

# Consumption of Electricity in the Union Territory of Pondicherry during 1970-2015

Anindita Mitra

Guest Faculty, Department of Economics, Pondicherry University, Pondicherry, India

**ABSTRACT:** The growing industrialization and commercialization in the country has resulted in increasing demand for electricity in India. This is evident from the studies on power consumption by different uses and growth of different sectors which have always indicated a positive relationship indicating power consumption a main component of economic growth. Though there was a deficit of 973 MW in meeting its peak demand during 2016, India has exported power to Nepal, Bangladesh and Myanmar in 2016-17. The Union Territory of Pondicherry on the other hand has had a favourable scenario with a surplus power supply. This research is an attempt to study the sector wise growth in electricity consumption by the Union Territory of Pondicherry. Secondary time series data for the period of 1970-2015 has been collected from Statistical Abstracts and Handbooks of the Directorate of Economics and Statistics, Pondicherry, records of the Central Electricity Authority and Handbook of Statistics published by Reserve Bank of India. Percentage, growth and regression tools have been used to analyze the growth rate in overall electricity consumption and by sectors over the study period. Rapid industrialization in the Union Territory since 1985-86 has caused exponential growth in power consumption by industrial, domestic sectors while reduced power consumption by agricultural sector.

**KEYWORDS:** power consumption, demand, economic growth, electricity, Pondicherry

## I. INTRODUCTION

Energy in the form of electricity among others is the most important of all inventions, which we depend on. It is a universal energy resource that is obtained from such other energy sources as thermal power, solar power, hydropower, wind power, natural gas, and the like. It is a keystone of human life and prosperity and a critical component and determinant of a nation's development. The Indian economy has demanded growth in the power sector at every stage of its development. An electricity-GDP elasticity of 0.8 indicates that electricity will continue to remain a key input for India's economic growth.

In the Five Year Plans, the outlay in the power sector shows an increase from Rs.393.4 crore in the First Five Year Plan to Rs.960542.4 crore in the Twelfth Five Year Plan. As a response, the power sector in India has also grown significantly since independence both in the installed capacity and transmission & distribution (T&D) system. India is now the fifth largest producer of electricity in the world with 871 billion KWh electricity generated annually (The World Factbook 2014)<sup>[9]</sup>. According to Central Electricity Authority, the rising appetite for electricity in India has necessitated an increase in the total power generating capacity from 1362 MW in 1947 to 267 GW in 2015.

Industrialization, growing commercialization and increasing number of households form a significant part of electricity consumption. The per capita electricity consumption in India has increased continuously because of the significant improvement in electrification of villages which is still a priority item on the agenda of successive governments. It has reached 1010 kilowatt-hour (kWh) in 2014-15 from 672 kWh in 2006-07 (CEA, 2015).

It is evident from the chart (i) that the percentage consumption of electricity in domestic to total consumption has increased (from 9.2 percent to 23.53 percent) from first to twelfth five year plans. While in industry per capita consumption is declining (from 74 to 42 percent), it has increased in agriculture from 3.11 to 18.45 percent (CEA 2015).

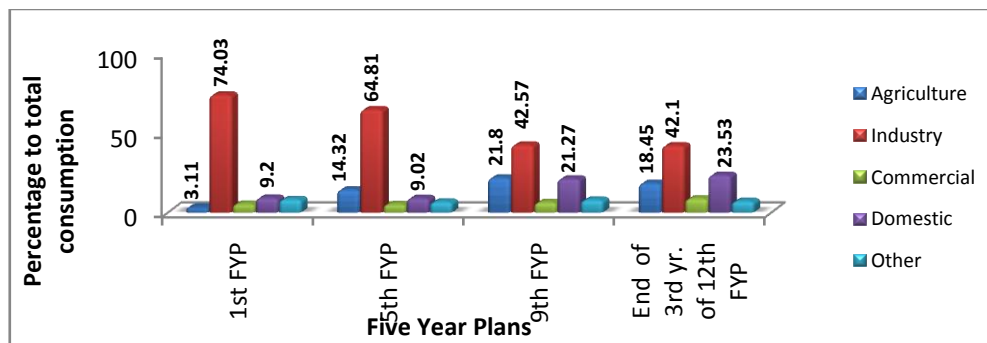
# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 7, July 2017

