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Power Sector in Andhra Pradesh: Trends and Prospects

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February 2011

Online at <http://mpa.ub.uni-muenchen.de/47664/>

MPRA Paper No. 47664, posted 12. July 2013 08:16 UTC

Power Sector in Andhra Pradesh : Trends and Prospects^{1*}

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I Introduction

In Andhra Pradesh power is an important sector that gained policy attention thereby priority in resource allocation during 1950s to 70s. Subsequently, state has emerged as a key player in the country's power sector and stands first in the generation of hydroelectric power and second in terms of thermal power generation. Most of the power generation in the state is through thermal and hydro power plants. In the recent period the state is promoting gas and clean technologies such as wind, solar and bio-mass, in power generation. Although most of the power generation and distribution units in the state are in the hands of public sector, the state is also promoting merchant power plant through PPP models and encouraging captive power plants in various industrial units for their self consumption. In terms of performance, the state's power sector emerged as the one of the best performing ones in India especially after implementing the power sector reforms in the state.

The installed capacity of power sector has increased from 213 MW to 12427 MW during the last five decadal periods 1959 to 2009. The total number of consumers has grown from 2.7 to 165.48 lakhs and the energy handled per annum rose from 686 MU to 51123 MU during the same period. The annual revenue increased from Rs.5.50 crores to Rs. 10170 crores. Of the total installed capacity about 27 per cent is from Thermal and another 32 per cent is in Hydel power sector. The total power generation in the state during the year 2008-09 was 67387 million-kilo Whatt Hours (MKWH). The state is the third largest state in terms of gross generation of power sector among Indian states next to Maharashtra and Gujarat. In the south it is the largest state.

In spite of having such a phenomenal growth in the power sector still the supply of the power is falling short of the demand in the state. When compared to the other states in India particularly Tamil Nadu and Gujarat, although the state of Andhra Pradesh is bigger in terms of the size of population, the power consumption in the state is low. Most of the demand for the power arises from agriculture especially for irrigation, and industrial sectors which plays vital role in the development of the state's economy. More than two-thirds of the energy sold is consumed by these two sectors. It indicates the crucial role of energy infrastructure for the growth of state economy.

* Paper Presented at **29th Annual Conference of Andhra Pradesh Economic Association** held during 11-12 February 2011 at Guntur. Paper included in the Conference Volume.

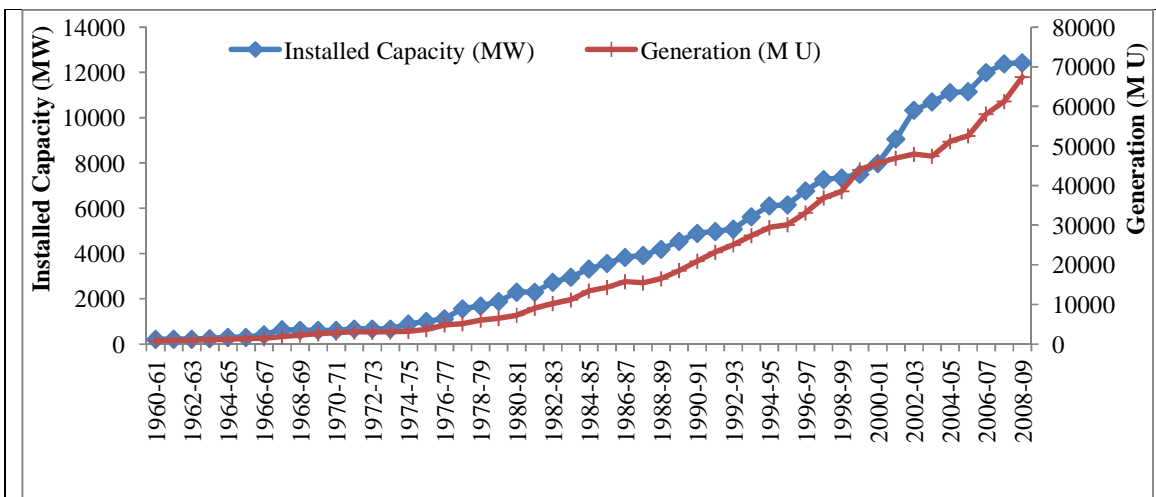
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In this context the present study has made attempt to examine the historical trends in the power and its impact on the state economy and to explore the scope for enhancing its generation capacity in the state.

II Power Generation Capacity of the State

The installed capacity of power sector in the state of Andhra Pradesh has increased from 213 MW (Mega Watt) in 1959 to 12427 MW in 2009. Whereas the actual power generation in the state has increased from 785 million units (MU) in 1959 to 67387 million units in 2009. During last five decadal periods the installed capacity has increased 58 times higher than its initial capacity and power generation has increased 86 times to its initial level in 1959. The rate growth in the installed capacity of the power sector during the period in the state is 8.9% per annum and in the power generation it is 9.5%.

Figure 2.1: Trends in the Installed Capacity and Power Generation in Andhra Pradesh



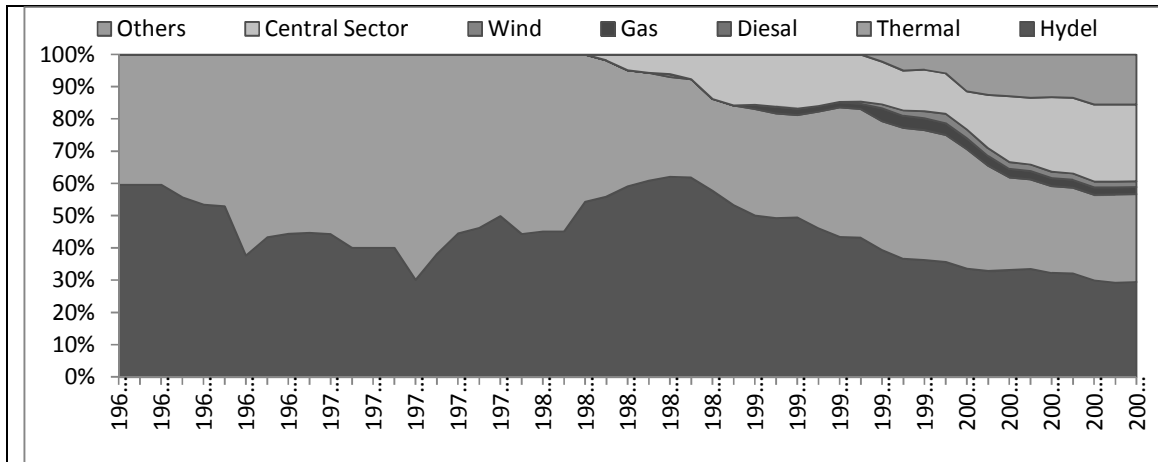
Note :

Source: Directorate of Economics and Statistics, Hyderabad.

