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Rural Electrification in the Changing Paradigm of Power Sector Reforms in India

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ABSTRACT

Rural electrification is an integral component of poverty alleviation and rural growth of a nation. In India, GDP is increasing with 8 percent where as contribution of agriculture sector is 1.9 percent. Government of India has ambitious target of providing electricity to all villages by 2008 and all rural households by 2012. Steps are already initiated by Government of India with Electricity Act 2003, Deregulation, Unbundling of State Electricity Boards (SEB), Independent Power Producers (IPP),Electricity Regulatory Commissions, Rural Electric Corporation (REC),Rajiv Gandhi Grameen Vidyutikaran Yojana(RGGVY),Accelerated Power Development and Reform Program (APDRP), etc. Electricity has not played effective role in the socio-economic growth of village. An attempt has been made in this paper to assess the progress of power sector reforms and its impact on rural electrification in India. Challenges faced by SEBin this process are also identified.

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1. INTRODUCTION

Power sector across the world is undergoing a lot of restructuring; India is no exception to this. The whole of the power industry in India is undergoing a state of flux. [1] Power sector reforms in India were initiated in the face of mounting commercial losses due to poor fiscal health of state utilities, endemic capacity, energy shortages and increasing subsidy burden on the states. Investment in the sector was falling far short of demand in power supply. The Government of India, in 1991 embarked upon an ambitious program for reforming the sector with the prime objective of transforming the electricity industry into an efficient enterprise. [2] The Power industry in India is changing from regulated industry to a competitive industry. Power sector re-structuring program in recent years along with Electricity Act 2003 in India has paved the path for the development of a power market in the country. In this transition phase, it is now essential to design the most appropriate market suitable for the country. [3] All these reforms are consistent with the view that competition should be introduced into the electricity supply industry, wherever, it is technologically feasible and India is not exception to these reforms. There is significant improvement in the areas of transmission and distribution, tariff rationalization and in availability of power supply. [4]

India has one of the fastest growing economics in the world and ranked 6th place in the worldwide consumer of energy.Six thousand villages inhabit 72.2 percent of its human resource (census 2001). About, 40 percent of the total energy is in rural areas, in which domestic sector constitutes major energy demand and its consumption accounts for 60 percent of energy used. The main energy sources are coal and oil, whilest hydro, wind, nuclear and biomass provide additional sources. Although hydropower has good potential, it has

not been utilized to its full potential. India holds 7% of the worlds coal reserves; 0.5% of oil reserves. Following are some of the salient aspects having direct and indirect bearings on energy supply, to rural –

- Both the traditional energy and commercial energy are in short supply and the demand supply gap is in increase.
- Pressure on traditional energy resources such as wood is continuously increasing.
- Heavy dependence on commercial fuels such as coal and oil as a short term measure for meeting increasing demand is alarming in view of depleting fossil fuels and environmental pollution.
- Energy supply to far–off rural areas is associated with high transportation cost and high electrical transmission losses.

Thus emphasis should be laid on the auditing of the energy in such a way that ensures affordable, environment friendly and clean energy.

2. IMPACT OF RURAL ELECTRIFICATION

Importance of electricity as a crucial infrastructure input for economic development of the country has been well established.Studies of rural electrification indicate the following broad consensus concerning the impact of electrification in the rural areas. [5]

A.Quantifiable benefits of rural electrification:

1 Industrial uses of electricity
   1. Motive power: replacing liquid fuel.
   2. Lighting: replacing liquid fuel or gas.
   3. Space heating, cooling and refrigerating: replacing liquid fuel, coal/gas, biomass/ animal waste.
   4. Processing food: replacing liquid fuel, coal, gas, biomass or animal waste.
   5. Transport: replacing liquid fuel

2 Commercial uses of electricity
   1. Lighting.
   2 Air-conditioning and refrigeration.
   3. Improved audio and video opportunities.
   4. More attractive atmosphere.
   5. Longer opening times

3 Household uses of electricity
   1. Lighting-replacing liquid fuel, gas, biomass or animal waste
   2. Cooking-replacing biomass, animal waste, liquid fuel, coal or gas.
   3. Space heating, cooling and refrigeration-replacing biomass, animal waste, liquid fuel, coal/ gas.
   4. Home appliances (fan, iron, radio, TV etc)-replacing batteries, biomass/ coal.