Chart (i): Plan/Category-Wise Growth of Electricity Consumption in India



Source: CEA, 2015

There is an increase of 102.75 percent in the outlay in power sector from the Eleventh to the Twelfth Five Year Plan and as per the report from the Central Electricity Authority, first time India has turned around from a net importer of electricity to net exporter of electricity. During the current year 2016-17 (April-February), India has exported around 5,798 million units to Nepal, Bangladesh and Myanmar which is 213 million units more than the import of around 5,585 million units from Bhutan (Press Information Bureau report 2017)<sup>[7]</sup>. Yet, the growing demand for electricity in all the sectors of the economy in conformity with and the rapid economic growth of India has resulted in an increasing deficit in power supply in the country. There is a shortage of 606 million units of electricity supply and a deficit of 973MW in meeting its peak demand during 2016 (CEA 2016).

Power development is placed in the Concurrent List of the Indian Constitution as a joint responsibility of both the State and the Centre. Unlike the States of India, Union Territories are the privileged regions of the country, receiving benefits directly from the Union government. The Union Territory of Pondicherry (UTP) comprising of Pondicherry and Karaikal in the State of Tamil Nadu, Mahe in Kerala and Yanam in Andhra Pradesh has historically had the reputation of offering a stable supply of electricity at cheaper rates.

Electricity supply in Pondicherry is the responsibility of the Electricity Department (ED) of the Union Territory of Pondicherry. The Union Territory has access to relatively cheaper power from Central Generating Stations (CGS), neighbouring State Electricity Boards and the 32.5 MW Gas Power Plant of Pondicherry Power Corporation Limited. In financial year 2015, about 36 percent of the power was sourced from National Thermal Power Corporation (NTPC) stations and 28 percent power from Neyveli Lignite Corporation (NLC). The UT also drew 354 MU power from Tamil Nadu Electricity Board (TNEB) for Karaikal and 42 MU from Kerala State Electricity Board (KSEB) for Mahe. As per CEA report of June 2016, the requirement of 298 million units of power was made available, leading to zero deficits in power supply unlike other parts of India. The present power demand of the Union Territory has risen to 465 MW from 368 MW in 2016 and at present there is no shortage in meeting the requirements of the present demand in any of the four regions (Electricity Department, Government of Puducherry).

## II. RELATED WORK

Electricity being generated mostly from the non-renewable source of energy, it becomes important to understand the extent of usage of electricity and its demand mostly to forecast its availability in future. Carlevaro and Spierer (1983)<sup>[4]</sup> analyzed the final consumption of electricity by all sectors of the Switzerland economy and developed dynamic energy demand models. Simple regression result on data collected on residential and commercial sectors indicated low responsiveness of demand to changes in gross domestic product of the sectors. Another study on the structural changes in United States by Gupta et.al (1987)<sup>[5]</sup> in the manufacturing sector revealed that the competitiveness of US industries had a direct bearing on the industrial electricity consumption and the change in the product mix had considerable impact on the usage of electricity. Douglas et.al (1987)<sup>[2]</sup> estimated the usage patterns of specific electrical appliances by using the Bayesian approach to combine the information from engineering approach on usage patterns of specific appliances and the statistical estimates of appliance usage pattern for conditional demand. Air conditioner was found to be of considerable interest to utilities as it was heavy user of electricity and the usage of