By the source of energy in the state, both the Hydel and Thermal energy systems account lion's share in the total installed capacity of power sector. The emergence of central sector (owned and operated by Government of India) power plants in the state since mid-1980s has expanded its share. Most of the central sector plants/units in the state are thermal energy system based ones.

In terms of the distribution of total power generated in the state by the source of energy systems, of the total power generated in the state the highest share (37.6%) is with the central sector units, about 34.6% is from the state's thermal sector units and another 11.4% from the its Hydel power units. The rest was the contribution of others that include the purchases from private sector, gas and captive power plants.

Figure 2.2: Trends in the Share of different Energy System in the Total Installed Capacity of Power Sector in Andhra Pradesh

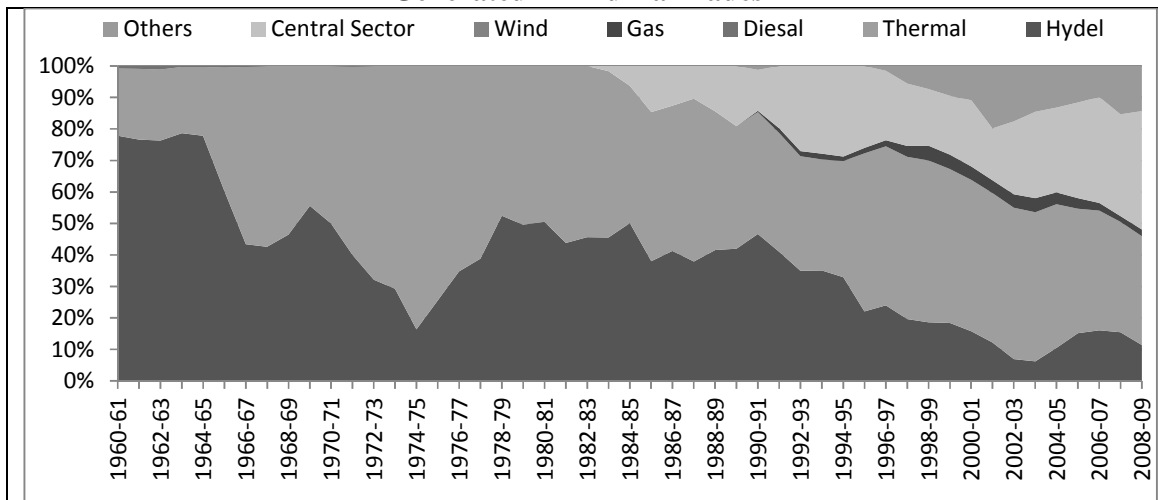


Note :

Source: Directorate of Economics and Statistics, Hyderabad.

In terms of the growth in installed capacity over period of time, the initial period i.e. 1960s has registered the highest rate of growth (14.3%) in the state and thereafter the rate of growth is declining. Similarly the case of power generation in the state, the highest rate of growth was during 1960s and thereafter it (the rate of growth) has shown a declining trend.

Figure 2.3: Trends in the Share of different Energy System in the Total Power Generated in Andhra Pradesh



Note :

Source: Directorate of Economics and Statistics, Hyderabad.

Among the energy systems, the growth of the installed capacity has been positive throughout the period during the last five decades (1960-2009) across all the energy systems but the rate

of growth varied. In the actual power generation, Hydel energy system has witnessed the negative growth during 1990s and the thermal system in the recent past (during 2001-09).

Table 2.1: Rate of Growth (%) in Installed Capacity and Power Generation in Andhra Pradesh

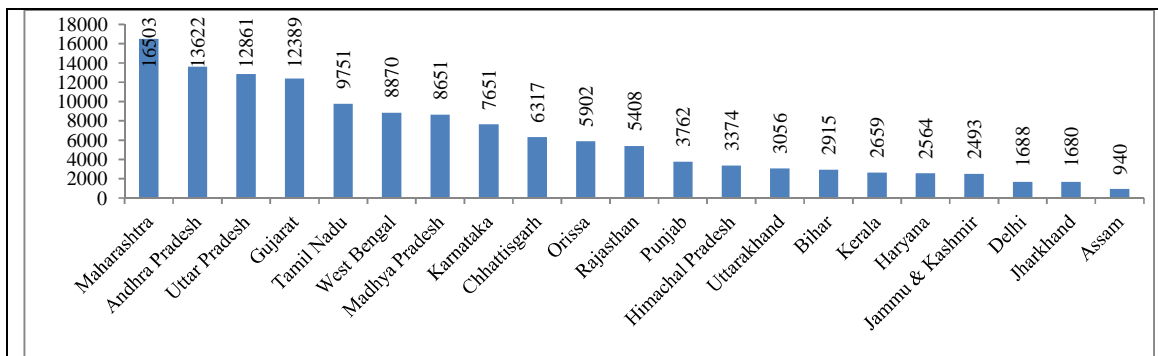
Period	Source of Energy						Total
	Hydel	Thermal	Diesel	Gas	Wind	Central Sector	
1	2	3	4	5	6	7	8
Installed Capacity							
1960s	10.3	19.5	-	-	-	-	14.3
1970s	15.4	12.4	-	-	-	-	13.7
1980s	10.4	0.1	-	-	-	38.2	7.9
1990s	1.1	8.2	-	16.8	-	2.0	5.4
2000s	3.2	1.8	-	15.2	-	12.3	5.1
1960-09	8.0	7.5	-	-	-	-	8.9
Generation							
1960s	6.1	25.7	-	-	-	-	13.1
1970s	12.1	8.4	-	-	-	-	9.8
1980s	7.4	6.9	-	-	-	38.9	9.6
1990s	- 3.3	12.2	-	28.1	0	7.9	7.7
2000s	8.0	- 0.1	-	- 6.4	0	13.4	4.7
1960-09	6.0	9.7	-	-	-	-	9.5

Note: 1. Growth is Exponential Growth presented in percentage form; 2. 2000s is the period between 2000-01 and 2008-09.

Source: Computed.

In the all India context, among Indian states the Andhra Pradesh is the second largest state next to Maharashtra in terms of installed capacity of the power sector. With respect to the actual power generation Andhra Pradesh is the third largest state next to Uttar Pradesh and Maharashtra.

