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Load Forecasting of Rural Areas for Rural Electrification

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ABSTRACT

In this paper the demand for rural electricity is increasing with the technology options available for rural electrification. Rural electricity access in India is currently inadequate for needs of the rural population and there is observed and revealed willingness to pay for better electricity supply. Distributed Generation can be economically suitable option in case studies in literature and analysed in the field survey.

The needs of rural electricity is met by conventional approaches is limited. In economic perspective, non-conventional forms of rural electrification may least-cost, particularly where villages are some distance from each others. In this paper the renewable energy reduces the burden on electricity supply shortfalls and the urgency of costly grid extension. In this paper presents actual conditions of remote areas.

Keywords: Renewable Energy, Distributed Generation, Load forecasting.

1 INTRODUCTION

India is the second fastest growing economy in the world. This strong economic growth would have been virtually impossible without increased energy consumption. With a targeted gross domestic product growth rate of 8%–9%, the energy requirements of the country are expected to grow over the next few years. The current statistics of energy access and shortages, and the likely need for energy in the future, India faces a challenge in meeting the growing energy needs. This is forcing India, which imports a majority of its oil, to reduce its import dependency and look for cleaner energy resources within its territory [6].

Energy flows from many sources, exists in a variety of interchangeable forms, and drives all systems. It is fundamental to the quality of our lives and today, we are dependent on an abundant and uninterrupted supply of energy for living and working [2]. Due to their geographical location and the lack of critical mass, rural areas are mainly suitable for renewable energy off grid application, systems which are connected to a battery via a charge controller, which stores the electricity generated and acts as the main power supply [6].

Rural electrification is the process of bringing electrical power to rural and remote areas. Electricity is used not only for lighting and household purposes, but it also used for purpose of farming operations, agriculture, milking, and hoisting grain for storage in areas facing labor shortages, this allows for greater productivity at reduced cost.. According to IEA (2009) worldwide 1.456 billion people do not have access to electricity, of which 83% live in rural areas. Rural electrification often demands decentralized solutions, called as isolated systems covering basic electricity needs or mini grids which are larger systems providing electricity to several households and other purpose. Renewable energies based mini grids are less dependent on larger-scale infrastructure and could be placed in service faster, especially in rural areas.

Renewable energy technologies avoid greenhouse emissions**,** have low operation and maintenance costs, generate employment and allow decentralized production of the rural areas. In rural areas, they are capable of electrify homes, villages, farms and small industries as well as being used for telecommunication, water supply and irrigation. The use of these technologies in rural areas reduces the need for candles, kerosene

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and battery charging and higher quality of lamps than kerosene and also improving the standard of life in the rural areas. [6]

The basic objectives of the development of renewable energy is ensuring energy security and reducing emissions. [6] The sustainable energy production is to be found in renewable energy sources that are clean, cheap and green [2].

2 SCHEMES OF THE GOVERNMENT FOR RURAL ELECTRIFICATION OF REMOTE AREAS

1. Pradhan Mantri Gramodaya Yojna (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 crores during the 10th plan period was being coordinated and monitored by Rural Development Division of the Planning Commission.

2. Kutir Jyoti Program (KJP)

KJP was initiated in 1988-89 to provide single point light connection (60 w) 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. 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.

3. Minimum Needs Program (MNP)

The MNP, exclusively targeted states with less than 65% rural electrification 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

4. 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 REC (Rural Electrification Corporation), PFC (Power Finance Corporation) and from NABARD under the Rural Infrastructure Development Fund (RIDF).

5. Rural Electricity Supply Technology Mission (REST)

The REST was initiated on 11th September 2002. The mission's objective is the electrification of all villages and households progressively by year 2012 through local renewable energy sources and decentralized technologies, along with the conventional grid connection [10] .

6. Rajiv Gandhi Grameen Vidyutikaran Yojana

The Government of India has started a rural electrification scheme "Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY)" in April 2003 to provide electricity to all households within five years in the country, including the electrification of un-electrified habitations with a population of above 100, providing free electricity connections to BPL households.

As per RGGVY, the Ministry of Power will provide financial assistance for execution of the scheme. In order to maintain the infrastructure created, revenue sustainability becomes a crucial factor. An innovative step has been taken under the scheme which mandated community participation in electricity distribution. The concept of village franchise for electricity evolved to address the issue of revenue sustainability, improvement in

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billing and collection systems and reduction of distribution loss in rural areas [6]. According to this appointed the nodal agency for implementation of the scheme and are responsible for complete oversight of the programme.

7. Jawaharlal Nehru National Solar Mission

Jawaharlal Nehru national solar mission is a major initiative of the government of India and state government to promote sustainable growth. The objective of this mission is to establish India as a global leader in solar energy. The main target is to promote programme for off grid application comes 1000 MW by 2017 and 2000 MW by 2022.