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 7, July 2017

electricity by dishwasher was found to be low in the morning and night and high in the afternoon. Ediger and Huvaz (2006)<sup>[3]</sup> observed that in Turkey during 1980-2000, the historical development of energy consumption and economic production demonstrated frequent fluctuations although there existed a linear relationship between primary energy consumption and total GDP. Shuvraet al. (2011)<sup>[8]</sup> summarized the factors that directly influenced the change of electrical energy demand by economic, demographic technological and environmental factors in a country. The variables used in electricity demand estimation were the growing population, introduction of new technologies in production, shift towards renewable energy and environmental factor such as the ambient air temperature, relative humidity, rainfall etc. The nature of demand for electricity in the productive sectors of Punjab and Kerala was studied by Singh and Bhargava (1991)<sup>[1]</sup> with the Houthakker and Taylor model. The result showed that the effect of lagged demand for electricity was positive and significant in agriculture and small and large scale industries. The lagged price had a positive significant effect on demand in case of small industrial sector but for other sectors it was statistically insignificant. Another study by Banerjee and Srivastava (1994)<sup>[6]</sup> on the demand for electricity in various sectors of Uttar Pradesh analysed the future demand through nonlinear, exponential, quadratic and cubic function for various time periods. Industrial consumption of electricity was forecasted to fall and be diverted towards agriculture. The result indicated a significant rise in demand from all sectors, government consumption, export and import and that it would be difficult for the State to mobilize resources for the required amount of investment in electricity generation.

## III. STATEMENT OF THE PROBLEM

The supply of electricity at cheaper rates combined with power tariff and other tax concessions offered by the Union Territory government to UTP has caused a significant growth of power intensive industries in the UTP. The economy witnessed a spurt in industrial consumption from 48 percent in 1985-86 to 67 percent in 1995-96. Since then there has been considerable growth in population, households and industries, especially the tourism industry that uses commercial power.

A gradual change in this comfortable scenario of Pondicherry is evident from the increase in per unit price of electricity, frequent power-cuts in the recent years and an alarm from the Center on the growing power shortage in the country. Thus, as the power sector forms a critical infrastructure element to enhance the growth of all the sectors of the economy, an attempt is made to understand the consumption of electricity in the UTP by different sectors of the UTP economy.

## IV. OBJECTIVES

The main objectives of this study are:

- to find the trend in electricity purchased and sold (consumed)
- to find the trend in the per capita growth rate of electricity consumption with respect to the economic growth of the UTP and
- to understand the pattern of electricity consumption by the different sectors of the UTP.

## V. RESEARCH METHODOLOGY

Annual time series data for a period of forty five years, from 1970 – 2015 has been collected from the various issues Statistical Abstracts and Handbooks of the Directorate of Economics and Statistics, Pondicherry, records of the Central Electricity Authority and Handbook of Statistics published by Reserve Bank of India (RBI). Percentage method and growth calculations have been used to analyze the data and the results are represented in graphs. Semi log regression method is used to analyze the growth rate of consumption of electricity by various uses.

The estimated semi log equation is of the form:  $\ln Y_i = m_0 + m_1 X_i + u$

where  $\ln$  is log,

$Y_i$  is the variable whose growth rate of electricity consumption is to be estimated. In this study  $Y_i$  represents electricity consumed by domestic, commercial, industrial, public lighting, agriculture and public water works over the years from 1970-71 to 2014-15.

$X_i$  is the trend (time series data) and

$u$  is the error term.