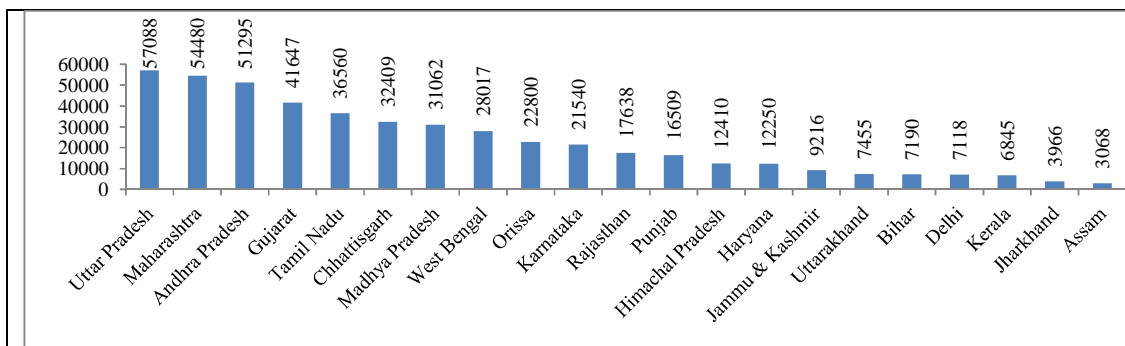
Figure 2.4: Installed Capacity (in Megawatts) across Major States in India, 2009-10



Note: The installed capacity includes only the state sector (including private and public) and excludes the contribution of Central sector in the respective states.

Source: Ministry of Power, GOI, New Delhi.

Figure 2.5: Actual Power Generation (in Million Units) Across Major States in India, 2009-10

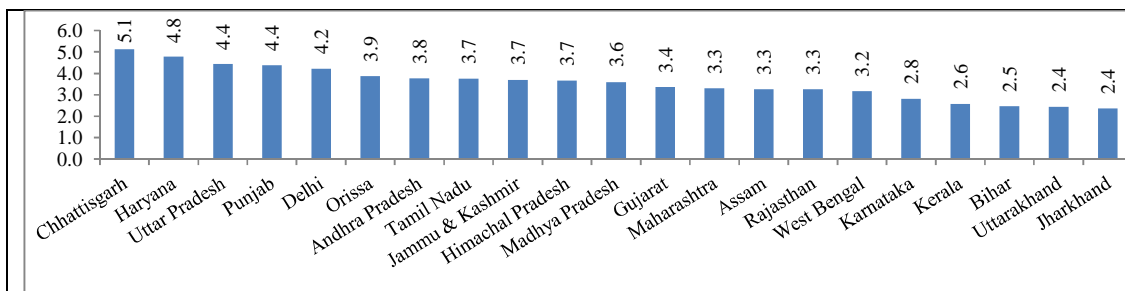


Note: The power generation includes only the state sector (including private and public) and excludes the contribution of Central sector in the respective states.

Source: Ministry of Power, GOI, New Delhi.

It seems that the installed capacity of the power sector in the state is not utilised at its optimal level. The actual power generated per one Megawatt (M W) of installed capacity in the state is 3.8 million units (M U) during 2009-10. In this respect the state stands at seventh position from the top. Chhattisgarh followed by Haryana, U P, Punjab, Delhi and Orissa are the top six states stands above Andhara Pradesh in terms of actual power generated per Megawatt of installed capacity.

Figure 2.6: Power Generation (in Million Units) per One Megawatt (MW) Installed Capacity across Major States in India, 2009-10

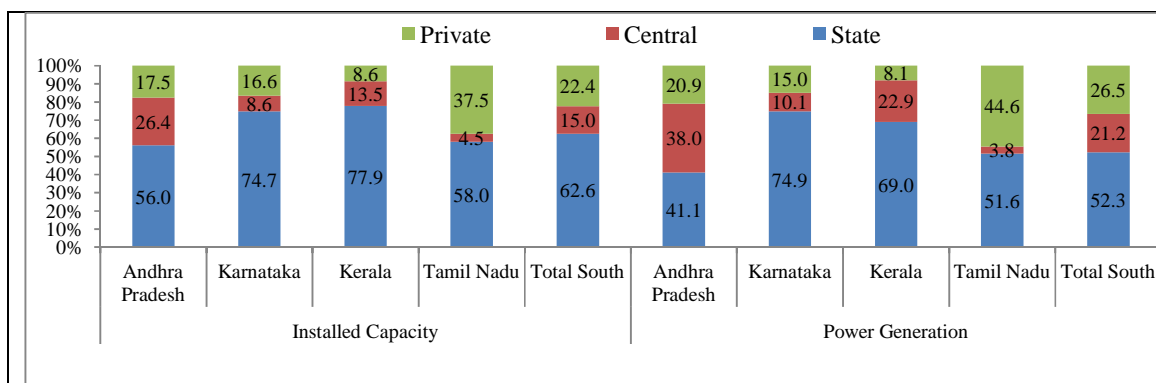


Note: The installed capacity and power generation includes only the state sector (including private and public) and excludes the contribution of Central sector in the respective states.

Source: Ministry of Power, GOI, New Delhi.

The distribution of the total installed capacity by the ownership of the power generating units in the state shows that 61% of the installed capacity owned by the government of Andhra Pradesh and another 21% is owned by central government (i.e. Government of India); the combined public sector (state and centre together) units accounts 82% of the total installed capacity in the state. The rest 18% of the installed capacity in the state is owned by the private investors/entrepreneurs. Among the four southern states, in Tamil Nadu the private sector share is the highest and the least is in Kerala.

Table 2.3: Distribution (%) of Installed Capacity and Actual Generation in the Southern states by the Ownership of the Power Generating Units in the respective States, 2009-10



Note:

Source: Ministry of Power, Government of India, New Delhi.

The distribution of the actual power generation by the ownership of the power generating units in the state shows that 41% of the power is being generated by the units under the Government of Andhra Pradesh and another 38% is generated by the units under the ownership of central government (i.e. Government of India); the combined public sector (state and centre together) units accounts 79% of the total installed capacity in the state. The rest 21% of the power generated in the state is under the ownership of private investors/entrepreneurs. Among the four southern states, private sector share is the highest in Tamil Nadu (44.6%) and the least is in Kerala (8%).

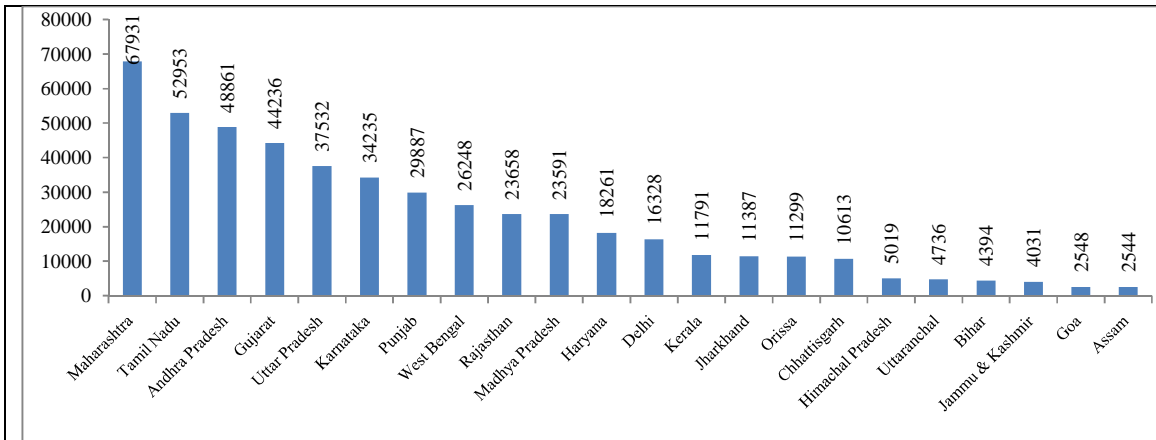
III Power Consumption in the State

The number of power connection services in the state had increased from mere 2.7 lakhs in 1960 to 206.8 lakhs services in 2009; the increase is 76 times during the last five decadal periods. It has shown the phenomenal growth @ 9.3% per annum during the period. With respect to the connected load in the state, it had increased from 4 lakhs to 383.4 lakhs Kilo Watt Hours (KWH) during the same period. The connected load in the state has witnessed 98 times increase at the rate of 9.8% growth per annum during the period.