4 Agricultural uses of electricity
   1. Water pumping-replacing liquid fuel, coal, and gas or muscle power.
   2. Parboiling, heating and drying-replacing biomass, coal or liquid fuel.
   3. Chaff cutting, threshing etc-replacing liquid fuel, hydro and muscle power, coal / biomass

B. Non Quantifiable benefits:

1 Modernisation, dynamic growth and attitude changes-catalytic effects.
2 Improvement of quality of life, community services (including medical) and participation.
3 Income redistribution and improving social equity.
4 Employment creation.
5 Other socio-political effects such as improving political stability, reducing discontent and disparities between urban and rural areas.

Features of rural electrification

Rural electrification is an important component of Integrated Rural Development; but it has not given due importance because of the following reasons [6].

- Villages are located from 3-30 km away from existing grid or even more.
- They are located in difficult terrain areas like forests, hill areas and deserts.
- The number of households may range between 2 to 200 with dispersed distribution of loads.
- Power demand in villages is quite low and rural domestic consumers are mainly peak time consumers and contributing for poor load factors of 0.2-0.3.
- The income level is low and hence the paying capacity.

3. STEPS INITIATED BY GOVERNMENT OF INDIA

From the time of independence, Government of India and State Electricity Boards have given priority for rural electrification and the phenomenal growth is evident from Table 1, Table 2 and Figure 1.

Table 1 .Status of Rural Electrification in India as on 31-12-2011 (Source: Rural Electric Corporation)

Variable	Value
Total Number of villages	5, 87,258
Villages electrified	5, 08,515
Villages to be electrified	78,743
Total number of households	13, 82, 71, 559
Electrified households	6, 42, 63, 719
Un electrified households	7, 40, 07,840

Table 2. Expansion of electrical transmission network as on 31-12-2011

Expansion of electrical transmission network	
Transmission line 400 kV : 56,090 km	Transmission line 220 kV: 1,03,724 km
Transmission line 800 kV : 1311 km	HVDC + / -500 kV: 5876 km
Sub stations 400 kV : 73,175	Sub stations 220kV : 1,38,312

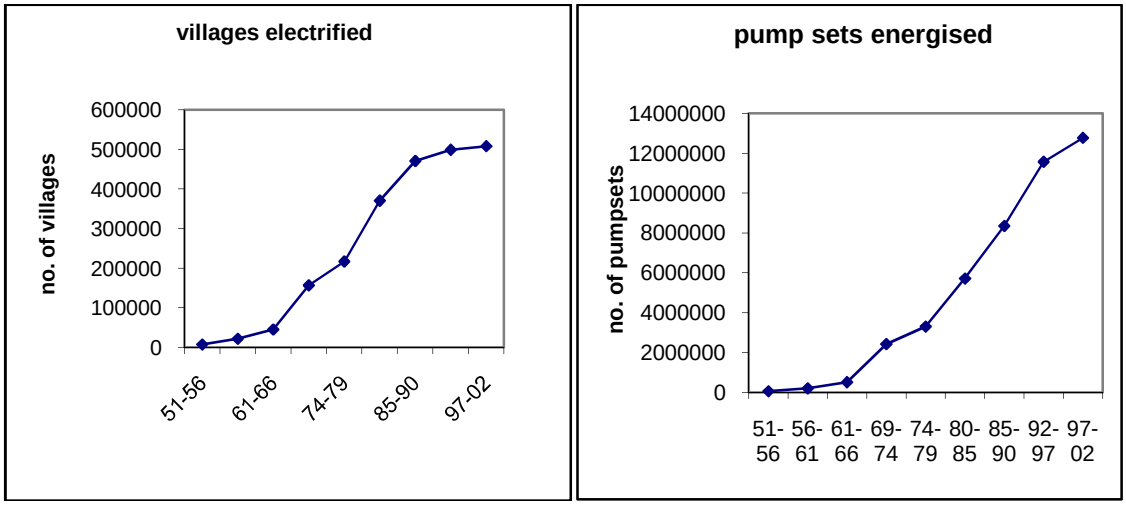

Fig. 1 Progress of rural electrification in India

To stimulate the process of rural electrification, Government of India has setup Rural Electric Corporation in July 1969. The purpose is to accelerate electrification to meet the goal of **'**Power for All by 2012'. The mission is also to identify technologies that could be used in providing affordable and reliable power supply to rural areas and effect implementation through distributed generation schemes, wherever feasible. The purpose is to provide electrification of remaining 'one lakh villages and one crore household'.

