IOSR Journal of Business and Management (IOSR-JBM)
e-ISSN: 2278-487X, p-ISSN: 2319-7668. Volume 17, Issue 2.Ver. IV (Feb. 2015), PP 54-59
www.iosrjournals.org

A Study of Rural Electrification Infrastructure in India

Dr. Pradeepta Kumar Samanta
Assistant Professor in Finance, National Institute of Construction Management and Research (NICMAR), Pune.

Abstract: *Energy is one of the key drivers of development and access to clean, safe and affordable sources of energy are considered as instrumental to stimulate economic, social and physical development. Availability of energy/power facilitates effective and efficient delivery of most basic services such as safe drinking water, public lighting, health care, education, etc. Besides, it also enables better standards of household living and fuelling economic and income generation activities. It has usually been observed that a high correlation exists between consumption of electricity (energy) and improvements in the Human Development Index (HDI), especially at low levels of HDI. Lack of access to clean and efficient energy sources has thus been proved as one of the significant barriers to alleviation of poverty. India, despite the unprecedented pace of addition in the generation capacity over the Plan period, continues to have very low levels of energy consumption. The per capita energy consumption in India remains well below the world averages. This low level of energy availability and consumption tends to affect the poorest the most. While 16 % of the global population are residing in India, its share of global energy consumption is a paltry 4.2 %. Similarly, India's per capita electricity consumption of around 734 kWh is way below the global average of 2,782 kWh and China's 2,471 kWh. In India, rural per capita consumption of electricity is only 8kWh per month compared to 24 kWh in urban areas. Indian economy has traditionally been characterised as an agrarian economy with majority of its population living in the rural areas and are dependent on their farm land to earn their livelihood. These areas often do not have access to energy resources for livelihood expansion like power for irrigation, cold storage or processing and for normal day-to-day activities and are instead dependent on traditional and unclean sources of energy like woody biomass, dung cakes, kerosene, etc. As a result, the opportunities for productivity enhancements and value addition get limited by the lack of modern and efficient energy services. India has approximately 400 million people with no access to electricity, a majority of whom live in the rural areas. One of the key reasons for this is that such rural population resides in areas where geographical distribution combined with terrain and low purchasing power of consumers creates hurdles in providing uninterrupted electricity supply. As a result, limited investments have gone into maintaining and sustaining infrastructure for energy delivery, even if it gets built under government programmes. Rural areas usually suffer on account of the poor and under developed state of transmission and distribution infrastructure and sometimes even lack adequate distribution capacity to supply electricity. Since independence, almost every Five Year Plan made provision for rural electrification through various policy initiatives. The establishment of Rural Electrification Corporation in 1969 mandated to finance and promote rural electrification projects all over the country. Notwithstanding these initiatives, household electrification and access to sustainable quality electricity services remains a dream for more than half of the households in India. The present study analyses the emerging issues of electrification infrastructure in rural India.*

Keywords: *Rural Electrification, State Electricity Board (SEB), Renewable Energy, RJJVY*

I. Introduction

Access to energy is a cornerstone for development and essential for a better quality of life. When this access doesn't exist or is very poor, it has negative impacts on everything from education, to health, employment and irrigation - touching all aspects of life and livelihood. According to a recent United Nations Development Programme (UNDP) supported study, energy insecurity and allied poverty is critically undermining the achievement of the Millennium Development Goals (MDGs). In India today 56% of rural households (approximately 78 million), do not have access to electricity. Rural electrification has been identified as a critical programme for the development of rural areas. The stated aims of the electrification programme is to ensure economic development by providing electricity access to all the villages and households in order to improve the quality of life and livelihood opportunities in the rural areas. The concept of rural electrification in India has undergone various restructuring programmes. Initially, until 1997, the main focus was on 'electrification for irrigation' to increase the agricultural production of the country. Later this changed to a more focused approach, recognising the importance of reaching electricity to rural areas.