Similarly with respect to the consumption of electricity in the state it has increased manifold since its formation. In Andhra Pradesh it has increased from 571 million units in 1960 to 53335 million units in 2009. It is 93 times increase from the base at the rate of 9.3% growth per annum during the period (1960-2009). Particularly during the last one decade period (1998-2008) the power consumption is doubled. The share of the state in the total consumption units at all-India level is increasing; it has increased from 8 to 10% during the last one decade period.

Among the major Indian states, Andhra Pradesh is the third largest state next to Maharashtra and Tamil Nadu in terms of power consumption (million units). From the south Tamil Nadu is ahead of Andhra Pradesh in this respect.

Figure 3.1: Power Consumption (in Million Units) across Major Indian States, 2007-08

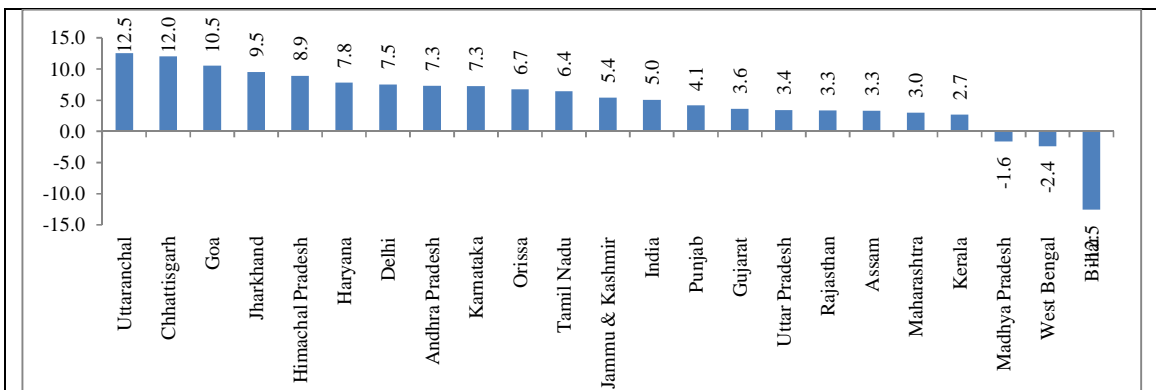


Note:

Source: Ministry of Power, Government of India, New Delhi.

In terms of the growth of the power consumption during the last one decade period, i.e. between 1997-98 and 2007-08 the state of Andhra Pradesh has registered 7.3% growth in power consumption in the state. The growth of total power consumption in the state is higher than that of all-India average.

Figure 3.2: Growth of Power Consumption across Major Indian States during 1997-98 and 2007-08

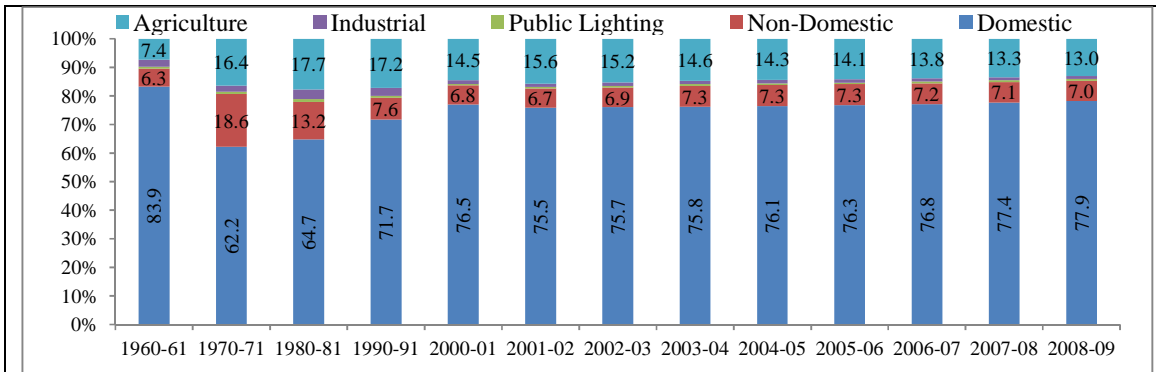


Note:

Source: Ministry of Power, Government of India, New Delhi.

Among the categories of consumer domains, the domestic sector has been accounting the lion's share of the total number of electricity services/connections in the state. More than three-fourths of services/connections have been in the domestic sector only. The other major category has been the agriculture sector. The industrial sector share in the total number of services/connection has been very minimal.

Figure 3.3: Trends in Share of Consumer Categories/Domains in the total Number of Services/Connections in Andhra Pradesh

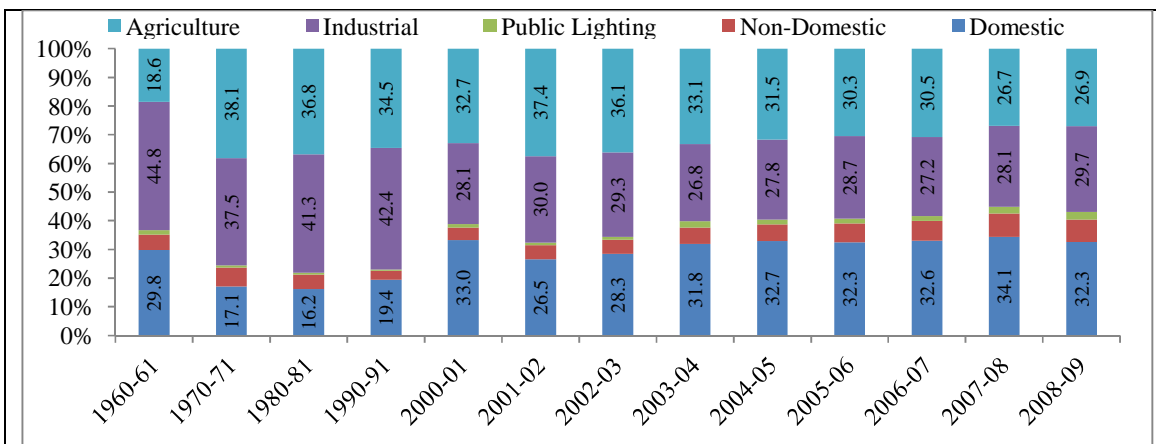


Note: Percentage of the each domain is stacked upon to 100%.