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 7, July 2017

## VI. ANALYSIS

### 1. Growth of electricity purchased and sold or consumed:

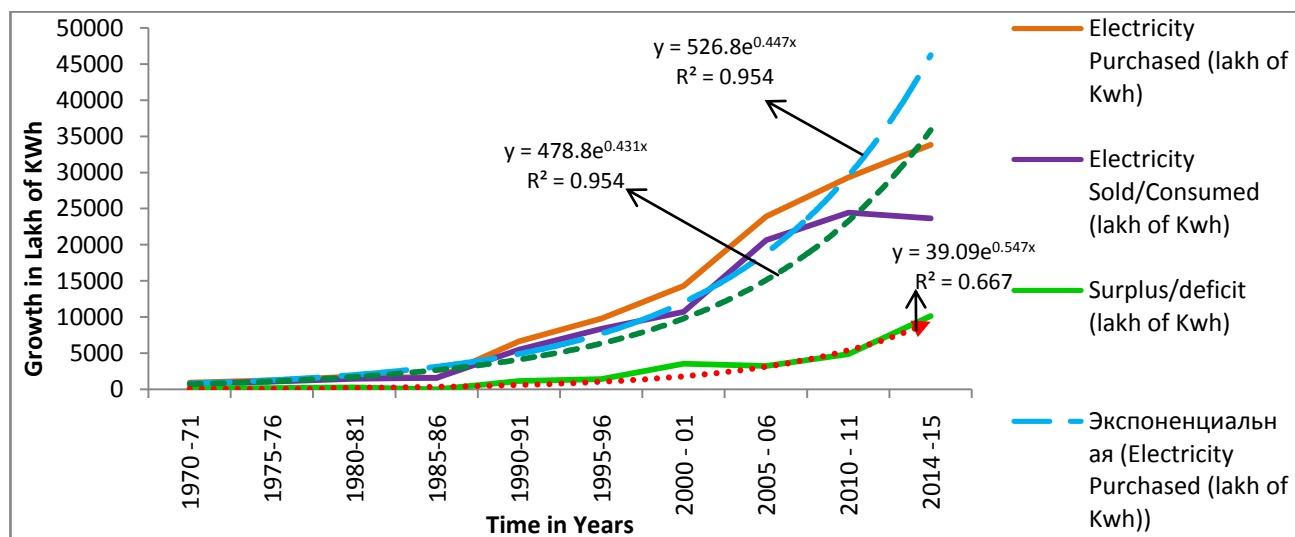
Table 1 shows the calculated growth of the actual data in electricity purchased by UTP from the center and neighbouring States, the electricity sold or consumed and the surplus or deficit arising therewith during 1970-2015.

**Table 1: Growth in Consumption of Electricity in the UTP during 1970 – 2015**

Years	Growth in Electricity Purchased (Lakh of Kwh)	Growth in Electricity Sold/Consumed (Lakh of Kwh)	Growth in Surplus/ Deficit (Lakh of Kwh)
1970 -71	824.18	737.33	67.60
1975-76	1289.26	1135.34	116.89
1980-81	2016.80	1748.18	202.14
1985-86	3154.88	2691.84	349.55
1990-91	4935.18	4144.87	604.46
1995-96	7720.12	6382.23	1045.26
2000 - 01	12076.59	9827.29	1807.52
2005 - 06	18891.44	15131.97	3125.66
2010 - 11	29551.91	23300.07	5405.06
2014 -15	46228.11	35877.22	9346.71
Growth Estimate in percent	44.7	43.2	54.7

Source: Directorate of Economics & Statistics, Puducherry, Handbook of Statistics, RBI

**Fig. 1: Growth in consumption of electricity in the UTP during 1970 – 2015**



There has been an exponential growth of 44.7 percent in electricity purchased by the UTP during 1970-2015 indicated by the sharp growth from 3154.88 lakh KWh in 1985-86 to 12076.59 lakh KWh in 2000-01, a gradual growth in 2005-06 and a step rise from 18891.44 lakh KWh to 49228.11 lakh KWh during 2010-11 to 2014-15. The electricity sold/consumed in the UTP has grown by 43 percent with a sharp rise from 23300.07 lakh KWh in 2010-11 to 35877.22 lakh KWh in 2014-15. The surplus/deficit shows positive growth figures indicating a surplus in electricity purchased which has widened over the years especially during 2001-02 to 2014-15 from 1807.52 lakh KWh in 2000-01 to 9346.71 lakh KWh in 2014-15.

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 7, July 2017

Figure 1 display the actual data on electricity purchased and sold with the calculated data on resulting surplus (the solid curves) as well as the growth curves (dotted).

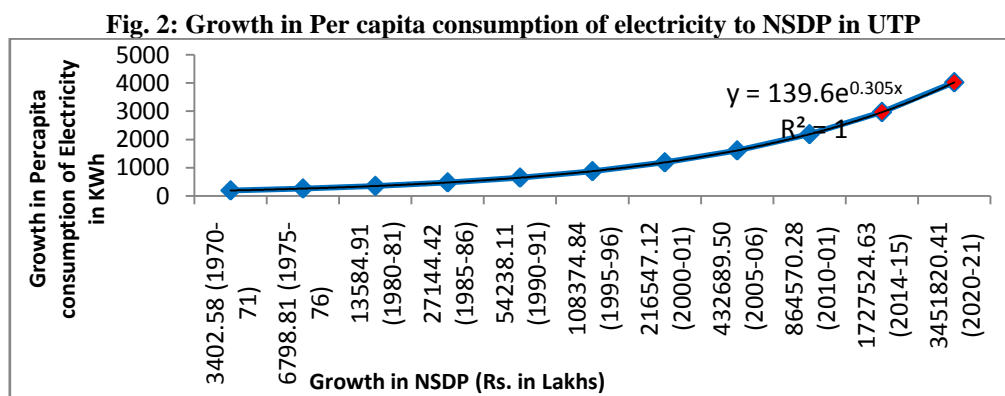
## 1. Trend in the per capita growth rate of electricity consumption with respect to the economic growth of the UTP:

Table 2 shows the calculated growth in Net State Domestic Product (NSDP) at constant prices and the growth in per capita electricity consumption in UTP during 1970-2015.

**Table 2: Growth in Per capita consumption of electricity to in NSDP in UTP**

Years	Growth in NSDP at constant prices (Rs. in Lakhs)	Growth in Per Capita Consumption of Electricity (Lakhs of KWh)
1970 -71	3402.58	189.58
1975-76	6798.81	257.30
1980-81	13584.91	349.22
1985-86	27144.42	473.97
1990-91	54238.11	643.28
1995-96	108374.84	873.08
2000 - 01	216547.12	1184.96
2005 - 06	432689.50	1608.26
2010 - 11	864570.28	2182.78
2014 -15	1727524.63	2962.52
Growth Estimate of Per capita electricity consumption to NSDP in UTP		30.54percent
<b>2020-21</b>	<b>3451820.41</b>	<b>4020.81</b>

Source: Directorate of Economics & Statistics, Puducherry, Handbook of Statistics, RBI



There was a gradual growth in per capita electricity consumption from 1970-71 to 1995-96 after which there has been a sharp growth in consumption from 1184.96 Lakh KWh in 2000-01 to 2962.52 lakh KWh in 2014-15. The growth estimate in per capita electricity consumption to NSDP is 30 percent. The predicted growth for 2020-21 shows sharp leap from 2962.52 lakh KWh in 2014-15 to 4020.81 lakh KWh in 2020-2021.

## 1. Pattern of electricity consumption by the different sectors of the UTP:

Table 3 shows the usage of electricity by different sectors over the years. While there was a fall in percentage of electricity used by industries from 52 percent in 1970-71 to 48.1 percent in 1985-86, the domestic sector's share in the consumption was rising from 6.9 percent in 1970-71 to 15.1 percent in 1985-86. The industrial sector consumed the highest (101.9 percent) in 2000-01. While commercial sector showed slight increase in percentage of electricity used

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 7, July 2017

from 5.7 percent to 7.7 percent, the share in public lighting and public water works showed fluctuations and agricultural sector's usage share declined considerably from 30.2 percent in 1970-71 to only 2.4 percent in 2014-15.

**Table 3: Percentage of Total Electricity consumed by use in UTP**

Year	Domestic	Commercial	Industrial	Public lighting	Agriculture	Public Water Works
1970 -71	6.9	5.7	52.0	1.6	30.2	3.5
1975-76	8.9	4.6	49.9	1.6	31.6	3.4
1980-81	12.3	5.0	49.8	1.5	26.3	3.1
1985-86	15.1	6.5	48.1	1.6	24.9	3.9
1990-91	10.2	3.6	71.6	0.8	12.2	1.6
1995-96	13.9	5.0	67.6	1.1	11.1	1.2
2000 - 01	20.3	7.1	101.9	1.1	9.0	1.8
2005 - 06	15.1	5.4	63.2	0.6	4.3	1.2
2010 - 11	21.1	6.7	57.0	0.9	2.2	1.4
2014 -15	26.8	7.7	58.9	1.1	2.4	2.4