3 OPTIONS OF SUPPLY ELECTRICITY IN RURAL AREAS

To satisfy the demand for rural electricity supply, the technologies are available to for their demand and costs. Decentralised distributed generation avoids the complexities for rural communities and mostly used to supply electricity from diesel generators by local areas. Decentralised distributed generation from renewable energy technologies can be economically compared with both grid electrification and diesel generators.

To satisfy the demand of rural areas by wind systems is limited due to its variable supply and need for battery back up. When combined in a hybrid unit, with diesel or biomass generation, the viability and potential contribution of wind power is increased. For smaller sizes costs of Biomass, Wind Hybrid and Micro hydro increase at smaller scales. Diesel and solar PV systems are more appropriate. The household level technology such as Solar PV can fulfill electricity needs for lighting and other low consumption activities, with minimal unit investment costs and organisational challenges but not a solution for sustainable development [1].

Local area generated renewable energy is an efficient technology, particularly compared to electrification with diesel generators. In India hundreds of thousands of Solar Home Systems have been installed in the last years. The deployment of these systems is coupled with microfinance schemes, such as Grameen Shakti. Most of these systems provide electricity for lighting and some small appliances (radio, TV). Mini-grids (central generation and village wide distribution network) can be a more potent alternative to energy home systems. Hybrid mini-grids (renewables combined with diesel generators) are a widely used technology for rural electrification in developing countries [6].

Renewable energy supplied in the rural areas is application, several projects by government and other agencies have demonstrated its distinct advantages. The renewable energy for rural areas on technical feasibility grounds and economic calculations of potential and costs for renewable energy used for distributed generation.

At present in India, non-conventional energy sources (excluding large hydro) represent around 5% of total installed capacity [1].

Table-1

S. No	Technology	Supply	
1	Grid Electrification	Distribution Company of SEB	Cheap, clean (locally), low maintenance, Costly to supply, high T&D losses, low cost recovery, poor quality.
2	Kerosene Lighting	House holds	Affordable and flexible but adverse health effects and poor quality light.
3	Diesel Generator	Firm, NGO, Privat	Easy maintenance, Continuous

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		e Company/Institutes, Agencies	energy services (24hrs), Allows for income generating activity, But high fuel costs and emissions.
4	Wind System	Firm, NGO, Private Company/Institutes, Agencies	Reduced fuel cost, flexible load, Relatively cost effective renewable option.
5	Solar System	Households, Private Company/Institutes, Agencies	No fuel cost, High upfront cost and battery replacement cost.
6	Biogas	Households, cooking,	Allows for income generating activities, Base Load operation, and continuous operation possible.
7	Micro-Hydro	Firm, NGO, Private Company/Institutes, Agencies	Long life, reliability. Allows for income generating activity, Limited resource, availability, seasonal variation in supply.

4 LOAD FORECASTING

Load forecasting is very important for electric utilities in a competitive environment created by the electric industry deregulation, planning and operational decision [5]. From the perspective of the system operators and regulatory agencies, the medium term forecasting is a source of primary information for the safe and reliable operation of the system. The basic tool for determining the optimal utilization of generators and power stations, some facilities are more efficient than others.

Load forecasting is classified as-

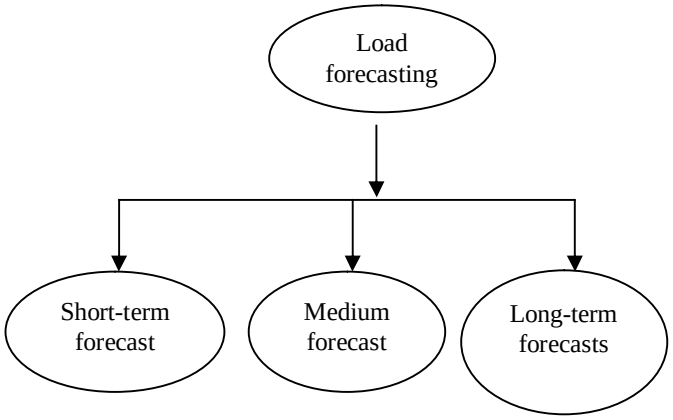

Fig-1, Load Forecasting

5 LOAD SURVEY OF RURAL AREA

The load survey of the rural area is achieved by taking the interview of sarpanch, school teachers, members of rural area etc. The following constraints are considered during the load survey of nearby villages up to 5 to 12 km distance from each other in the district of sehore state MP. The population of khandawar panchayat is 900 and ratanpur panchayat is 1500 under sehore district

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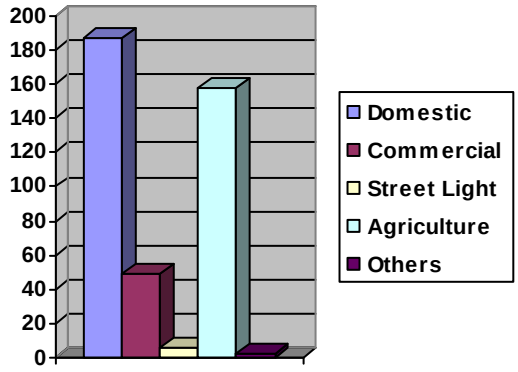
and no. of houses are near about 400. The load survey of rural area depends on-

(1) Number of villages of rural area
(2) No. of Houses of rural area
(3) Population of rural area
(4) Demand of domestic load
(5) Demand of street lighting load
(6) Demand of commercial load
(7) Demand of agriculture load
(8) Average energy consumptions
(9) Others demand.