Source: Directorate of Economics and Statistics, Hyderabad.

However in terms of the connected load the distributions across categories of consumer domains are different from that of the services/connection. The domestic sector accounts only one-third of the total connected load in the state. But the share of industrial and agricultural sectors in the total connected load has risen to around one-fourth each. The share of public lighting and nondomestic/commercial in the total connected load has been the lowest in the state.

Figure 3.4: Trends in Share of Consumer Categories/Domains in the total Total Connected Load (KW) in Andhra Pradesh



Note: Percentage of the each domain is stacked upon to 100%.

Source: Directorate of Economics and Statistics, Hyderabad.

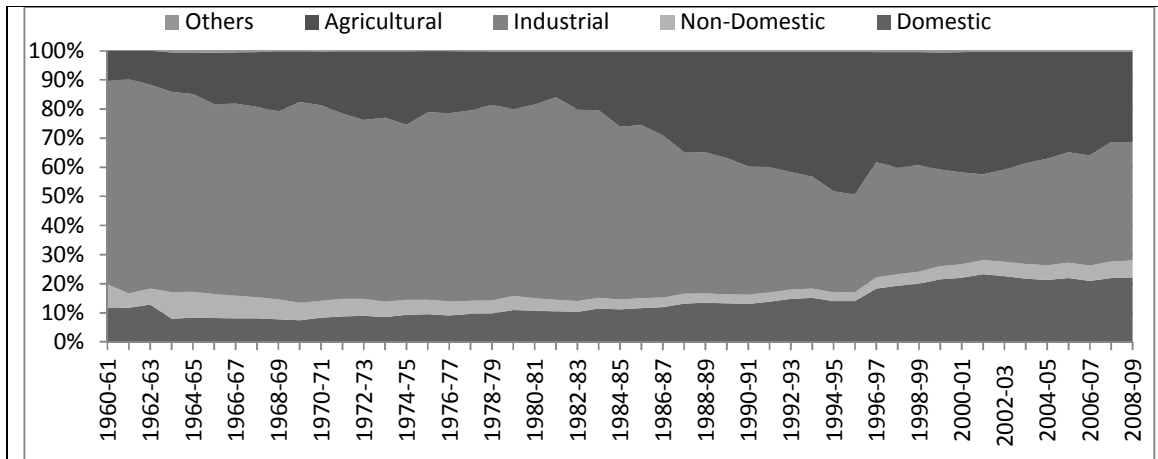
The average connected load per service/connection is below one Kilowatt in domestic sector, around two kilowatts in non-domestics/commercial sector and around 4 kilowatts in agriculture sector. Whereas in industry the average connected load per service is 17 kilowatts for low and medium voltage (LV and MV) industry category and around 800 kilowatts for high voltage (HV) category of industry.

The number of industrial services in the state has increased from around six thousands in the late 1960 to 51 thousands by 1990 and further to 2.2 lakh by 2009. The connected load of industrial sector has increased from 178 thousand Kilo Watts in 1960 to 4.6 Mega Watts in 1990 and further to 11.4 Mega Watts in 2009. The total power consumption in the industrial sector has increased from 390 million units (GWH) in 1960 to 21 thousand million units in 2009.

The number of agricultural services in the state has increased from about four thousands in the late 1950s to 13.4 lakhs by 1990 and to 26 lakhs by 2009. The connected load of agriculture sector has increased from 74 thousand Kilo Watts in 1960 to 3.7 Mega Watts in 1990 and further to 10.3 Mega Watts in 2009. Andhra Pradesh was the second highest among the Indian states in terms of number of agricultural services. The number of pump sets energized through electricity in Andhra Pradesh was around 23 lakhs (as on 31st March 2005), which was one of the highest next to Maharashtra.

The actual consumption of power across the categories/domains of consumers also indicates similar trend wherein industry followed by the agriculture has been the major power consumption sector in the state. The distribution of power/electricity consumption across different sectors shows that industry is the single largest sector in the state that accounts relatively higher share in the total electricity consumption in the state (37.2%) as well as in India (46%). The share of industry in the state is lower than that of the all-India average. The power consumption in industrial sector has registered its highest growth in the recent past only.

Figure 3.5: Distribution of Energy Consumption by the Categories/Domains in Andhra Pradesh



Note:

Source: Directorate of Economics and Statistics, Hyderabad.

Agriculture particularly irrigation, in Andhra Pradesh, is the second largest sector in terms of electricity consumption. The share of agriculture in the state is higher than that of the all-India average. The total power consumption in the agriculture sector has increased from 57 million units (GWH) in 1960 to 16 thousand million units in 2009.

The rate of growth in power consumption across categories/domains shows that agricultural consumption in the state has registered the highest rate of growth (12%) during the last five

decadal periods (1960-2009) followed by domestic consumption whereas the industrial consumption has registered relatively lower rate growth when compared to growth of consumption other categories.

Table 3.1: The Rate of Growth (%) in Power Consumption across Categories/Domains in Andhra Pradesh

Year	Total	Domestic	Non-Domestic	Industrial	Agricultural	Others
1	2	3	4	5	6	7
1960s	12.7	7.2	13.0	11.8	20.9	2.7
1970s	9.0	11.4	5.8	9.3	8.1	7.6
1980s	11.3	14.4	8.2	6.7	20.8	10.7
1990s	4.8	10.2	8.7	2.2	4.4	11.3
2000s	8.3	7.7	10.8	12.3	4.2	6.9
1960-09	9.4	11.7	8.3	7.6	12.0	10.0

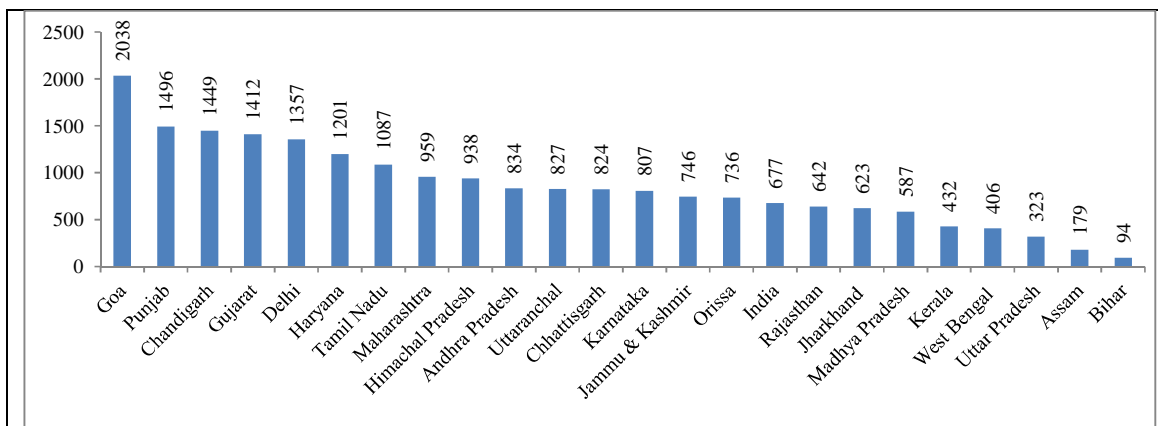
Note: Growth is exponential growth and presented in percentage form.

