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Communication

Initiative for 100% rural electrification in developing countries: Case study of Senegal

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HIGHLIGHTS

- Rural electrification in developing countries.
- Problems of access to electricity in rural areas.
- Fees-for-service solution for small villages/highly dispersed population villages.
- Situation of Senegal.
- Presentation of a pilot project in a small village of Senegal.

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ABSTRACT

Sub-Saharan Africa has the lowest access to electricity in the World. In Senegal, less than 25% of the rural population benefit of electricity service. Solar energy offers an important potential to Senegal with over 3000 h of sunlight a year. This is a real opportunity to generalize the access to electricity. But, the efforts to bridge the gap must be diversified and completed. We approach the problem of rural electrification with a different point of view. Grid expansion and centralized solutions may be adequate for villages with a population organized in high-density of habitations. Small size villages or those with highly dispersed population may need different propositions because of cost. These regions will not be the priority of electrification programs. Furthermore, this rural population is characterized by its low income and saving. Such a conjuncture suggests the opportunity of a service based fees model for access to electricity. On the basis of a fees-for-service model, individual standalone photovoltaic systems may be a more appropriate solution to cover the priority needs of lighting and mobile phones battery charge for telecommunication. We present a pilot project in a village of Senegal to support the model and demonstrate its feasibility.

1. Introduction

About one fifth of the world's population does not have access to electricity (International Energy Agency). The low level of electrification in rural areas is a characteristic of number of developing countries. This is generally related to the high cost of the grid expansion combined with the insufficiency of energy resources. The priority demand for electricity in these regions is for lighting and telecommunication. Mainly, small private business owners collect fees to charge mobile phone batteries. In fact in most countries, wireless mobile phone coverage is generalized even in the most remote villages that generally do not even have access to electricity. The solutions used for lighting are generally candles, kerosene lamps, wood fire or solid-state batteries operated lamps. Such a situation affects many aspects of daily life especially safety, health, education and income generating activities that generally have to cease at night (Davidson et al., 2007).

Another reality that generally characterizes the populations of rural areas in developing countries is their low incomes and savings (Youm et al., 2000). Consequently, they cannot invest up front in an autonomous electric power system. The standard banking system does not attribute loans to these populations because of lack of guaranties. The conjuncture of the above listed problems should be the guideline for a targeted solution for rural electrification. Propositions above the means of the populations so far did not lead to a successful implementation of available solutions.

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In fact technical solutions exist, standalone solar photovoltaic or wind systems among others are well used in different parts of the World with great satisfaction, but generally they are not accessible to the common rural populations in developing countries (Karekezi and Kithyoma, 2002). The failure for the generalization of rural electrification is partly explained by inadequate propositions and government policies. A number of businesses have opened to satisfy the rural market, but the statistics are still revealing that the problem remains widely unresolved (Youm et al., 2000; Karekezi and Kithyoma, 2002).

1.1. Rural electrification models

There are two main financial models for the large-scale development of rural electrification; the fee-for-service model and the micro-credit scheme (EDRC, 2003; IEA, 2003; Lemaire, 2010). The choice of one model over the other changes from one country to another, it may even change from one region to another within the same country. Furthermore, it will depend mainly on the local available finances as it will be presented later in this paper.

It appears that the fee-for-service model was first introduced in the Pacific region, where small cooperatives were launched in the 1980s (Mala et al., 2009). In Africa, Morocco has a wide experience in hybrid solutions combining a mix of solar and diesel systems, it conducted to achieve a high rate of rural electrification. In Southern America, rural concessions started for example in Argentina in the province of Jujuy since 1999 (Alazraki and Haselip, 2007; De Gouvello and Maigne, 2002).

On the other hand, numerous programs based on micro-finance institutions for the funding of rural solar home systems have successfully supported the expansion of solar rural electrification, mainly in South Asia, as in Indonesia, Sri Lanka, the Philippines, Bangladesh, India and China (Miller, 2000, 2009).

An alternative to these two main models, the cash and carry model is in favor of the development of smaller systems generally providing only lighting which could be affordable without credit. Such a model generally carried by the private sector, has been very successful in Kenya for example (Duke et al., 2002). This model generally does not deal with bigger solar home systems for cost reasons.

