

Photovoltaic Electrification in Economically-Depressed Areas

In Peru, around the 30% percent of the population live in rural areas, and a high percentage of them, in economically-depressed areas that do not have electricity. In this context, in the 90's, different projects began to introduce the use of photovoltaic systems in rural areas. One of the most important was the executed in 1996 by the Renewable Energy Center of the National Engineering University (CER-UNI in Spanish). With the support of Project to Save Energy of the Ministry of Energy and Mines (PAE-MEM in Spanish), the use of Solar Home Systems (SHS) were introduced at the Titicaca Lake, Puno, in the south of the country, and over the 3,500 meter over the sea level.

This region has good conditions to use the solar energy, because this region has an annual solar radiation average of 6 kWh/m², and lower temperatures. The project began with 100 SHS in the Taquile Island. To be successful, CER-UNI put special emphasis in the quality of the equipment, installation, technology transfer and the management of the project. Each SHS was comprised of one 50W solar panel, 100 A-h battery, 3 lamps of 11W, and a 10A charge controller.

The main activities after the installation were: the one-year guarantee for the correct operation of the system; the training of five people from the community for the maintenance of the SHSs; the provision of a reserve lot at the island to replace any unit that failed. In the economic aspect, the payment system was designed according with the users economic capacity.

The main work was to determine the resident's capacity to pay so that the corresponding annual payment could be determined, A single annual payment was established to allow to the residents to gather the money and also diminish the cost incurred in the collection of the money (transport, salaries, etc.). When the people finished to pay the total cost, they became a owner of the systems.

According with the different economic capacity of the residents, CER-UNI established four different payment options. Only one person paid the SHS using the option A. Another user returned the system before the second payment because he did not have the economic possibility to continue in the project. At the end, 75 families became the owners of the SHS installed in their homes. The four payment options are detailed in Table 1.

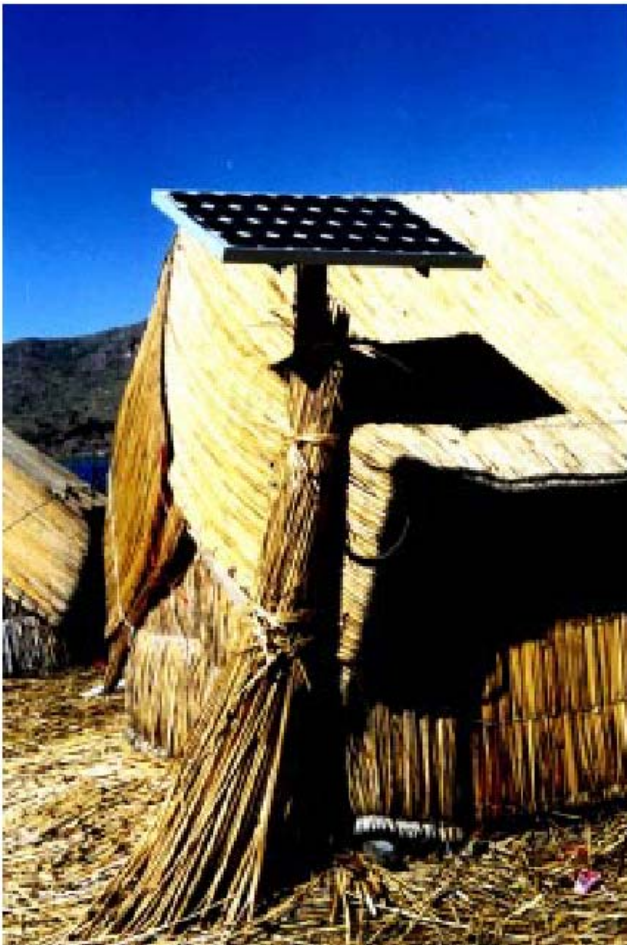
In 1997, CER-UNI could not make any installation, because they did not have enough money to acquire SHSs with good prices. However, in 1998 they decided to expand the project to neighbors islands Uros and Soto, with better prices and offer a new alternative with a solar panel of 35W, a charge controller of 8A, a 60 A-h battery and 2 lamps for US\$500, or five payments of US\$100. This new arrangement attracted a growing interest of islands residents to have their own SHS. To have an adequate administration of the total incomes generated by the installations, CER-UNI decided to create a fund dedicated to the installation of SHS under the same conceptual frame followed in Taquile island. In 1999, the second phase of the project began but now without the support of governmental institutions, and under the complete responsibility of CER-UNI. To do this, the CER-UNI asked a loan for US\$100,000 for five years with an interest rate of 5%. CER-UNI sold 249 SHS more including Amantani and Suasi islands and Huancho, a riverside population, offering two kinds of systems, the first (A) with three lamps for US\$ 750 and the second (B) with 2 lamps for US\$ 725. The payment system is shown in Table 2, and is very similar with the first phase of the project. That is, single annual payments and ownership of the SHSs only after the cancellation of the debt.

Nowadays exist a good acceptance of the photovoltaic technology in the Titicaca Lake region, and many families want to have a SHS in their homes. In addition to that, CER-UNI is working to repeat the project in other economically-depressed zones of the Country . In the Titicaca Lake, the present owners consider solar energy more reliable than conventional electricity, and it is expected that the market will be grow with adequate supervision.

Actually in the Titicaca Lake exist already 421 SHS, with more of the 50% installed in Taquile Island. There are good perspectives in the islands like Amantani and Uros, where already exists a list of people who want to have their own SHS. The numbers of SHS installed, and to be installed, by island and by year are listed in the Table 3.



Taquile island



Uros island



Uros island

Table 1: Alternative options of payment in US dollars

Payment at	First	Second	Third	Fourth	Fifth	Total
	The sale	05 months	12 months	24 months	36 months	
Option A	675.00					675.00
Option B	500.00	200.00				700.00
Option C	249.00	167.00	167.00	167.00		750.00
Option D	150.00	150.00	150.00	150.00	150.00	750.00

Table 2: Alternative options of payment in US dollars - Second phase

Payment at	First	Second	Third	Fourth	Fifth	Sixth	Total
	The sale	05 months	12 months	24 months	36 months	48 months	
Option A	150.00	150.00	150.00	150.00	150.00	150.00	750.00
Option B	100.00	125.00	125.00	125.00	125.00	125.00	725.00

Table 3. SHS installed in the Titicaca Lake by the CER-UNI

Year	Taquile	Uros	Soto	Amantani	Suasi	Huancho	Total
1996	100						100
1997							
1998	36	23	13				72
1999	88	86		52	5	18	249
TOTAL	224	109	13	52	5	18	421
Number of families in the island	350	300	25	7000	5	100	1480

Cenergía, 1998