Source: Computed.

It may be noted that the power consumption in the domestic sector has registered its highest rate of growth during 1980s. Under the rural electrification programme during 1980s has expanded the base of the power sector in terms supply. During this period electricity connection has reached number villages in the state even in remote areas. Subsequently the base of the domestic sector consumption has expanded during this period.

With respect to the per capita consumption of electricity, it has also been increased from around 21 KWH in 1960 to 840 KWH in 2009. Among major Indian states Andhra Pradesh stands at 10th position in terms of per capita power consumption.

Figure 3.6: Per Capita Power Consumption across Major States in India, 2007-08



Note:

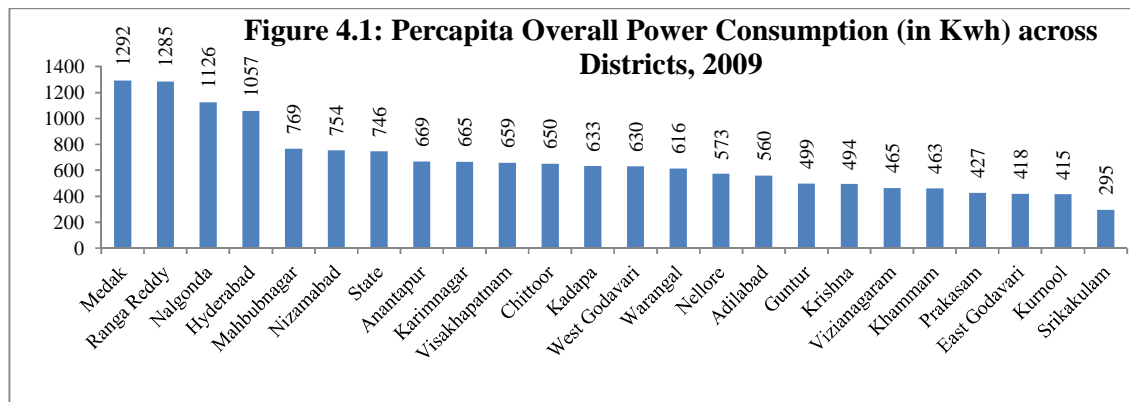
Source: Ministry of Power, Government of India, New Delhi

Across the consumer domains the per capita consumption of electricity (utility) in the state is highest in industrial sector followed by agriculture and domestic sectors. These two sectors are major consumer domains of the power sector in the state.

IV Inter-District Variations in Power Consumption

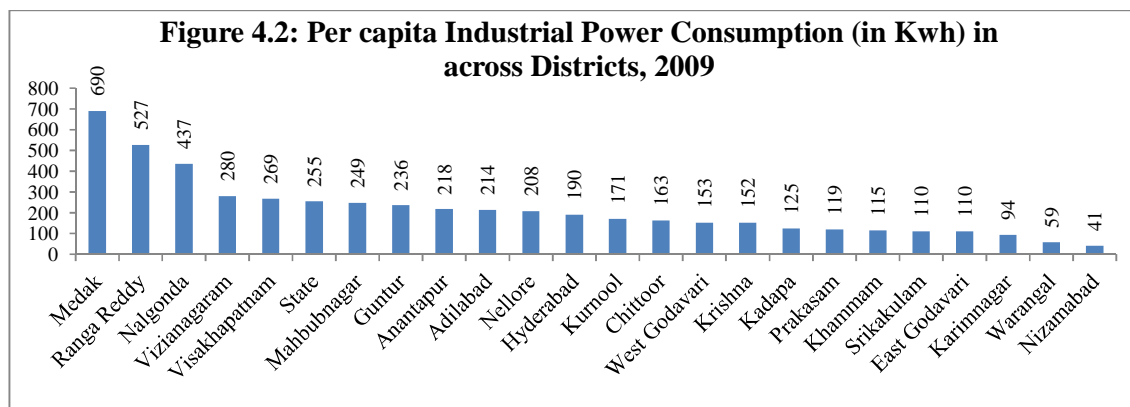
Within the state there exist inter-district variation in terms of the power consumption in general and different purposes/consumer domains in particular.

Across districts of Andhra Pradesh the per capita power consumption is varying in the range between 1292 and 295 kwh. The per capita overall power consumption is the highest in Medak followed Rangareddy, Nalgonda, Hyderabad and Mahabubnagar. The lowest per capita overall power consumption is in Srikakulam followed by Kurnool, East Godavari, Prakasam and Khammam.

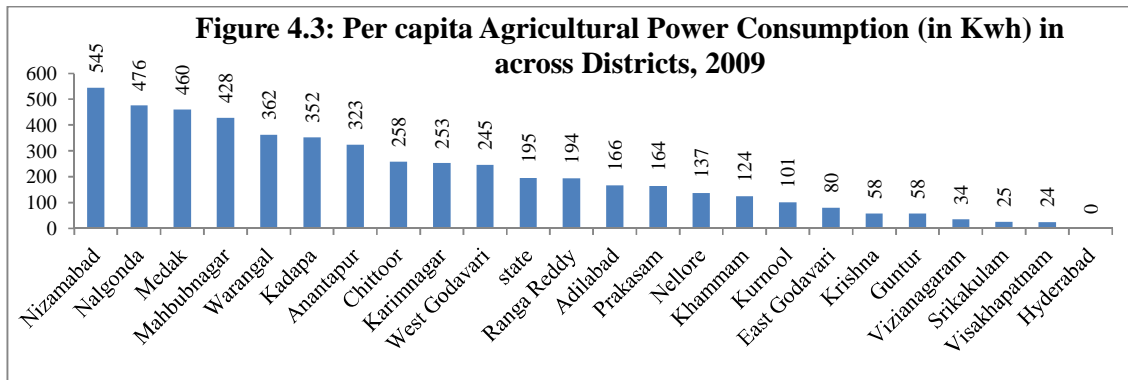


Source: DES (2009)

The sectoral decomposition indicates that the per capita industrial power consumption is the highest in Medak followed by Rangareddy, Nalgonda, Vizianagaram and Visakhapatnam. The lowest per capita power consumption is in Nizamabad followed by Warangal, Karimnagar, East Godavari and Srikakulam. The relative positions of district by levels of per capita power consumption indicate that a few districts are having disproportionately higher power consumption for industrial activities which in turn indicates disproportionately higher concentration of industries in these districts.



