*Zaida Contreras*

# SECURING ELECTRICITY ACCESS IN SENEGAL THROUGH DE-SCENTRALISED SYSTEMS

GTZ 'Deutsche Gesellschaft für Technische Zusammenarbeit'
for PERACOD 'Programme pour la Promotion de l'Electrification Rurale
et l'Approvisionnement Durable en Combustibles Domestiques'
PERACOD, B.P. 3869 Dakar, SENEGAL
Email : zaidacontreras@gmx.de, esolgtz@sentoo.sn

## Overview

By 1998 the rural electrification rate in Senegal was estimated around 8%. It is usually expected that cost reduction of electrification has to be achieved through economies of scale. Consequently, the state owned SENELEC and investors are more interested in the deployment of electrification projects for big localities close to existing grids. However, countries like Senegal consist mostly of villages classified as small rural localities with less than 500 inhabitants (84%). Such villages accounted for 46% of the rural population in 2003.

The restructuring of the energy sector was initiated in 1998 with the creation of the ASER, or Senegalese Agency for Rural Electrification. In this framework a National Action Plan for Rural Electrification was elaborated: the state-owned electric utilities are in transition to be privatized and 18 concession regions were defined to be assigned to private investors for 25 year periods through a bidding scheme. Alternatively, electrification projects of local initiative (ERIL) can be developed by the local communities under the assistance and financing of the ASER.

## Method

A microeconomic model was elaborated. The model assesses the choice of electrical supply systems for rural localities with less than 500 inhabitants. Four configurations of technologies were chosen for the comparison: mini-grids of Diesel, photovoltaic (PV) and hybrid (PV-Diesel) power plants, as well as solar home systems.

The demand is based on real data of socio-economic studies that serve as a basis to determine segments of the population with a distribution of the willingness to pay and four levels of service. Household, communal and production sectors are characterized by the estimated amount of their daily electricity consumption. Communal infrastructure consist of public lighting, schools, medical services, administrative offices and religious places. The production sector is comprised of activities like commerce and working machines.

The TEC, or Taux d'Enrichissement en Capital, is a Profitability Index used as the main criterion for the economic evaluation of the supply systems. After assessing the profitability of each project, some simulations with modifications in the village demand structure were systematically introduced in order to explore the measures that could improve their economical feasibility.

The analysis of externalities is integrated in a last stage of the economic evaluation. The Clean Development Mechanism (CDM) is considered as an instrument, which could facilitate the financing and could increase the interest of investors in clean technologies for rural electrification.

## Results

The model has shown that an optimum service in these small localities has following characteristics: limited electricity availability (from 6 am to midnight), operation management of working machines (non-simultaneously) and low power equipment, minimal use of communal and non-production equipment like fans, radios and televisions. A rational utilisation of diesel engine systems demands the clear determination of time schedules.

Photovoltaic based systems require the highest amount of initial investment. On the other hand, diesel generators in pure or PV-hybrid systems must be replaced often and show an important annual operation expenditure due to the consumption of fossil fuels. These facts result in insurmountable barriers to the capacity of payment of rural populations. Therefore, rural electrification projects in this context are not profitable without subsidies.

The minimal amount of subsidies required for one locality is achieved through the photovoltaic mini-grid. However, decentralised solutions are only reasonable when a village lies further than 5,4 kilometers from the transmission grid.

25 tons of $CO_2$ emissions could be spared per year for each small village. The issuance of certified emission reductions (CER) of a photovoltaic mini-grid over 21 years is about 2% of the investment. Considering registration and transaction costs of each CDM small-scale project, even if many of them are bundled into a large one, the CDM scheme does not succed in providing a significant incentive in the choice of clean technologies for rural electrification of small villages.

## Conclusions

In the long term, both photovoltaic-based systems (PV-mini-grid and Solar Home Systems) seem to be the technical solutions with the best economic performance for all demand simulation cases of a village with 500 inhabitants.

The following action path could facilitate the implementation of electrification in small villages:

- Pre-selection of villages: if the payment capacity is at least 5EUR monthly in the poorest segment of a village, the electrification can be feasible without subsidies.
- Reduction of service levels at the supply side: if the capacity of payment is lower, then the supply should be limited to two or three levels of service. Fulfilling energy needs of the richest segment results in a considerable reduction of the profitability index.
- Management lead by communal associations: if no investors are still motivated, then management lead by communal associations will reduce the amount of necessary subsidies.

## References

Chabot, Bernard (2004) “Evaluation de la rentabilité des projets par la méthode TEC”.
De Gouvello, Cristophe and Maigne, Yves (2002). “L’Electrification Rurale décentralisée : une chance pour les Hommes, Des techniques pour la planète”. ADEME, CIRED.
PERACOD, Dahouénon, Mansour (2005) “Politique et Stratégie d’Electrification Rurale au Sénégal, procédures et mécanismes de l’Agence Sénégalaise d’Electrification Rurale”.
PERACOD (2003) “Etude socio-économique pour un Projet d’Electrification Rurale d’Initiative Locale, Département de Matam/ îles à Morphil”.