Source: Directorate of Economics & Statistics, Puducherry

**Fig. 3: Percentage of Total Electricity consumed by use in UTP**

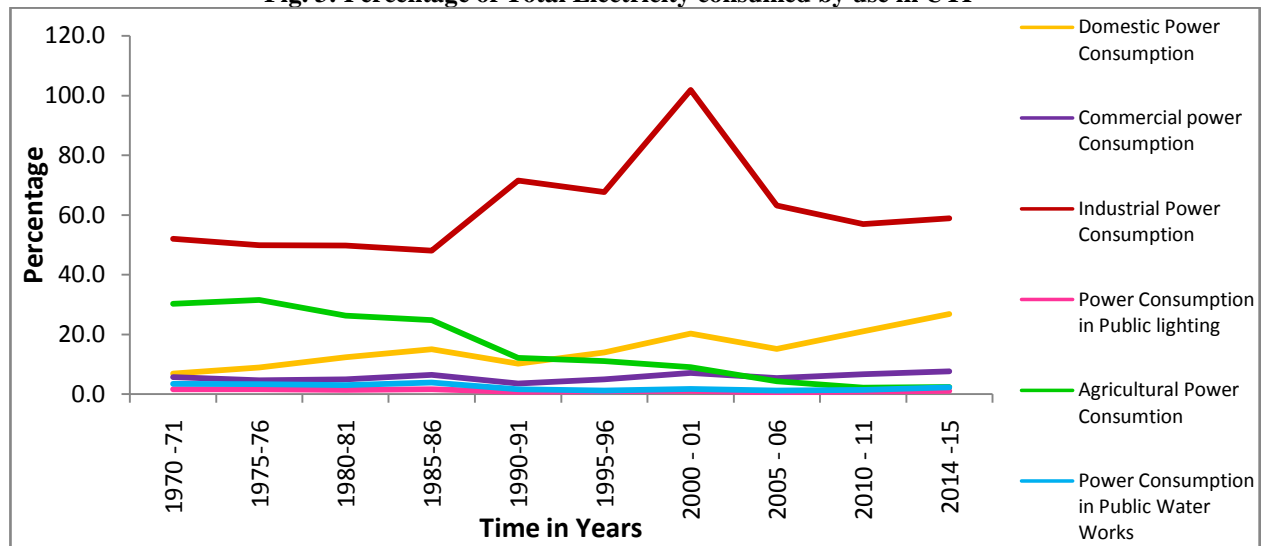


Table 4 below gives the growth rates of electricity consumption in different uses. The result shows highly significant values of all variables at one percent level of significance. Over the years from 1970-2015, the growth rate in power consumption in industries have been the highest (7.9 percent) followed by domestic consumption (6.5 percent) and commercial consumption (5 percent). Consumption in electricity in agriculture has been low at 1.9 percent while that in public lighting and water works have seen a growth of 3.9 and 3.2 percent. The  $R^2$  and  $\overline{R}^2$  values are very high which is attributable to the time series data.



# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 7, July 2017

**Table 4: Growth Rate of Electricity Consumption by Sectors in UTP during 1970-2015**

S. No.	Variables	Intercept	Coefficient	R <sup>2</sup>	$\overline{R^2}$	F- Value
1.	Domestic Power Consumption	1.629 (119.39)*	0.0650 (71.09)*	0.994	0.994	5053.85*
2.	Commercial Power consumption	1.449 (42.98)*	0.050 (22.37)*	0.943	0.942	500.29*
3.	Industrial Power Consumption	2.368 (45.86)*	0.0799 (17.76)*	0.913	0.910	315.54*
4.	Power consumption in Public Lighting	0.994 (32.99)*	0.03912 (21.14)*	0.937	0.935	446.95*
5.	Agricultural Power Consumption	2.314 (93.35)*	0.0197 (17.32)*	0.909	0.906	229.89*
6.	Power consumption in Public Water works	1.432 (73.59)*	0.032 (21.80)*	0.941	0.939	475.31*

Note: Brackets show 't' value and \* indicates significance at 1 percent level.

## VII. RESULTS AND DISCUSSION

The total consumption of electricity in UTP has increased remarkably since 1970 and so has the surplus in electricity purchased. At present there is no requirement of short term purchase as the total consumption has also declined. The sudden increase in industrialization during late 1980s had resulted in a fall in surplus purchased from 1990-91 to 1995-96 after which the demand for electricity by the territory has been increasing rapidly thereby causing an exponential growth in surplus.