Source: DES (2009)



Source: DES (2009)

The per capita power consumption for agricultural purpose is highest in Nizamabad followed by Nalgonda and Medak, and the lowest is Visakhapatnam followed by Srikakulam, and Vizianagaram if Hyderabad is excluded given its complete urban entity and no place for agricultural activities. The levels of per capita agricultural power consumption across districts also indicate a few districts are having disproportionately higher power consumption for agricultural activities especially for irrigation. Most of these districts are located in Telangana and Rayalaseema regions.

V The Rise, Fall, Reform and Recovery

Since the Andhra Pradesh state formation, the power sector in the state has seen phenomenal growth particularly the period during 1960s and 1970s has seen the remarkable growth in all aspects of the power sector: installed capacity, power generation and power consumption.

Till 1990s, the whole of power (electricity) sector is managed by the Andhra Pradesh State Electricity Board (APSEB). The performance of Andhra Pradesh State Electricity Board (APSEB) till 1990s was quite appreciable. The APSEB was outperforming all other SEBs in India. Till 1980s almost all the electricity available for sale was sold on metered sale system, there was no unmetered sale during the period. Moreover the pricing of the electricity sales was frequently updated along with increasing cost of power generation. Also it is observed that the increase in pricing of electricity was moving along with the rise in consumer price index (Sankar, 2003). During 1980s for the agricultural purpose, the pricing of the power supply was fixed based on flat rate tariff system. However, the power sector in the state especially the APSEB has managed it efficiently.

The period during 1990s witnessed the crisis in power sector. The growth capacity addition in this period was very low. Moreover, whatever the capacity additions were there in the state they were in Thermal sector which is more costly than the Hydel energy systems. As a result the cost of the power generated increased but the revenue collections of the power sector have not increased to align with its cost (Sankar, 2003). The efficiency and effectiveness of power sector management in the state has suddenly been gone down. The power sector has experienced the situation of its revenue generation was lower than the total costs of the sector.

The consumption pattern during this period changed in favour of the subsidized agriculture sector. The agricultural consumption was subsidized with flat rate system. The subsidized tariff offered since mid-1980s might have driven the increase in the power consumption for

the agricultural purposes. There was a steep rise in agricultural consumption during 1980s and early 1990s. The high tariff for industrial sector to cross subsidise the agricultural consumption has resulted in declining share of industrial consumption during the period.

Moreover the distribution efficiency in this period has deteriorated not only on the technical side but also the commercial side owing management problems. There were increasing transmission and distribution (T&D) loses during this period. Some of the transmission and distribution (T&D) loses were shown under the agricultural consumption since it is unmetered consumer domain (Sankar, 2003). The arrears of power charges, the billed amounts, have risen unprecedentedly.

Finally the Government of Andhra Pradesh has noticed the fast deteriorating financial and overall performance of power sector especially the APSEB and setup as High Power Committee in 1995 to look into ‘Reform and Restructuring of APSEB’ under the chairmanship of Dr. Hiten Bhayya. Although the committee has submitted its report within four months and the Government Andhra Pradesh has accepted in principle most of its recommendation, it has sought the World Bank assistance for designing the reform and restructuring of the APSEB. Consequently the Andhra Pradesh Electricity Reform Act was enacted in 1998 and the Andhra Pradesh Electricity Reform Rules were issued Andhra Pradesh Electricity Regulatory Commission was set up in 1999. With the implementation of power sector reforms in the state the APSEB was restructured in to APGENCO (with generation responsibilities) and APTRANSCO (with transmission responsibilities). In 2000 these two separate bodies began their functioning. Thereafter, as result of reforms the state power sector gained its glory back. At present, Andhra Pradesh is one of the best performing state in India.

VI The Power Sector and the Growth of the State Economy (GSDP)

Infrastructure in general, energy infrastructure in particular is the crucial factors determining the growth of state economy. It is explicit from the above analysis that most of the demand for the power arises from agriculture especially for irrigation, and industrial sectors especially for manufacturing. The industry (manufacturing) and agriculture play vital role in the development of the state’s economy.

Table 5.1: Elasticity of GSDP in Andhra Pradesh with respect to Growth in its Power Consumption

Year	Growth of GSDP	Growth of Power Consumption	Elasticity of GSDP
<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>
1960s	1.8	12.7	0.14
1970s	2.7	9.0	0.31
1980s	4.8	11.3	0.42
1990s	5.1	4.8	1.06
2000s	7.8	8.3	0.94
1960-09	4.7	9.4	0.50

Note: 1. Growth is exponential growth and presented in percentage form; 2. Elasticity of GSDP – The ratio of growth rate of overall GSDP to the growth rate in overall power consumption.

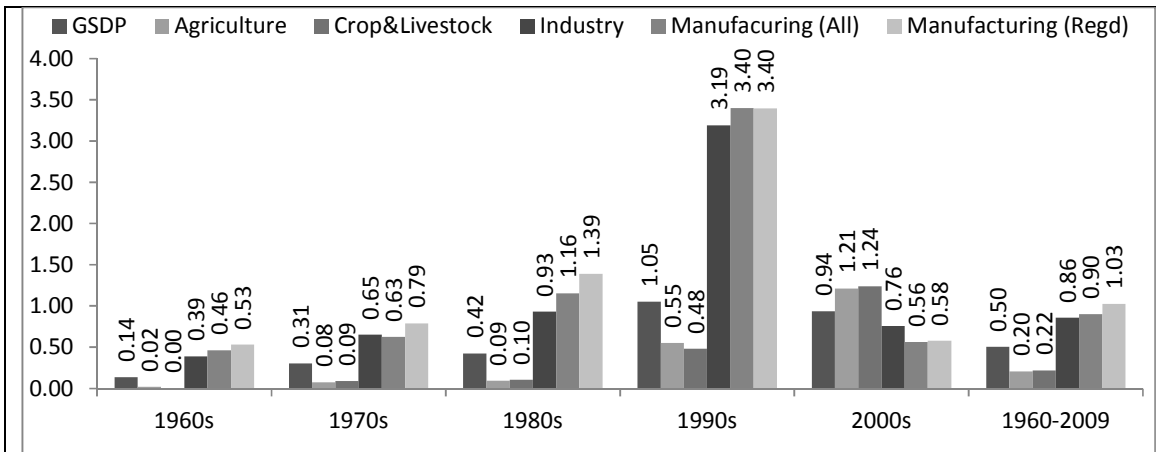
Source: Computed.