The power sector in India is one of the most diversified in the world. Sources for power generation range from commercial sources like coal, lignite, natural gas, oil, hydro and nuclear power to other viable non-conventional sources like wind, solar and agriculture and domestic waste. The demand for electricity in the

country has been growing at a rapid rate and is expected to grow further in the years to come. In order to meet the increasing requirement of electricity, massive addition to the installed generating capacity in the country is required. The Indian energy system is concentrated around the conventional system of centralised electricity generation relying heavily on coal based thermal power plants and large dams. However, there is a large body of evidence to show that the centralised system has not been able to balance demand and supply, and has resulted in inequities and environmental degradation which has left more than 40% of the Indian rural population in the dark as reported by Kaudinya, *et al.* (2009). While large-scale reforms have repeatedly been attempted in the past, India's achievement in the field of rural access to electricity leaves much to be desired. India is home to 35% of the global population without access to electricity and only 44% of all rural Indian households are electrified. According to the 2001 Census, 6.02 crore households use electricity as the primary source of lighting out of a total of 13.8 crore households in the country.

The Planning Commission's strategy for the development of rural India as well as the ited Nation's Millennium Development Goals is inherently dependent on the integration of electricity services to achieve a set of varied development goals. Viable and reliable electricity services result in increased productivity in agriculture and labour, improvement in the delivery of health and education, access to communications (radio, telephone, television, and mobile telephone), improved lighting after sunset, facilitating the use of time and energy-saving mills, motors, and pumps, and increasing public safety through outdoor lighting. Rural electrification at a household level provides at the very minimum services such as lighting and communications (e.g. radio/television) and can increasingly meet the aspirations of the rural populations to own other household appliances. Household electrification also increases the likelihood that women will read and earn income.

Power Sector in India-State Electricity Boards

Both the central and respective state governments in the country enjoy legislative rights on the subject of electricity. Electricity distribution, however, is the exclusive domain of state governments. Prior to 1991, the electricity business in the states was in the form of vertically integrated State Electricity Boards (SEBs). These SEBs were owned and operated by the states and were responsible for generation, transmission and distribution services within the state. SEBs operated under the proviso of the Electricity Supply Act of 1948, and were supplemented in their efforts by the Central Public Sector Utilities (CPSUs) like the NTPC (National Thermal Power Corporation), the NHPC (National Hydro-electric Power Corporation), and the PGCIL (Power Grid Corporation of India). But over the years, the SEBs suffered from financial crunch and operational inefficiency.

Irrigation pumping for agriculture has been cited as one of the principle causes of poor cost recovery of SEBs and a prime cause of the poor financial health of the SEBs. However, it is observed from the literature that irrigation reduces poverty by increasing employment, incomes and real wages and by reducing food prices for rural and urban poor. In India, in un-irrigated districts (less than 10% area irrigated), 69 % of people are poor, while in irrigated districts (more than 50% area irrigated), poverty level drops to 26%. Agricultural performance is fundamental to India's economic and social development and will critically determine the success of efforts in poverty reduction. Hence a sudden and substantial shift away from current pricing of electricity for agriculture could have jeopardize agriculture, an activity that is the primary source of livelihood in rural areas, accounting for 72% of India's population. Irrigated areas in India contribute two-thirds of food grains output and provide livelihood and income to more than 650 million people in India. Of the 57 million ha net of irrigated area, as much as 34 million ha is from private investments in tube wells, pump sets and water distribution channels. The poor frequently pay a high fraction of their gross farm income for irrigation.

Rural Electrification in India

The need for extension of the electricity system to rural areas was felt quite early, just after the independence of the country. Rural Electrification programme in India was launched with two distinct dimensions i.e. (1) Village Electrification. (2) Irrigation Pump set Energization. The former enhances consumer satisfaction and the latter optimises crop yield. The area of focus was certainly maximising farm output, which did result in the Green Revolution in the mid-1960s. Accordingly, the indicator of electrification was not based on the percentage of households or population with access to electricity but merely extension of electricity lines to a particular area. By this definition, almost 86% of the villages have access to electricity. In 2004, the programme has been refocused to provide electricity access to rural households.

