW
2015-16	48	290.85
2016-17	70	1490.8
2017-18	66	1588

Source: CESC Data

It can be seen from the above Table 4 the number of installed capacity increased for the year 2017-18, the total installed capacity is 3.36 MW.

3.5 Solar Rooftop Installations based on Capacity

The data obtained were further grouped into subcategories based on kW for further understanding of the installed load.

Table 5. Installed Capacities based on kW year wise

The capacity of Solar Rooftop PV plants	No of Connections Year Wise		
	2015-16	2016-17	2017-18
1 to 10 KW	45	54	55
>10 kW upto 50 kW	03	12	07
>50 kW upto 100 kW	Nil	02	Nil
>100 kW	Nil	02	04
Total	48	70	66

Source: CESC Data

It can be seen that the highest number of installations are done in the range of 1 to 10 kW.

IV. Conclusion

This paper has attempted an assessment of electrical power consumption of Mysuru city along with the potential of solar rooftop PV systems for the city. The findings of the present study are concluded as:

- It is clear from the study that there has been an increasing demand for electricity in Mysuru city from 1145.18 MU in 2017-18 to 1192.97 MU during 2018-19 at a rate of 3 to 4% year to year.
- The electric consumption in industrial sectors decreased continuously for 2016-17, 2017-18, 2018-19 due to muted growth and drawing electricity directly from the power producing stations which is referred as wheeled energy.
- The solar potential for Mysuru according to RET screen is around 5.09 kWh/m^2/day which proves solar PV system has great scope and can act as an alternate for electricity drawn from conventional sources.
- Reducing the solar tariff will demotivate the public from coming forward to install the PV system
- The Central and State Government needs to come forward for arranging soft loans so that public will be motivated for installing solar rooftop photovoltaic system.

V. Acknowledgement

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