Previously, "a village was deemed to be electrified if electricity is used in the inhabited locality, within the revenue boundary of the village for any purpose what so ever". Ministry of New and Renewable Energy (MNRE) modified this definition on 29th September 2006 as-"In accordance with the approved definition of village electrification, remote villages/hamlets will be deemed to be electrified if a minimum of 10% of the households are provided with electricity is also made available for community facilities and for dalit bastis (habitants) of the village if any." Rural electrification comprises of basically two folds-

- Electricity is available nearby; households (53.5%) are not connected supply network.
- Villages (78,743) are faraway, inaccessible and hence not connected to either grid or stand alone power systems.

4. STATUS OF STATE ELECTRICITY BOARDS

As per constitution of India electrification is in the concurrent list of article VII and state governments are responsible for electrification, well supported by Central government. During the last two decades, the electric power sector has been subject to dynamic changes including regulation, market

formation and structure, technology mix, and political aspects. Power sector reforms were initiated in 1990 with the unbundling of the SEBs, enactment of the Electricity Act 2003, National Electricity Policy (NEP) etc. have created a strong policy framework to ensure investment in all sectors.

From last five decades SEB played significant role in generation (Fig. 2), transmission and distribution (table II) of electricity. Initially the growth of rural electrification was-(i) very slow up to 1966, (ii) increased from 1966 (due to severe draught) up to 1990 and (iii) slowed down later after 1990s (Fig. 1).

a) Present Generation of electricity indicate that 56.5% of electricity by state governments. (fig.2)

b) Higher i.e. 69% of this is by thermal generation followed by hydal 29 % and other. (Fig. 3)

c) Power demand density is low, and main T&D lines tend to be elongated geographically. Therefore, power distribution loss becomes high. The future energy consumption is expected to increase leading to higher distribution losses. Presently,aggregate technical and commercial losses are above 30 %.(Fig. 4 and Fig. 5) T & D losses are high in 11 kV and 440 V distribution network. Farmers are compelled to go for higher capacity pump sets, leading to frequent motor burnouts, distribution transformer failures.