The per capita electricity consumption to NSDP increased gradually till 1995-96 and rapidly thereafter indicating increased demand of consumer durables, the production and consumption of which require heavy use of electricity in the industrial, domestic and commercial sectors. This indicates rapid progress of the economy of the UTP.

There was a tremendous increase in electricity consumption by the industrial sector from 1985- 2001 whereas agriculture sector showed a rapid decline. This was due to the fact that the revision of the Industrial Policy shifted the focus of development from agriculture to industrialization. But the industrial consumption of electricity to total share has been falling after 2000-01 owing to the introduction of uniform sales tax which closed down many industries. The share in domestic consumption has increased significantly whereas that in commercial sector has shown a gradual rise. The percentage to total consumption of electricity by public lighting and water works shows a marginal rise during the period.

The growth rate calculation using a semi log equation shows an increase in power consumption in domestic, industrial and commercial sectors which can be attributed to rapid urbanization of the UT, development of tourism and commercialization of the territory. The decreasing area under cultivation results in the decreased power consumption in agriculture.

## VIII. SUGGESTIONS

The Union Territory of Pondicherry has excess power supply that has been growing over the years. Hence the government should

- ensure reliable 24x7 power supply to consumers,
- ensure that the excess power purchased is distributed at a cheaper rate to all unconnected households who cannot apply for electrification due to socio-economic causes,
- plan tie ups for power from various sources at affordable prices to meet the projected power demand in future,

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 7, July 2017

- cater to the expected growth in demand of existing as well as future consumers by strengthening the transmission and distribution network,
- optimize its purchase of electricity according to its requirement and should sell the surplus power to prospective deficit states.

## IX. CONCLUSION

Pondicherry is a prosperous Union Territory with almost 100 percent electrification. It is committed to provide full support to all utilities for ensuring quality power supply. However, there is need for establishing a system that improves the average hours of power supply to consumers and control the cost of power supply. Moreover, the demand for electricity is growing in the country which necessitates harnessing it that is mostly done from non-renewable sources. Towards concern about environmental degradation, the Union territory needs to optimize its consumption of electricity.

## REFERENCES

- [1] Singh Baldev and Nisha Bhargava, "Demand for Electricity: A case study of productive sectors", National Energy, V.S. Mahajan (Ed), Ashish publishing house, New Delhi, 1991. Pp. 189 – 200.
- [2] Douglas W. Caves, Joseph A. Herriges, Kenneth E. Train, Rober J. Windle, "A Bayesian Approach to combining conditional demand and engineering Models and Electricity Usage", Review of Economics and Statistics, Vol. 69, No. 2, April 1987, pp. 438-448
- [3] Ediger, V. S. Huvaz, O., "Examining the Sectoral Energy Use in Turkish Economy (1980-2000) with the Help of Decomposition Analysis", Energy Conversion and Management, 2006, Vol.47, pp.732-45.
- [4] Carlevaro Fabrizio and Charles Spierer, "Dynamic Energy Demand Models with latent Equipments", European Economic Review, Vol. 23, 1983, pp 161 – 194
- [5] Gupta C. Pradeep, Ahmed Faruqui, Joseph B. Wharton, "Structural change in Us Manufacturing and future Electricity Demand", Global Energy Interaction, R. K. Pachauri (Ed.), Allied publisher pvt. Ltd., New Delhi, 1987, pp. 75-90
- [6] Paritosh Banerjee and Ashok Srivastava, "demand for Electricity in Uttar Pradesh during the year 2000 -01", Indian Journal of Economics, Vol LXXV, No. 297, October 1994, pp 181-203
- [7] Press Information Bureau, Government of India, Ministry of Power, 29-March-2017, <http://pib.nic.in/newsite/PrintRelease.aspx?relid=160105>
- [8] Shuvra, M. M. Rahman, A. Ali and S. KhanI, "Modeling and Forecasting Demand for Electricity in Bangladesh: Econometrics Model," *International Conference on Economics, Trade and Development*, Vol. 7, 2011, p. 74.
- [9] The World Factbook 2013-14. Washington, DC: Central Intelligence Agency, 2014.  
<https://www.cia.gov/library/publications/the-world-factbook/index.html>