Table-2

S. No	Category of Consumer	Energy in MWh
1	Domestic	187
2	Commercial	49
3	Street Light	6
4	Agriculture	158
5	Others	2
6	Total (1-5)	402
7	Distribution losses 10% of the total	40.2
8	Total Energy Demand	442.2



(X-axis-Category of load, Y-axis-Energy in MWh)
Fig-2, Load Demand Graph

Table-3

S. No	Category of Consumer	Load in MW	Duration in hours
1	Agriculture	40	4
2	Domestic	31.1	6
3	Commercial	8.1	6
4	Street Light	1	6
5	Others	1	2

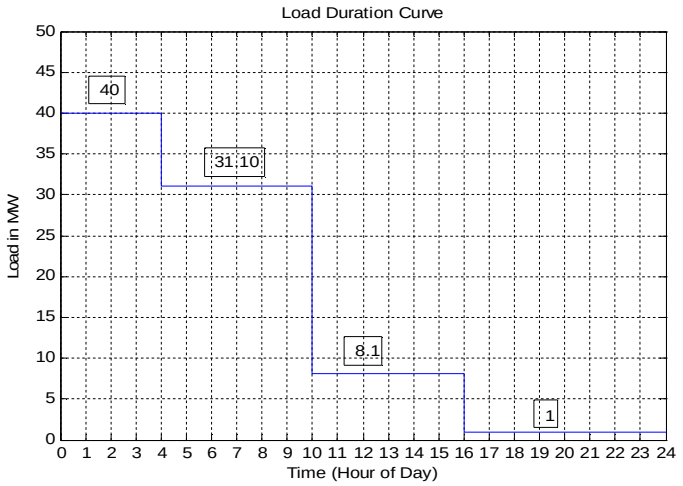


Fig-3, Load Duration Curve

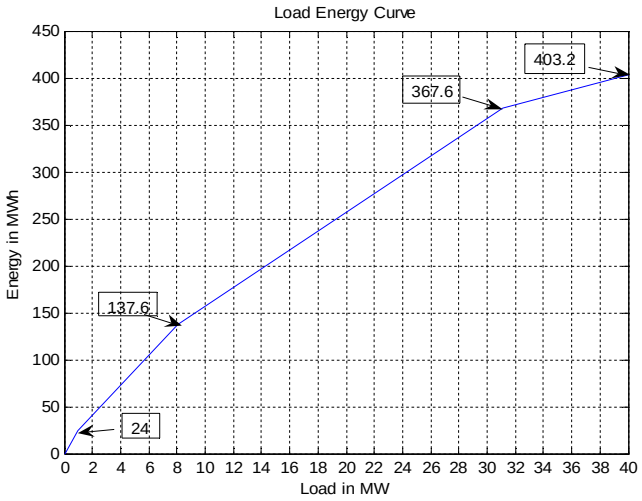


Fig-4, Load Energy Curve

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6 MAXIMUM DEMAND OF RURAL AREA

- The load factor is define as-

Annual load factor = No of units supplied in a year / Maximum Power Demand x 8760

- Maximum demand in year is define as-

Maximum demand = Number of units actually supplied in a year/ Load factor x 8760 (hrs in one year)

Maximum demand in a year = 442.2x1000 / 0.5 x 8760

= 100 kW

(Assume load factor = 0.5)

Considering the benefits that forecasting may bring to the security, economics and resource management fields [3, 4].

The factor that affect the accuracy of the forecasts such as weather data, time factors, customer classes, as well as economic and end use factors. Additional progress in load forecasting and its use in industrial applications can be achieved by providing short-term load forecasting [5].

7 CONCLUSIONS

Renewable energy resources and technologies have the potential to provide long-lasting solutions to the problems faced by the economic and environmental sectors of a nation. The renewable energy systems can provide direct benefits at national and local levels, which justify their wide use in developing countries. At the local level, availability of electricity contributes to improved productivity and indirect positive effects are also visible in the form of the creation of new employment opportunities.

Distributed generation through renewable energy is the suitable options for the present situation. This paper presents economic power generating option by renewable energy sources for villages and proposes a real and practical option for improvement the condition of villages in Madhya Pradesh.

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