



Barriers for Implementation of Renewable Energy Technologies in Rural Areas - A Review

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ABSTRACT

This paper provides a review on barriers of rural electrification and mechanisms for these activities. Access to affordable and high-quality electricity is essential for the development of modern economies. Low rates of electricity access in the developing world pose a significant barrier to sustainable economic and social development, particularly in rural areas. The International Energy Agency (IEA) estimates that about 1.3 billion people in the world, primarily in South Asia and Sub-Saharan Africa, still lack a connection to electricity.

Keywords: Renewable energy techniques, Solar home systems, Off Grid, decentralized, Barriers, Drivers, Rudimentary.

I. INTRODUCTION:

Rural area is defined as a region, which is not urbanized. One of the main characteristics of rural area is its low population density, common highlights of rural areas. Normally high portions of the lands in rural areas are devoted to agriculture. On the other hand, there are vast arid regions around the world that are also considered as rural areas. Therefore, there is no unique definition of the rural area that can be applied to all regions in the world and it can be variable from each country to another. However, the most critical aspect in the rural area rather than low population density is less access to energy sources, lack of education, health, and welfares. Increasing access to affordable and reliable energy services is an

approach to reduce the energy poverty in these regions. Electrification is one of the most promising services that can significantly affect decreasing energy poverty, improving life quality, reducing migration from the rural area to the towns and developing sustainable socioeconomic.

II. Off-Grid Rural Electrification:

In the absence of legacy systems, many developing countries can leverage decades of technological advancement and experience in developed countries as they build innovative modern infrastructure systems. Microgrids, small electricity networks that can operate autonomously, can play a key role in developing an electricity infrastructure built around decentralized renewable energy technologies. At the same time, microgrids can accelerate electricity access to areas the central electricity grid cannot reach. As these microgrids develop, they can be easily interconnected, creating a decentralized network that can aggregate loads and generation capacity, while maintaining the ability to operate as isolated systems should the need arise. Many developed nations are now devoting significant resources to retrofit existing infrastructure and permit the integration of decentralized technologies.

III. Ease of Off-Grid Electrification:

The decentralized nature of microgrids is viewed as having several inherent advantages over traditional

centralized infrastructure. These advantages include improved economics, technical performance, environmental sustainability, and regional equity in the context of rural electrification. In many countries, the reach of the electricity grid is extremely limited and almost exclusively serves urban areas. Sub-Saharan Africa is a prime example of electricity access disparity between rural and urban communities.^[9]

IV. Drivers for Off Grid Electrification:

Several pilot programs have been undertaken by relevant government organizations to demonstrate RETs like solar PV, biogas, SHSs, and improved cooking stoves. Many pilot programs were based on donor support.

V. Barriers and Challenges:

There are many challenges and several types of barriers for electrification. The barriers are sorted and divided based on their factors acting or effect of those barriers. In rural and remote areas, the barriers are related to the distribution of electricity, including the technical means of transmission and consumption metering.

A) Solar Barriers:

Renewable energy technologies in India are still in the development stage. Lack of Research & Development (R&D) work barrier is making adoption of renewable technologies difficult. Large investment requirement for R&D work is one of the major barriers in the adoption of renewable/sustainable energy technologies. R&D often results in benefits that cannot be captured by private entities. Although benefits might accrue to the society at large, individual firms cannot realize the full economic benefits of their R&D investments.^[5]



Fig 1: Off grid using Solar Energy^[10]

Most RETs projects are embryonic or in preliminary study phase, and do not allow large-scale implementation. Unavailability of solar radiation data is also a major barrier. Solar energy incident on the earth's surface depends on the geographic location, earth-sun movement, tilts of the earth's rotational axis and atmospheric attenuation due to suspended particles. Accurate solar radiation data, required to establish solar power projects, is not available. It is suggested that India should set up its own solar radiation data collection stations for accelerating development of solar power projects in the country.