During 1960s and 1970s the industrial sector especially the manufacturing was consuming more than two-thirds of the total energy sold/consumed in the state. However the share of

industrial sector has been declining over a period of time. Correspondingly the share of agricultural sector especially for irrigation purposes has been increasing.

Elasticity of GSDP with respect to the power consumption in the state has increased from 0.14 during 1960s to its peak 1.06 during 1990s. It indicates that over a period time especially during 1990s the power supply/consumption has become a critical factor for the growth of the economy of Andhra Pradesh.

Figure 5.1: Elasticity of GSDP by sub-Sectors with respect to the Power Consumption, Andhra Pradesh



Note: Elasticity – The ratio of growth rate of sub-sector GSDP to the growth rate in sector-wise power consumption

Source: Computed.

Among the sub-sectors of the state economy, as mentioned above, the industry and agriculture sectors are the major consumer domains of power. The higher elasticity values especially for industry during 1990s indicate that power supply has become critical factor.

Cross subsidization system followed in the state with subsidized flat rate power tariff for agriculture and highly increasing tariff for industrial sector that began since mid 1980s and the resulted subsequent crisis in the power sector has in fact hampered the growth of manufacturing sector in the state during 1990s. Otherwise growth of manufacturing sector in the state would have been higher what it was in the period.

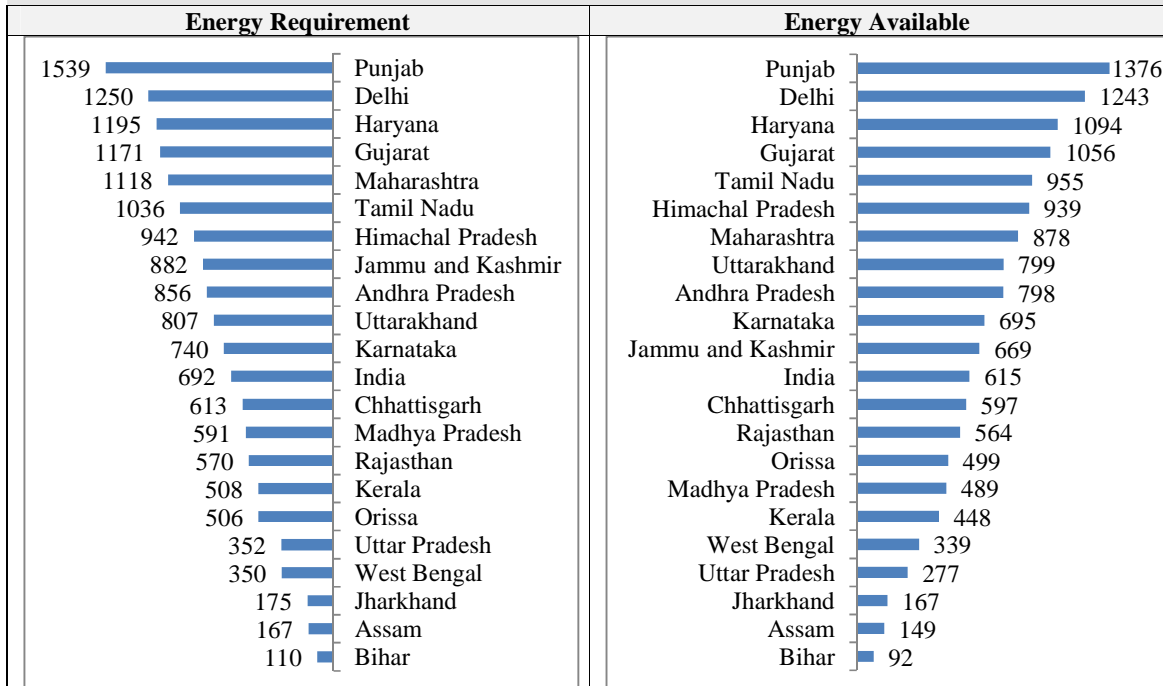
Since the implementation of reforms the share of agriculture is declining. In the process of implementing the power sector reforms, the electricity consumption of agriculture is being reduced through the limited supply of power for the agricultural purposes.

VII Challenges Ahead

The challenge ahead is the mismatch between the demand and supply of electricity. The power generation in the state could not meet the increasing demand in the state. For instance, the energy requirement in the state for the year 2009 is estimated at 856 Kwh/person/pa (Kilo watt hours per person per annum) but the energy availability in the state is 798

Kwh/person/pa. It indicates the 58 Kwh/p/pa deficit/shortage of energy availability for the year 2009. The deficit/shortage has been increasing over a period of time.

Figure 7.1: Per Capita Energy Requirement and Availability across Major Indian States, 2009



Note: Per Capita energy requirement and availability is in Kwh per person per year.

Source: Ministry of Power, Government of India, New Delhi.

The state of Andhra Pradesh stands at ninth position across major Indian states in terms of both the per capita energy requirement and the energy availability in 2009. Eight states (Punjab, Delhi, Haryana, Gujarat, Maharashtra, Tamil Nadu, Himachal Pradesh and Jammu and Kashmir) are ahead of Andhra Pradesh with respect to energy requirement. The ranking of states according to energy requirement is also indirectly indicating their level of development. Relatively developed states are having higher energy requirement and vice versa.

The capacity addition of power generation especially in the public power sector is not aligned with the increasing demand for the power. As the state policy is proactive in promoting private sector in the power sector, more of private investment may fill the balancing capacity additions required for meeting the increasing demand for energy in the state.

There is great potential for the alternate energy systems in the state, other than those of Hydel and Thermal energy systems. The state of Andhra Pradesh rises to the challenges of energy security, renewable energy is considered to be one of the most promising alternative solutions. However, the development of the renewable energy systems in the state is still in the infant stage. Gas-powered power plants are an in timely option. An advantage of the gas-powered power plants is that they can be shut down and start up several times, it is not possible with the other thermal power plants like coal. It acts as an energy saving mechanism

the plants can be operated based on the requirement. As the state turning to Gas-Hub of India with the exploration of K-G basin gas resource, the state can utilise its resources. Also the vast coastal area in the state as a resource base for developing tidal energy system is not attempted.

Given the challenges of energy security and climate change, the transformation of the energy systems and power sector from a conventional organisation to a climate-responsive organisation through sustainable strategies and solutions would be the concern of the state policy.

VIII Conclusions

The present paper has examined trends in the power and explored the scope for enhancing its capacity. It is observed from the analysis that although state's power sector has witnessed phenomenal growth in every aspect of the sector (installed capacity, power generation, and power consumption) and shown the better performance over a period of time, it has experienced serious crisis during 1990s and getting recovered during the last one decade period. At present the state power sector turned up to be one of the best performing state power sectors in India. There is a large scope for expanding the base of the power sector in the state especially with promoting the private investment and exploiting the alternative energy systems.

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