The First Five Year Plan emphasized to support for projects that ensure irrigation potential. During this period, only one in 200 villages was connected to grid supply across the country. The Second Plan named rural electrification as an area of special interest, and proposed to cover all towns with a population of 10,000 or more. Only 350 out of a total of 856 of were eventually electrified. The Third Plan for the first time raised the issue of efficiency in the sector. The REC (Rural Electrification Corporation) was created in 1969 with renewed focus on poverty alleviation. The target based approach of rural electrification was developed in the Fourth and

Fifth Plan periods, with focus on pump set energization and guidelines for village grid connectivity for all villages with a population of at least 5000.

The early 80's saw major changes in conjunction with the creation of the Commission for Additional Sources of Energy (CASE) in 1981, which evolved into a full-fledged Ministry for Non-Conventional Energy Sources (MNES) in 1992. The Sixth and Seventh Plan periods witnessed the launch of innovative rural energy programs like the National Program on Improved Chulha (NPIC) in (1983), The National Project on Biogas Development (1981-82), Special Program Agriculture (SPA) and integrated energy programs like IREP (Integrated Rural Energy Planning) and Urjagram. With the institutionalization of the MNES in the early 90s, rural energy provision now largely rests with the RECs and MNES. Covering a wide range of technology and fuel options including renewable sources, national efforts at rural energy provision floated variety of programs to address the range of energy requirements of rural populations. With the change in definition of an electrified village, the mid-term review of India's Tenth Five-Year Plan has acknowledged that the year-end figures as of 31st March 2004 of 84.3% village electrification would reduce to less than 70%. An all-party consensus recommended complete rural electrification by 2007 and complete coverage of all households by 2012

The main sources of funding for current rural electrification programs are:
(i) The Rural Electrification Corporation
(ii) Plan allocation to the States.
(iii) Funds support from Government as loan and grant
(iv) Institutional financing bodies like Commercial Banks
(v) International financing agencies like OECF, etc.

As on 31st August 2013, a total of 32,227 villages of India are yet to be provided with electricity access. Out of a total of 593,732 inhabited villages as per the 2001 census, as on 31st August 2013, a total of 561505 villages were electrified (*Table 1*).

Table 1 : Status of Village Electrification* in India

Total inhabited Villages as per 2001 Census	Villages electrified as on 31/03/2013 as per new definition (Provisional)		Cumulative achievement as on 31/08/2013 as per new definition	%age of villages electrified as on 31/08/2013	Un-electrified villages as on 31/08/2013
	No.	%			
593,732	560552	94.4	561505	94.6	32227

* A village is deemed electrified, if 10 % of all the households of the village has electricity access and if electricity provided to public spaces such as schools, panchayat officers, health centres, community centres and dispensaries.

Table 2 gives an overview of the status of village electrification across the 29 states of India. Out of total of 29 states, only 10 states have achieved 100 % village electrification as on the 31st October 2013.

Table 2 : Percentage of Villages Electrified per State as of October 2013

State	Percentage	State	Percentage
Andhra Pradesh	100.0%	Maharashtra	99.9%
Arunachal Pradesh	75.5%	Manipur	86.3%
Assam	96.1%	Meghalaya	86.3%
Bihar	96.7%	Mizoram	93.5%
Chattisgarh	97.1%	Nagaland	70.1%
Delhi	100.0%	Orissa	78.9%
Goa	100.0%	Punjab	100.0%
Gujarat	99.8%	Rajasthan	97.6%
Haryana	100.0%	Sikkim	100.0%
Himachal Pradesh	99.9%	Tamil Nadu	100.0%
Jammu & Kashmir	98.2%	Tripura	92.9%
Jharkhand	89.2%	Uttar Pradesh	88.9%
Karnataka	100.0%	Uttaranchal	98.9%
Kerala	100.0%	West Bengal	100.0%
Madhya Pradesh	97.7%		

