

## 2009 Ashden Awards case study ECAMI (Empresa de Comunicaciones, SA)

**Finalist's work:** Supporting rural development with photovoltaic power systems

**Organisation:** Private business, established in 1982. Annual turnover US\$1.95 million and 28 employees (2008)

**Location:** Managua, Nicaragua

### Summary

In Nicaragua 31% of the population are without mains electricity. ECAMI was founded in 1982 to rebuild radio communications equipment in rural areas which had been destroyed during the conflict in Nicaragua. Photovoltaics (PV) were the ideal way of powering this equipment, because there was no grid electricity. Seeing the other benefits of PV power in rural areas, ECAMI developed into a general provider of renewable energy equipment.

- Installed over 400 kWp PV capacity since 2004, benefitting over 100,000 people.
- Includes 2,100 solar-home-systems; over 400 PV systems for health centres, schools, community buildings and offices in rural areas; 70 systems for telecommunications and 40 for urban houses and tourism.
- About 170 solar-water-heating systems provided for homes, swimming pools and hotels, and over 40 wind turbines.
- About 100,000 people benefit, directly or indirectly, from installations since 2004.
- Diverse customer base includes NGOs, private individuals and government programmes.
- Solar-home-systems provide brighter light, radio and TV, phone charging and opportunities for income generation.
- Clinics can stay open longer and provide emergency cover, run nebulisers and vaccine refrigerators, and have good light for minor surgical procedures.
- Schools get better light, radio and satellite internet, and can be used for adult literacy programmes in the evening.
- PV supply for a mobile phone mast has cut generator use from 24 hours to four hours per day, saving fuel and CO<sub>2</sub> emissions.
- PV-powered mini-grid for island community supports homes and tourist facilities.
- Greenhouse gas savings from replacing kerosene lamps and diesel generators, difficult to quantify but between 400 and 4,000 tonnes/year CO<sub>2</sub>.
- Business has strong social commitment to working with other organisations to help rural communities gain the benefits of renewable energy.
- Now setting up branches throughout the country, to make the benefits of PV and other renewable energies more accessible.

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## Context

Empresa de Comunicaciones SA (ECAMI) was founded in 1982 by Luis Lacayo, to supply radio communications equipment in rural areas of Nicaragua where infrastructure had been destroyed during the prolonged civil war and revolution. Solar photovoltaic (PV) systems were the obvious choice to power the equipment, because there was no mains grid. Many other opportunities for PV were apparent to the ECAMI staff undertaking the radio communications installations, like home lighting, battery-charging, water pumping and refrigeration. Over the years the provision of renewable energy systems became more important than communications and is now the main activity of the company.

Many rural areas of Nicaragua are still without grid power, so the work of ECAMI is still very important for providing rural services.

<b>Statistical information, Nicaragua</b>	
Population (2005) million	5.5
Urban Population % of total	59%
GDP per capita US\$ (2005)	US\$954
- at purchasing power parity	US\$3674
Population living on less than \$1 a day (2005)	45%
Population living on less than \$2 a day (2005)	80%
Population with access to grid electricity (2005)	69%
Annual electricity consumption per person (2004)	525 kWh
Annual CO <sub>2</sub> emissions per person (2004)	0.7 tonnes
Population % undernourished (2002 -2004)	27%
Population with access to improved water supply (2004)	79%

Source: *UNDP Human Development Report, 2007/08*

## Technology and use

The main activity of ECAMI is the supply and installation of solar PV systems in rural areas. These have been mainly solar-home-systems (SHS). An SHS consists of a PV module, which generates electricity from sunlight; a rechargeable battery, which stores electricity so that it can be used during both day and night; a charge controller, which prevents the battery from being over-charged or deep-discharged; lights; wiring and fixtures. In addition to lighting, households use the systems to power radios and small black-and-white televisions, and also to charge mobile phones. A typical SHS sold by ECAMI uses a 50 Wp PV module and 100Ah battery. Health and community centres and schools use similar systems, though somewhat larger.