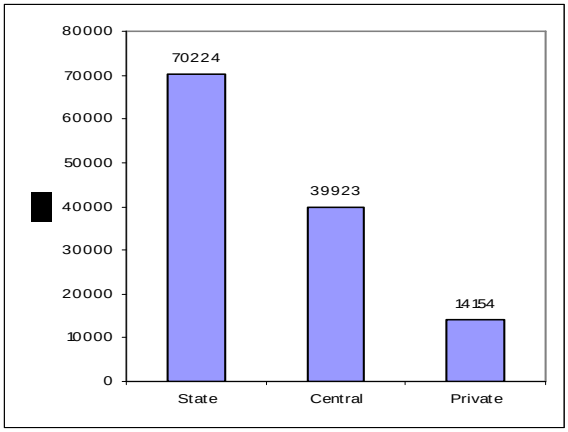

Fig. 2 Electricity generation

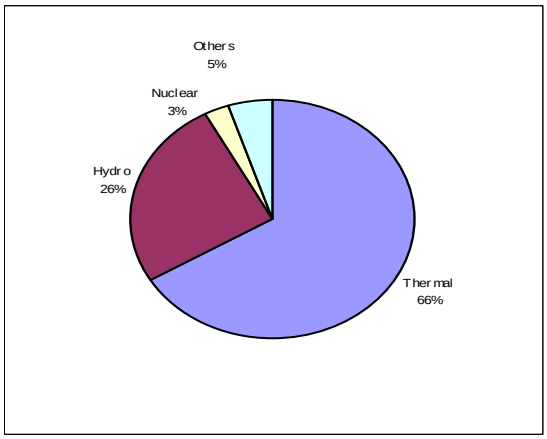

Fig. 3 Electricity Generation

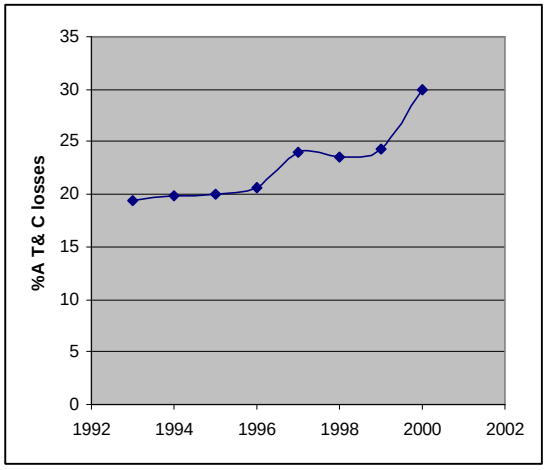

Fig. 4 Agg. Trans. & commercial losses

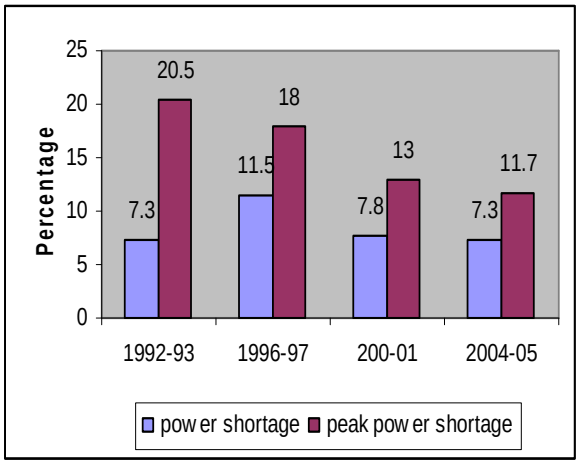

Fig.5 Power shortage

d) Available transmission capacity currently is almost fully committed to existing generators and there is little surplus capacity. A kW of new transmission and distribution capacity has been estimated to cost on average Rs. 70000 per kW.

e) Commercial losses increased to above Rs.24000 crores. (Fig. 6) Eighteen out of Nineteen SEBs incurred heavy financial losses in 2011.

f) SEBs reluctant for rural electrification process mainly due to high transmission and distribution losses and low Economic Rate of Return less than 20%. Hence drastic reduction in number of villages electrified; but energisation of pump sets is still increasing, reached to above 19 lakhs on 31st Oct, 2011(Fig. 8)

g) Transmission and distribution losses are reduced by 7.17% and aggregate, technical and commercial losses by 7.63%. (fig 8)
h) Contribution of electricity generation towards agriculture is above 30%; Revenue Return is 2.5%.

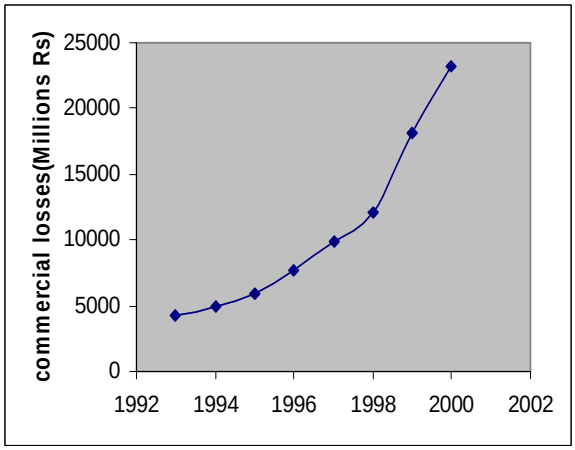

Fig. 6 Commercial losses (in Rs.)