Source: Central Electricity Authority, "Progress Report of Village Electrification"

Rural Electrification Corporation (REC)

The Rural Electrification Corporation (REC) was established as a public sector undertaking in July, 1969. Initially, the principal objectives of the corporation were to finance Rural Electrification (RE) schemes

and promote rural electricity co-operatives for funding rural electrification projects across the country. The tasks assigned to the corporation have occasionally been expanded. The main objects currently are:

(i) To subscribe to special rural electrification bonds that may be issued by the SEB on conditions to be stipulated from time to time.
(ii) To promote and finance rural electricity co-operatives in the country.
(iii) To administer the money received from the govt. and other sources such as grants.
(iv) To promote, organize or carry on the business of consultancy services and/or project implementation in any field of activity in which it is engaged in India and abroad.
(iv) To finance and/or execute works on small/mini/micro-generation projects, to promote and develop other energy sources and to provide financial assistance for leasing out the above sources of energy.
(v) To finance survey and investigation of projects.
(vi) To promote, develop and finance viable decentralized power system organizations in cooperative, joint, private sector, panchayat and/or local bodies.

Major Rural Electrification Schemes in India

Rural electrification is the backbone of rural economy and a basic input for rapid rural development. It is also the main infrastructure for ensuring speedy growth of the agriculture sector and agro based industrial structure in rural areas. Some of the rural electrification schemes implemented in the post-independence period are discussed below:

Pradhan Mantri Gramodaya Yojana (PMGY)

The PMGY launched in 2000-2001 provided additional financial assistance for minimum services by the central government to all states on a 90% loan and 10% grant basis. These included rural health, education, drinking water and rural electrification. The PMGY, with an outlay of about Rs. 1600 crore during the 10th Plan period, was being coordinated and monitored by the Rural Development Division of the Planning Commission. More importantly, under PMGY states had the flexibility to decide on the inter-reallocation of funds amongst the basic services. Thus states could enhance allocations to expedite the pace of rural electrification. The scheme has been discontinued from 2005 onwards.

Kutir Jyoti Program (KJP)

KJP was initiated in 1988-89 to provide single point light connection (60w) to all Below Poverty Line (BPL) households in the country. KJP provides 100% grant for one time cost of internal wiring and service connection charges and builds in a proviso for 100% metering for release of grants. The Scheme connected nearly 60 lakh households in 15 years or at a rate of approximately 4 lakh households per year Nearly 5.1 million households have been covered under the scheme to date. The scheme was merged into the 'Accelerated Electrification of one lakh villages and one crore Households' in May 2004 and now into the RGGVY.

Minimum Needs Program (MNP)

The MNP, exclusively targeted states with less than 65% rural electrification (by the old definition) provides 100% loans for last mile connectivity. The program resources are drawn from the Central Plan Assistance. Rs. 775 crore was released during 2001-03 for rural electrification under the MNP. The scheme was discontinued in 2004-05 on account of difficulties in implementation.

Accelerated Rural Electrification Program (AREP)

The AREP, operational since 2002, provides an interest subsidy of 4% to states for RE programs. The AREP covers electrification of un-electrified villages and household electrification and has an approved outlay of Rs. 560 crore under the 10th Plan. The interest subsidy is available to state governments and electricity utilities on loans availed from approved financial institutions like the Rural Electrification Corporation (REC), Power Finance Corporation (PFC) and from NABARD under the Rural Infrastructure Development Fund (RIDF).

Rural Electricity Supply Technology Mission (REST)

The REST initiated on 11th September 2002 with the objective of electrification of all villages and households progressively by year 2012 through local renewable energy sources and decentralized technologies, along with the conventional grid connection.

REST proposes an integrated approach for rural electrification and aims:

• To identify and adopt technological solutions
• To review the current legal and institutional framework and make changes when necessary
• To promote, fund, finance and facilitate alternative approaches in rural electrification, and

• To coordinate with various ministries, apex institutions and research organizations to facilitate meeting national objectives

Accelerated Electrification of One Lakh Villages and One Crore Households, MNP and Kutir Jyoti have been merged with the RGGVY.

Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY)

The RGGVY is the latest national rural electrification scheme launched by the Ministry of Power to execute the vision for rural electrification as recommended by the Chief Ministers conference in 2001. The plan was instated in April of 2005 with the following objectives:

• 100% electrification of all villages and habitations in the country
• Electricity access to all households
• Free of cost electricity connection to BPL (Below Poverty Line) households

For achieving the said objectives, the RGGVY envisions creating a:

• Rural Electricity Distribution Backbone (REDB) with at least one 33/11 KV (or 66/11 KV) substation in each block
• Village Electrification Infrastructure (VEI) with at least one distribution transformer in each village/habitation
• Decentralized Distributed Generation (DDG) systems where the grid is not cost-effective or feasible

The RGGVY positions rural electricity as a necessary component for broad based economic and human development, looking beyond the existing framework of increasing agricultural production through irrigation. The program, in addition to meeting the household electricity needs, looks at 24 hours supply of quality grid power to rural areas for spreading industrial activity, provision of modern healthcare facilities, and the use of IT.

The RGGVY recognizes the need for revenue sustainability for RE projects and boldly states that Electricity supplied must be paid for. The scheme proposes the management of rural distribution through franchisees who could be user associations, cooperatives; NGO's or even individual entrepreneurs. Further, the distribution utilities under the new RE framework are required to enter into Bulk Supply Tariff agreements (BST) with the proposed franchisees to ensure commercial viability. The state governments are also required to make adequate provisions for revenue subsidy to the utility. RGGVY thus, for the 1st time, even while providing capital subsidy for RE projects, links subsidy provision to revenue sustainability barring which the REC could convert the said capital subsidy into interest bearing loans.

Challenges of Rural Electrification in India

According to the current rate of electrification, nationally about 1 million new connections are added each year, whereas the annual growth in households is 1.85 million. Approximately 78 of the 138 million rural households do not have access to electricity services. Lack of adequate infrastructure and properly trained manpower at the district level to carryout the electrification work also impedes the work. At the same time utilities either have limited equipment and operational resources like vehicles and block and tackle which need to be hired if a transformer has to be taken down. Most meter readers/ linesmen use bicycles. For moving equipment the customers are usually asked to bear costs. Shortage of material is also a chronic problem and a bottleneck in the speedy implementation of RE programs. This shortage is usually of materials such as conductors, aluminium, cement, steel and insulators. It is only after the funds are received that the order for material is sent to the supplier. Release of funds through the central government, state government, utility head quarters route takes time, causing delay and implementation problems at the SDO level.

II. Conclusion

Successes in electrification and electricity services can be achieved, nonetheless, by boldly confronting the difficulties that have incapacitated the power sector for decades and by adopting a multi-pronged approach to re-vitalizing energy services in India. Future efforts must implement best practices and address setbacks in all of the following areas: distribution, power generation, tariffs, subsidies, monitoring and implementation of government schemes – in effect by addressing all aspects of energy generation and distribution. While electrification rates have generally increased over time (recent setbacks recognize that a village as electrified using a stricter definition of at least 10% households as being electrified) household electrification nationally is still below 50%. For economic and financial viability of rural electrification projects, expansion of productive use of electricity is essential. Use of electricity in agricultural water pumping was the traditional productive use of electricity in India. But this has created the well-known problems of excessive demand, huge subsidies, non-payment of dues and even supply at selected times. The new programme has to be careful in avoiding committing same mistakes of the past. Integrating other rural development programmes with rural electrification could create a synergy for promoting agro-based industrial activities and productive use of electricity in rural areas.

References

[1]. Chaurey and Kandpal T.C., "A techno-economic comparison of rural electrification based on solar home systems and PV microgrids," Energy Policy 38, no. 6 (June 2010): 3118-3129.

