12 Charging up: Senegal

General information

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- **Implementation period**
  Two years (late 2000 until late 2002).

Summary

Photovoltaic (PV) energy has become a technologically reliable alternative to conventional sources of electricity. It can be used for many different applications, and its generation has proved to be financially and economically profitable. However, in rural Senegal, the economically viable use of PV electricity faces two main constraints: systems are expensive to install, and it is difficult to operate and maintain those systems once they have been installed.

Various schemes have been devised to encourage people to use photovoltaics, including government-funded systems that are provided without charge to users, government-subsidized systems, and systems driven by credit and cash sales. The success of these schemes, however, has been hampered by a lack of management systems that can coordinate equipment, operating and maintenance costs with the income of electricity users.

To help overcome this problem and to promote the use of solar energy in rural areas of Senegal, the Governments of Japan and Senegal initiated a project that experiments with charging fees for providing rural communities with electricity from decentralized PV systems. The scheme is based on the concept of selling an energy supply service. Users pay a monthly rental fee, which is calculated according to their incomes and the costs of providing, installing, operating and maintaining the system. A private operator, MATFORCE, manages the decentralized PV systems.

The project has demonstrated that such a management model for supplying PV power is particularly appropriate to rural areas in developing countries, especially in Africa. It is an innovative way of guaranteeing sustainable rural electrification by providing high-quality service that makes solar electricity available, accessible and affordable for rural areas and for which users are willing to pay.

Background and justification

Senegal has a population of just over 9 million people, over half of whom live in rural areas. In urban areas, 55.5 per cent of households have electricity, but in rural areas, this figure falls to a mere 7.2 per cent. The demand for electricity is growing by 5 per cent a year.

The actual and potential electricity situation in Senegal is as follows:

- 348 megawatts of thermic power installed by the national power company (SENELEC), with an additional 50 megawatts installed by independent producers;
- 66 megawatts of hydroelectricity installed, and the potential to increase this to 1,400 megawatts;
- just over 1 megawatt of solar power installed — 3,000 hours of sunshine a year produce an annual 2,000 kilowatts per square metre;

- more than 200 wind pumping systems installed—coastal wind potential is 3 to 5.5 metres per second; and
- diverse biomass resources, especially in the northern, eastern and southern regions of the country.

In Senegal, PV systems were first used to provide electricity to rural areas in the 1980s, with support from foreign donors that included France, Germany, Italy, Japan and Spain. These early applications consisted of solar home systems (SHSs), which were provided and installed with government financing and subsidies. When the CFA currency (a unified currency originally linked to the French franc and now linked to the euro used by the 14 mainly francophone countries of the African Financial Community) was devalued in 1994, the Government was no longer able to provide financial support, so Government-supplied SHSs became as expensive as commercially supplied ones. SHS diffusion was therefore transferred to the private sector and the Government focused on standardizing SHSs instead. However, this system was not successful because SHS prices increased drastically (again as a result of the CFA devaluation) and very little credit was available.

Now, the SHS is well developed, so attention has turned to improving the operating, maintenance, management and financial aspects of PV use in rural areas. Most of the organizations involved in diffusing SHSs had found it difficult to collect fees for the services that they provided and to maintain systems that had to serve users who were scattered over large areas. A pilot project was initiated by the Government of Senegal and the Japan International Cooperation Agency(JICA) with the main objective of establishing an efficient operating and management system for SHSs. The project was begun in late 2000 and continued through late 2002. It took place on a small island off the southwestern coast of Senegal and was expected to improve users' payment conditions by providing guaranteed maintenance and renewal of SHSs.

Description

The Pilot Project Management Committee (PPMC) supervised all the other groups involved in the project, monitored the effectiveness and efficiency of the PV systems, and responded to new situations. The PPMC comprised the following members:

- the Senegalese Agency for Rural Electrification (ASER), which appointed project operators and used the project as a model for promoting the inclusion of PV power in the national rural electrification plan;
- the Energy Directorate, which used its previous experience in PV electrification in Senegal to monitor the technical and economic management of the pilot project;
- a JICA study team, which decided the basic management policy of the project and technical specifi-

cations for the PV systems to be used, purchased and installed the systems, monitored villagers' use of the systems (including how it affected their living standards), and analysed project experiences to improve PV rural electrification plans and prepare manuals on PV system operation; and

- local consultants with broad experience in the development of PV electrification systems, who advised the PPMC, collected data and conducted surveys on use.

Day-to-day project management was handled by an independent private organization, MATFORCE, which employed a local technician with expertise in PV technology and a PV engineer who lived nearby and could repair the system in case of a breakdown. The main activities of MATFORCE included:

- monthly checking of all the systems installed in user households;
- ensuring that individual users utilized the systems correctly;
- repairing systems and replacing system components when necessary;
- collecting and managing electricity service fees;
- withdrawing systems from persistent non-payers of fees;
- advising customers on how to use electricity rationally and economically; and
- reporting back to the PPMC.

The first step in the pilot project was to carry out a field survey to select the most appropriate site. Only villages that were not going to be connected to the national grid in the next 10 years and that had high enough average household incomes and expenditure levels to pay for services were considered. In the end, three villages on Mar Island, which is a 30-minute boat ride from the coast of Senegal, were selected: Mar Fafako, Mar Lothie and Mar Soulou. Project staff held public meetings to meet villagers and explain to them what the project involved.

