RSVP RENEWABLES FOR SUSTAINABLE VILLAGE POWER

PROJECT BRIEF

Joint U.S./Brazilian Renewable Energy Rural Electrification Project

by Roger Taylor 12/97

Introduction

In Brazil, an estimated 20 million people do not have access to electric energy. Much of this population lives in the arid northeast part of the country. The electric grid reaches the larger towns and is being systematically extended to rural properties and villages. However, rural extension is costly and the rural electric cus- tomers consume only very modest amounts of electricity, typically 10 to 30 kWh per month. The cost of even short grid extensions is often greater than $1,000, making investments in electricity connections for these populations financially prohibitive.

Small stand-alone photovoltaic (PV) systems can provide the basic low-energy consumption services needed by the rural peoples (lighting, TV, radio) for $500 or less, making the renewable energy option a very promising alternative to grid extension.

A different situation exists in Brazil's northern Amazon Basin. More than 300 villages in this region have diesel electric generators operated by local utility providers. These generators often provide electric service for only six hours each day due to the very high cost of diesel fuel deliveries to these villages—many places are accessible only by boat. Thousands of small privately owned generators also operate in the region.

Renewable energy hybrid (PV, wind, battery, diesel) power systems are of great interest to the state utilities and to Eletrobras (the main federal utility) for enhancing electric services in the Amazon Basin while reducing diesel fuel consumption and the associated cost of fuel deliveries. Today, electricity in 310 villages is being subsidized by the rest of the Brazilian population at approximately $300 million per year. The demonstration of viable hybrid power operation in these remote regions could open a significant near-term market for renewable hybrid power systems.

Scope

The U.S. Department of Energy, through the National Renewable Energy Laboratory (NREL), is undertaking a two-phase joint technology research and demonstration effort with the Centro de Pesquisas de Energia ElÄtrica (CEPEL) in the Federal Republic of Brazil. Objectives of the cooperative U.S./Brazilian program are:

- to establish technical, institutional, and economic confidence in renewable energy systems to meet the needs of the citizens of rural Brazil
- to establish ongoing institutional, individual, and business relationships (U.S./Brazilian partnerships) necessary to carry out sustainable programs that benefit both Brazil and the United States
- to lay the groundwork for large-scale rural electrification with renewable energy systems.

Phase 1 of the cooperative effort put PV electric lighting systems in about 350 homes in the Sertao de Sao Francisco region in the Brazilian state of Pernambuco and PV electric lighting systems in about 400 homes and 14 schools in the outback of the state of Cearç. Under the terms of a contract for subsequent use by the state utilities in Cearç (COELCE) and Pernambuco (CELPE), NREL provided key system components (PV panels, batteries, and charge controllers) to CEPEL. COELCE and CELPE were responsible for obtaining the balance-of-system components not provided by NREL/CEPEL, and for doing the systems integration, installation, maintenance, and evaluation for a 3-year period following installation. Installation of all systems was complete in early 1994.

In Phase 1, a total of 65 kW of PV modules, 1300 (100 Ah) batteries, and 900 charge controllers were installed. The electric utilities in Cearç and Pernambuco provided all other equipment (structures, wiring, switches, DC breakers, housings, conduit, fluorescent lights and ballasts) and installation. Training courses for the instal-lers were provided through a cooperative effort among CEPEL, the equipment vendor (Siemens Solar Industries [SSI]), and PV experts at the Federal University of Pernambuco.

Phase 2 extends the pilot project into six additional Brazilian states (Acre, Alagoas, Amazonas, Bahia, Minas Gerais, and Para). It also extends the demonstration of PV applications to a

wider variety of stand-alone end uses and hybrid village power, and introduces the use of wind-electric power generation for selected sites and applications.

The hardware subcontracts awarded under Phase 2 were carried out much like the implementation of Phase 1 and completed in October 1994. The subcontracts awarded under the project expansion have three primary tasks: system design integration assistance, supply of specific U.S.-manufactured components to Brazil, and system installation supervision and operator training. The NREL agreement with CEPEL also was extended to cover supervision of Phase 2 equipment installation and a 3-year operations and maintenance period following installation.

Phase 2 stand-alone systems are being supplied to the Brazilian states of Acre, Alagoas, Bahia, and Minas Gerais. U.S. vendors providing the equipment include SSI, Solarex, Photocomm (using USSC modules), and Bergey Windpower. A total of 51.5 kW of PV modules, 195 charge controllers, 25 inverters, 32 water pumps, 5 wind-electric systems with water pumps, and 2 wind-electric systems with inverters were shipped by the vendors in early 1995.

Besides the stand-alone projects, ***two hybrid power systems*** were installed in the Amazon basin. The first is a 50-kW PV-wind-battery hybrid system in the village of Joanes, on the island of Marajo, near Belem, Parç. The system control and power processor were supplied by New World Village Power, four 10-kW wind machines were supplied by Bergey Windpower, and 10 kW of PV modules were supplied by SSI. A battery bank of approximately 350 kWh capacity was supplied by the local electric utility, CELPA.

The second hybrid system is at the village of Campinas, approximately 100 km upstream from Manaus between the Solimões and Rio Negro rivers at approximately 3.3 degrees south latitude. Accessible only by boat, electricity in Campinas is supplied to about 100 houses through a local electric grid. The grid operates for six hours per day, from 6:00 pm to midnight, off one of two on-site 48-kW diesel generators. Diesel fuel is supplied to the power plant every two months and stored in a local tank.

A 50-kW PV-battery hybrid system was installed in Campinas. As a subtier contractor to Bergey Windpower, Advanced Energy Systems Ltd. Supplied the system control and power processor. The 50 kW of PV modules were supplied by Solarex Corporation. As with Joanes, a battery bank of approximately 350 kWh capacity was supplied by the local electric utility, CEAM.

Conclusion

The Brazilian utilities and federal government continue to show strong interest in developing and deploying solar electric systems as an alternative to grid extensions. Exemplifying the growing interest in renewable energy in Brazil, CEPEL has organized a PV working group among the utilities and other interested stakeholders. The Grupo Trabalho de Fotovoltaica has established a number of working committees to address the broad array of data, standards, and development concerns regarding PV commercialization in Brazil. A program to install solar systems in rural schools and health clinics was recently started by the Brazilian federal government with the assistance of CEPEL.

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