[2]. Barkat A., Access to electricity in rural Bangladesh: some empirical evidence of socio-economic impact. In: Shrestha RM, Kumar S, Martin S, editors. Proceedings of the Asian Regional Workshop on Electricity and Development: Asian Institute of Technology, Thailand. ISBN: 974-93753-6-X; 2005, p. 12–32.

[3]. Barnes, Douglas F. (2005) 'Draft for Discussion: Meeting the Challenge of Rural Electrification in Developing Nations, The Experience of Successful Programs,' ESMAP.

[4]. Bhattacharyya, S. C. 'Energy access problem of the poor in India: Is rural electrification a remedy?' Centre for Energy, Petroleum and Mineral Law and Policy, University of Dundee, Scotland, UK.

[5]. Central Electricity Authority, Government of India, "Growth of Electricity Sector in India," 2012.

[6]. Palit Debajit, et al., "The trials and tribulations of the Village Energy Security Programme (VESP) in India," Energy Policy 57 (June 2013): 412.

[7]. 'Electricity in India: Providing Power for the Millions' (2002) International Energy Agency and Organization for Economic Co-operation and Development, OECD/IEC: Paris.

[8]. Energy services for sustainable development in rural areas in Asia and The Pacific: policy and practice. Energy Resources Development Series No. 40. United Nations Publication; ISBN: 92-1-120435-6; 2005.

[9]. Government of India, Ministry of Power (2005) Standing Committee on Energy APDRP Ninth Report: Delhi.

[10]. Hayden K. Electricity and development- the Asian perspective. In: Shrestha RM, Kumar S, Martin S, editors. Proceedings of the Asian Regional Workshop on Electricity and Development: Asian Institute of Technology, Thailand. ISBN: 974-93753-6-X; 2005, pp. 3–11.

[11]. India Infrastructure Report. (2007). Rural Infrastructure. 3i Network, Oxford University Press.

[12]. India rural Development Report 2012-13, IDFC Foundation, Orient Blackswan Pvt. Ltd.

[13]. Kaundinya D P, Balachandra P. and N.H. Ravindranath., (2009). Grid-connected versus stand-alone energy systems for decentralized power – A review of literature Renewable and Sustainable Energy Reviews, Vol. 13, Pages 2041-2050, [ENERGY].

[14]. Nouni M.R., Mullick S.C. and T.C. Kandpal, "Providing electricity access to remote areas in India: An approach towards identifying potential areas for decentralized electricity supply," Renewable and Sustainable Energy Reviews 34, no. 5 (June 2008): 1187–1220.

[15]. Ministry of New and Renewable Energy, "Annual Report 2012-2013," http://mnre.gov.in/filemanager/ annual-report/2012-2013/EN/chapter5.html.

[16]. Ministry of Power, Government of India, "Rajiv Gandhi Grameen Vidyutikaran Yojana Progress Report," Rajiv Gandhi Grameen Vidyutikaran Yojana, 2013 http://powermin.nic.in/bharatnirman/pdf/MIS_of_RGGVY.pdf.

[17]. Ministry of Power, Government of India, "Rural Electrification Policy," The Gazette of India, 2006, http://powermin.nic.in/whats_new/pdf/RE%20Policy.pdf.

[18]. Modi, Vijay; and Dominique Lallement, Susan McDade, Jamal Sagar. (2005) Energy and the Millennium Development Goals. Millennium Project Report, New York, 2005. Available from www.unmillenniumproject.org

[19]. Raman P., Murali J., Sakthivadivel, D. and Vigneswaran V.S., "Opportunities and challenges in setting up solar photo voltaic based micro grids for electrification in rural areas of India," Renewable and Sustainable Energy Reviews 15, no. 5 (June 2012): 3320-3325.

[20]. World Bank (2003). 'Why Are Power Sector Reforms Important for the Poor?' The International Bank for Reconstruction and Development/ The World Bank: New Delhi.

[21]. World Bank, Empowering Rural India: Expanding Electricity Access by Mobilizing Local Resources, (Washington, DC, DC: World Bank, 2010).