An appropriate system then had to be designed. Those living on Mar Island tend to belong to large, extended families. As a result, planners decided that SHS installations had to be capable of lighting six rooms. The specifications and components of the Mar Island SHS are:

- an output of 12 volts DC;
- the capacity to operate autonomously for up to three days of continuous rain;
- PV panels capable of generating a maximum of 55 watts;
- a solar-grade 12-volt battery;
- a 10-amp charge regulator;
- a voltage converter for 3, 6, 7.5 and 12 volts;
- fluorescent lamps of 8 and 11 watts;
- an LED lamp of 0.7 watts;
- a load capacity of up to six lamps; and

- a socket for radio and/or a television.

Plans called for an operator to be selected through tendering. The operator would be required to provide 20 years of service (under a contract renewable every five years); guarantee the rapid replacement or repair of faulty equipment and materials (unless the damage is caused by incorrect usage by customers); ensure that customer fees are collected and deposited in a reliable bank; and remove any systems from households that defaulted on payments. PV modules were to be replaced after about 20 years, charge controllers after about 10 years, and batteries after about four years. Once appropriate user fees had been established, 100 system units were purchased and 95 of them installed. The remaining five units were to be used to supply spare parts.

Users pay an initial sum of CFA 45,000 (approximately US$80), which covers 10 per cent of the price of the system, and monthly fees of CFA 3,700. These fees cover maintenance and replacement costs over a period of 20 years. MATFORCE saves part of these fees in an interest-bearing bank account, which it uses to pay for replacement components.

Project success depends on having reasonable management and operating costs and an efficient management system that is capable of collecting fees and providing a service for which people are willing to pay.

Overall, the systems are operating well, and 70 per cent of malfunctioning components have been replaced or repaired within the period stipulated in the operator's contract. About 80 per cent of the fees are being collected, and the operator has not yet found it necessary to withdraw any systems from their users. Customers trust the local technician, who has carried out his job well, and report overall satisfaction with the service provided. Indeed, a few hope to have the capacities of their systems expanded to cope with additional electricity demand. Reports about the project have been published and presented at national and international seminars.

Partnerships

The project involved many public and private bodies working in partnership. Public-sector partners were ASER, the Centre for Studies and Research on Renewable Energy (CERER), the Energy Directorate and SENELEC. Private-sector partners were Energy Services in Sahelian Environment (SEMIS) and the operator MATFORCE. All the international partners were from Japan: the Government of Japan, the Institute of Energy Economics (IEE), JICA and KRI International Corp.

Replicability

Although no specific electrification strategy or programme using SHSs has been drawn up yet for Senegal, ASER

assigns an important role to the SHS in its rural electrification plans. However, it is still too early to assess how appropriate the SHS is to widespread electrification plans because, although customers are satisfied with the service at present, user demand for power tends to increase over time (for example, they want to run refrigerators or other electrical appliances) and the SHS may not be able to keep up with future requirements. Furthermore, the success of the project, at least in part, is due to the fact that the systems were supplied by a donor. If the operator had to supply all the systems used, the fees charged to users would probably need to be at least 50 per cent higher, putting them beyond the reach of many villagers in developing countries.

The project provides a model that can be adapted to the needs of other developing countries, especially those in Africa, which have similar energy situations to that of Senegal. If projects like this are to be successful there is a need to:

- have a consistent PV support policy within the framework of the national electrification policy;
- provide minimal government subsidies for fossil fuels and grant tax exemptions to PV power;
- exempt some PV system components from import taxes;
- build capacity;
- integrate renewable energies into the national electrification policy through the allocation of renewable energy quotas in the national energy balance;
- develop hybrid systems (such as solar-diesel);
- create financial and investment mechanisms to support the new industry; and
- offer initial subsidies for SHSs to make them more affordable, thereby increasing the market and reducing system costs.

Lessons learned

The pilot project faced various problems during its development and implementation, including:

- Many villagers had difficulty making the down payment of CFA 45,000.
- People were initially suspicious of the project.
- The LED lamps used were not bright enough.
- Users were unable to run radio-cassette players from the power supplied by SHSs.
- Some users found it difficult to pay the first fee on time.
- Some users were unable to use receptors working from 220 volts AC.
- Some of the components installed did not meet the required specifications.
- The fee collector lives in Dakar, a long way from the project site, so fee collection was costly.

These problems were solved through discussions among the organizations concerned, namely, the suppliers, project operator and users. Solutions were drawn up, discussed and tested before being put into practice. Throughout the project, the participatory approach was used to inform users and stay in touch with their needs and views. Meetings were held and questionnaire surveys conducted, and all decisions were discussed with users. User participation was particularly important because project success and sustainability ultimately depended on users' willingness to pay for project services—something that they were less likely to do if they felt in any way alienated from what was happening.

Impact

Benefits reported by users of the project include improved learning conditions for schoolchildren, street lighting (from the entrances of SHS users' homes), reduced petrol consumption, and improved night-time working conditions.

Although the project depended on donors to build the systems, it has provided a sustainable mechanism for the continued maintenance and running of those systems through a carefully thought-out management plan that includes user participation and involvement. Future success and development depend on the operator's capacity to keep up with increasing demands for electricity and on the availability of technical and financial support. Price monitoring is also essential so that user fees can keep up with increased costs of PV equipment and materials.

Future plans

When JICA withdraws at the end of the pilot project, ASER plans to establish its own project to take over all the activities of the pilot project. Villagers, too, are enthusiastic about continuing the project, and some 200 households are on a waiting list for the next wave of new solar home systems.