B) Tidal Barriers:

Firstly, the resource is available in multiple locations (from shoreline to deep waters). Secondly, the correlation of demand and resource (distance between generation and load) is high in islands. Finally, this type of renewable resource has less environmental impacts than other alternatives. This is particularly important for islands with limited space and particularly for islands the economy of which relies on tourism.^[3] Limited space, public opposition and local factors do not allow vast investments in conventional power plants.^[3] India has a long coastline about 7500 km with the estuaries and gulfs where tides are strong enough to move turbines for electrical power generation. There is an estimated potential of about 8000MW tidal energy in the country. This may include about 7000MW in the Gulf of Cambay, 1200MW in the Gulf of Kutch in the State of Gujarat and about 100MW in the Gangetic Delta in the Sundarbans region in the State of West Bengal. Government of Gujarat has signed a 'memorandum of understanding' in January 2011 for establishing a 250MW tidal power project in Gulf of Kutch. A Special Purpose Vehicle has been incorporated in May 2011 and Gujarat Power Corporation Ltd. (GPCL) has taken up a 50MW tidal power project at Mandavi in district Kutch in first phase.^[5]

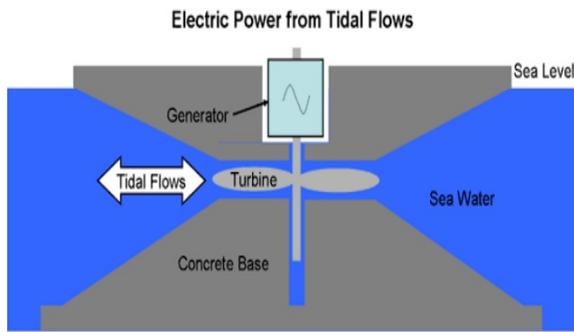


Fig 2: Tidal Energy Generation^[10]

C) Geo-thermal Barriers:

For geothermal energy, the drawbacks are associated with characteristics of the available resources that are mostly unknown involving a high degree of uncertainty around investment costs.^[7] Uncertain load profiles add to this problem, making it difficult to size the generators required to meet the demand.^[9] Recently, several hybrid systems combining geothermal energy have attracted research interest to achieve a more efficient usage of this resource. Hybrid fossil- geothermal plants have been developed but they led to a compromise of the environmental benefits that standalone geothermal plants have to offer because of the increased greenhouse gases emissions.^[3]

VI. Economical Barriers:

Renewable/sustainable technologies are primarily targeted at rural areas or poor customers, who have limited capacity to absorb these technologies. High initial costs and investments associated with mass manufacturing remain as barriers. Both users and the manufactures have very low capital. For developing countries, those technologies (which had not been used in their context before) had been more expensive as well as presented more risk than existing technologies. Unwillingness to pay more money has been attributed to the physical distance from a renewable/ sustainable energy projects, low income and an overall low priority given to environmental issues.^[5] Clearly, the economic parameters affect the overall results significantly. As mentioned earlier, some recent studies on Bangladesh have used quite different economic parameters. Clearly, a lower capital and operating cost of any equipment makes it more desirable for the optimal solution and the cost of

generation reduces. However, unrealistic costs reduce the relevance of the analysis and distort the optimal solution.^[2]

VII. Effect of Environment:

There are some forms of renewable resources which are available everywhere in the world, for example solar radiation, wind, tidal waves, heat from biomass. Some forms are infinite and virtually limitless, like solar. The solar radiation reaching the earth's surface in one year provides more than 10,000 times the world's yearly energy needs. Furthermore, harnessing just one-quarter of the solar energy that falls on the world's paved areas could meet all current global energy needs comfortably. Technologies that converts these resources in electricity and energy are available and rapidly improving.^[8] Nowadays, air pollution, global warming and climate change are the major concerns of the humanity. This is due to the exponential evolution of greenhouse gases (GHG) emission such as carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O) which have been obtained from a vast combustion of fossil fuels concurrently with increasing world population.^[6]

VIII. Conclusion:

Since most rural households have no access to modern energy and use of commercial fuel is limited, opportunities for use of RETs by rural households are potentially large. The relationship between energy access to rural areas and indicators for rural development is well established. Utilization of RETs is directly linked to social, economic, environment, and energy security issues like jobs, income level, and poverty, access to agricultural production, social services, health, climate change, and environmental quality. RET development and implementation is at an early stage in rural Bangladesh and there are many solar and tidal barriers that hinder this sector from being able to achieve reasonable progress. Implementation of RETs requires concrete strategies and mechanisms before getting any opportunity. RET projects from NGOs like Grameen Shakti and BRAC show very promising results. An important characteristic of these projects is that they take local circumstances, such as demand characteristics, available knowledge and skills, and financial circumstances, into consideration and put into place financial mechanisms, training programs, and income generation opportunities. This will mean that opportunities for improved quality of life, reduced

CO₂ emissions, job creation, income generation, women empowerment, and a cleaner environment through increased use of RETs in rural areas will be missed.

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