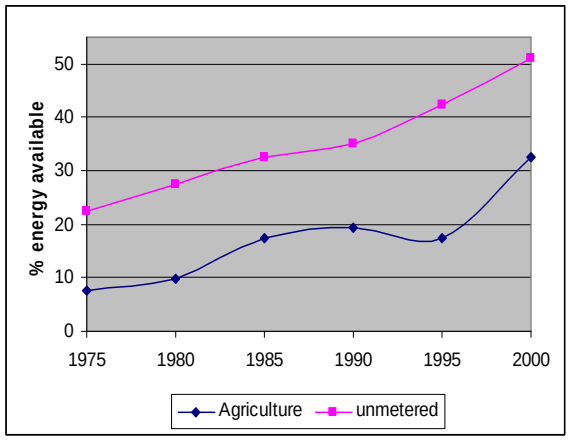

Fig. 7 Percentage Energy available

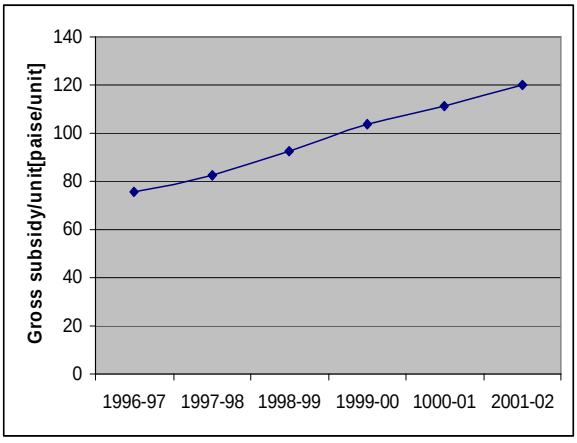

Fig. 8 Gross subsidy

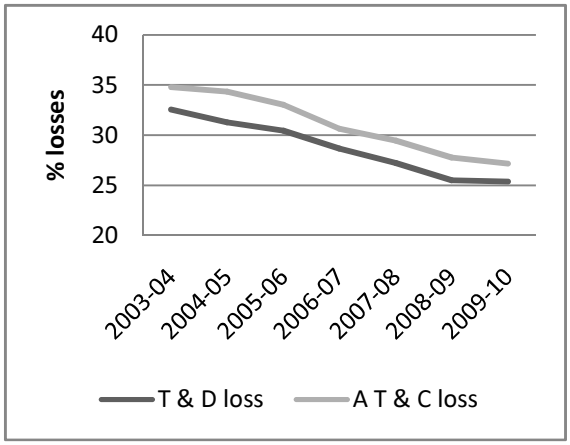

Fig. 9 Reduction in losses

j) Subsidies introduced to promote economic development and initial impact was small and could be funded through government budgets. However over the year's element of subsidy increased manifold (Fig. 8). Rather subsidies led to negative consequences and many unintended effects, more difficult to phase out.
k) National average cost of generation is rupees 3.50 per unit and average realization is rupees 2.50 per unit.

5. POWER SECTOR REFORMS

Primary objective of power sector reforms is to achieve overall efficiencies in the performance of generation, transmission and distribution, improve financial viability, reduce the dependence on power utilities on government, reduction in t&d losses, control of theft and pilferage and provide quality service to various consumers at an affordable price. Thus by reforms rural electrification problems are effectively addressed. Following are the changes observed in rural electrification sector due to power sector reforms-

a) Private sector participation is increased to 14% from mere 1% during 1990 to 2010. Isolated grids are established in remote and inaccessible areas with solar photovoltaic, mini/micro hydal, wind farms.
b) Over all power shortage reduced to 11.7% due to measures taken by stake holders.(Fig. 5)
c) The reduction in the T &D losses occurs due to identification of the weakest areas in the distribution system and strengthening / improving them so as to draw the maximum benefits of the limited resources.Average technical and commercial losses are still above 30%, because SEBs included commercial loss to get subsidy benefits.(Fig. 4)

d) Per capita consumption was 238 kWh in 1990 to 779 kWh in 2011.
e) Previously SEBs gave less preference to management of distribution lines over the years. Presently there is a positive change in the quality of supply and its availability.
f) Increase of electricity unit cost from 1.1 per unit in 1991-92 to 3.54 in 2009-10 is primarily due to cost of fuel about four times of 1990s. In India there is every chance that prices may decrease after an initial upsurge to adjust to the realistic costs.
g) Costs for agriculture and residential households are far below the actual supply costs, where as electricity price to commercial and industrial consumers is cross subsidised by above cost prices. Average farmer pays about 10% of the cost of supply and average domestic consumer pays less than 60% of the cost of supply.
h) Rural committees are involved in bill collection and hence Economic Rate of Return doubled.