From an organizational point of view in the fee-for service model, energy companies that have to collect fees, remain the owner of the installed equipment and are in charge of maintenance or repair if necessary. In the micro-credit scheme they can leave the task of fees collection generally to micro-finance institutions and deal only with installation and maintenance of the systems; in this case the system is sold to the final user. The two groups need to work in tight collaboration to have a successful model.

For a universal access to electricity without grid extension in rural areas of developing countries, it appears that the solution adopted to sell complete solar home systems directly to the rural end user is inadequate, the fee-for-service model or micro-credit model may need to be adopted. In remote rural areas another problem rises for system owners: the lack of service. For those who can afford it, number of systems in these remote rural regions is out of use because once a breakdown occurs the technical repair service or parts are not available.

A fee-for-service model looks to be more promising and realistic to overcome the problem of rural electrification in small isolated villages without any technical resource and where neither standard bank loans nor micro credits are available and incomes too low to buy up front a solar home system.

The first step for a successful generalized solution should be the quantitative evaluation of the energy needs in rural areas and compare them with the average income of the populations. The fees to receive an electricity service should be based on incomes and populations' current monthly expenses in energy.

So, there are two major reasons to propose fees-for-service to achieve the general access to electricity in remote rural areas of developing countries. The first one is obviously due to the financial restriction of rural populations, who cannot pay up front for a product beyond their revenues and do not have access to any loan (Youm et al., 2000). The second reason is that when the system is the property of the rural user, in case of breakdown the lack of human resources and qualified repair services will leave the unit nonfunctional. Furthermore, there is a need to change the batteries every 3 to 5 years for a standalone system. Such situations can be covered in the case where a fee-for-service model is available.

1.2. Context of Senegal

Senegal in common with a number of sub-Saharan African countries has a low rate of rural electrification (Karekezi and Kithyoma, 2002). Less than 25% of the Senegalese rural population has access to electricity (Senegalese Agency of Rural Electrification) with a certain difference between the regions.

In 1998 the Senegalese government created an agency for rural electrification (Senegalese Agency of Rural Electrification: ASER) to promote access to electricity in rural areas (Senegalese Agency of Rural Electrification). The results targeted by this agency are not matching the expectations yet.

Senegal suffers from a lack of accurate statistics, a real research and development sector and an industrial policy committed to improve the living conditions in rural areas.

Nevertheless, Senegal, with its geographic position, has a real potential in solar energy with over 3000 sun hours a year (Youm et al., 2000; RETScreen).

Senegalese government's projections for rural electrification are 30% by 2015 and above 70% for 2022 as presented in the graph Fig. 1. With the present evolution of access to electricity in rural areas, these numbers do not look very realistic.

The solution adopted by the government in Senegal for rural electrification is based mainly on grid expansion (by the public electricity company: Senelec), local micro/mini photovoltaic or diesel power plants managed by private companies (RETScreen). Such solutions reach their limits when it comes to small remote villages with a low population or villages with a low density of population. In the two situations the problem of grid expansion or power distribution in general becomes a more important issue. These regions will not be the priority of classical rural electrification programs.

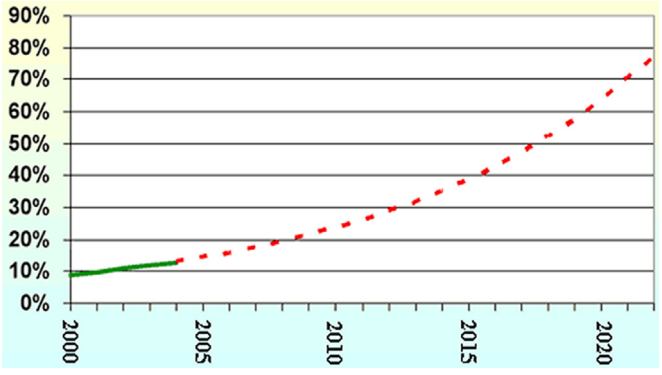

Fig. 1. Previsions for rural electrification in Senegal (Système d'Information Energétique du Senegal).