6. CRITICAL CHALLENGES AHEAD

Rural electrification is an old challenge with news ways. Any delay in reforming the sector will only make it much more difficult to tackle the task later. Government of India is committed for improving energy services in rural areas since access to electricity "in itself" with well being. Thus, for speedy implementation of the reforms the following critical points are to be addressed.

- All successful rural electrification programs have developed their own systems for ranking or prioritizing areas for obtaining a supply. Capital investment costs, level of local contributions, number and density of consumers, and the likely demand for the electricity are among the factors considered.
- Smaller companies that concentrate solely on electricity may be better able to address India's rural electrification problems, including low loads, low household connections rates, subsidies for agricultural consumers, poor consumer service and inadequate bill collection. Many small rural electric cooperatives are providing better services. Development of cooperative, user associations, Non Governmental Organizations, private rural electrification is a worthwhile goal.
- As restructuring of state power utilities is gaining momentum, appropriate institutional frameworks and incentives needs to be created to ensure that rural electrification expands in ways that are sustainable. The reforms should not focus on large companies but should consider creating an environment in which smaller companies are encouraged to serve rural markets.
- Successful rural electrification programs indicate that both large and small companies must follow certain principles. Rural families find the initial connection costs a far greater barrier than paying monthly electricity bills. Hence reducing initial charges or spreading payments over several years, even if it means charging more per unit of electricity, allows many more low-income, rural families to obtain supply.
- Charging the right price allows the electricity companies to provide a supply effectively, reliably and sustain ably to an increasing number of satisfied consumers. Successful rural electrification programs have strongly emphasized covering their costs, despite the wide variation in how they approached the problem. Smaller, more flexible companies might encourage day time use of electricity in rural commerce and industries, encourage more people to connect to the systems, involve local leaders in bill collection to lower costs, and provide flat rates for minimal service. Companies would also have an incentive to develop lower-cost example Single wire earth Return, designs to provide service to low-demand consumers.
- Development of community based, cooperative [7], Non-Governmental Organizations and private companies provides more responsive service to consumers.
- Studies revealed that 42 percent rural people are willing to pay for reliable electricity; they distrust the SEBs. Hence local companies are better able to deal with this tariff and pricing problem since they are located closer to their consumers, Example if residential customers understood that they were paying higher prices because of subsidies to agricultural pumping they might have less resistance to reducing agricultural subsidies. Today people have no understanding of how electricity prices are set and many even believe they are being taxed for electricity.
- SEBs prefer to handover unprofitable rural systems. However incentives are not in place for encouraging the development of local electricity business because they must abide by thee same pricing and distribution policies that are causing problems for SEBs.

8. CONCLUSION

The main objective of power sector reforms in India is to enhance competition in the sector, to improve the fiscal health of the SEBs, as well as attract private investment in the ailing power sector, have

been the main driving force to undertake reforms in India. Regulatory changes have been able to bring about tariff rationalization and transparency and consumer protection in the regulatory process. Benefits of the reform programme has started bearing fruits some of which are evident in the form of reduction in the AT&C losses as well as the reduction in the commercial losses of the SEBs.Longer-term challenges may require additional elements of restructuring similar to those proved in the industrialized countries. Phasing out cross-subsidy in a gradual manner, prices reflective of costs, improving the technical and commercial efficiency which requires political will and support would go a long way inbuilding a strong and vibrant power sector having positive net worth.

- Short-term implementations- in next 5 years for immediate improvement
- Medium term implementations- in next 5-15 years-technologies that can potentially achieve improvements relative to current technology
- Long-term implementations- in next 15-30 years- Proven technologies that could reduce net energy costs and reduce emissions, leading to sustainable development.

A combination of short, medium and long-term strategies helps the policy makers to plan and implement the programmes for sustainable rural electrification, with emphasis must shift from energy consumption to energy services. Rural electrification is a 'selective catalyst' to improve agricultural productivity through mechanization and is essential for many rural activities. Electrification cannot by itself ensure economic development but it is a necessary but insufficient condition. It works best when it is complemented by social and economic infrastructure development.Recent programs are showing good results but more promising new approaches need to be tested to determine if they can address poverty, equity, environmental and public health concerns in the context of on going global restructuring of energy industries. Time will tell, but the indicators are promising.

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