Recently, ECAMI has built larger PV installations. Twelve PV-power water-pumping systems have been installed of between 1 and 2 kWp PV capacity. ECAMI designed and installed a PV-powered mini grid for the island of San Fernando, to provide power for 11 homes, two small hotels, a museum and gift shop, and a planned health centre. The system uses a 3.9 kWp PV array, made from 30 PV modules and 50 kWh of battery storage. The charge controller includes maximum-power-point-tracking to optimise the PV output, and an inverter converts the direct current (DC) from the batteries to the required 110 V alternating current (AC) required by the users. An underground distribution system connects all the users to the supply, with individual current limits to each house.

A recent installation of a 6.5 kWp PV supply for a mobile phone mast has allowed the use of a diesel generator to be cut from 24 hours a day to four hours, with associated savings in diesel fuel. ECAMI engineers designed the system so that the diesel generator cuts in automatically when there is insufficient power from the PV or rechargeable batteries to run the mast. ECAMI has now installed two further phone mast systems, and has been invited to bid for more.

Most of the PV modules used by ECAMI are made from polycrystalline silicon and produced by Kyocera. A few amorphous silicon modules are used for installations in cloudy areas, because amorphous silicon has relatively better performance in diffuse light. Batteries, charge controllers and inverters are sourced from a number of well-known international companies.

In Managua, the capital of Nicaragua, six hotels have been supplied with solar water heating systems by ECAMI. One with 50 m<sup>2</sup> of panel area supplies 100 rooms each of which had previously required a 6 kW immersion heater, another with 16 m<sup>2</sup> of panels supplies 40 rooms. About 150 domestic solar water-heaters have also been installed.

ECAMI supply and install small wind turbines of between 400 W and 5 kW output, and can also install hydro-electric systems.

### **How users pay**

A 50 Wp SHS with four lights and a socket costs about US\$600 installed including tax. This is typical for Latin American countries, although about twice the cost of similar system in India or Bangladesh. ECAMI is planning to introduce a smaller system with two lamps and a socket which will cost around US\$390.

ECAMI sells and installs on a commercial basis. About 50% of sales are to NGOs, 30% to private customers and 20% to government programmes. ECAMI does not provide financial support itself, but in some cases works with NGOs, micro financing initiatives (MFIs) and banks to help users arrange grants and loans. A typical case is ECAMI's support for the NGO FEM (Federation of Women) who encouraged their members to save for an initial payment of US\$120 towards the cost of a SHS; arranged for a grant for 40% of the cost and for an MFI loan for the balance of US\$250 (£170) which would be repaid over three years.

Other systems are grant-funded. For one of the water pump systems the equipment cost was financed by the charity CARE, with the community completing the civil works and taking responsibility for future maintenance. In addition to installing the equipment, ECAMI also ensured that training was given to the users in the care and maintenance of the system. The mini-grid system on the island of San Fernando was also grant-financed by the World Tourism Federation. Again, the community worked on the civil engineering side and are responsible for management and paying for professional maintenance.

The domestic solar hot water systems cost about US\$1,800 and save US\$600 per year in electricity bills. Most users pay cash, although ECAMI has worked with a bank on credit-card promotion of solar water heaters. A similar rapid payback has been found by one of the hotels, which paid US\$11,000 for the solar-water-heater and is saving about US\$3,500 per year on gas.

The cost of the PV installation for powering a telephone mast was funded by the telephone company, who expect to achieve a three year payback from the savings in diesel fuel alone, as well as reduced costs for maintenance and fuel transport to a remote area.

## **Training, support and quality control**

ECAMI emphasises the importance of good training, both for employees and for the users of the systems, the NGOs and cooperatives. ECAMI technical staff are sent for regular updates from equipment manufacturers, and this is also considered to be an important incentive for retaining good staff.

Quality is maintained by buying equipment from reputable manufacturers, with certification to international standards. A record is kept of the GPS location and serial number of each PV module used, which helps in quality control and also in identifying stolen modules. ECAMI offers a one-year warranty on installation. PV modules carry a warranty of achieving at least 80% of their rated efficiency for 20 years.

ECAMI takes pride in setting high standards of workmanship, and rapid follow-up if anything goes wrong. An ECAMI calendar with contact details is left at every installation, so that users can get in touch quickly. SHS owners tend to want to over-use their systems, and ECAMI therefore sells systems as providing three hours of light per evening, when they can actually provide four, to avoid disappointment!

ECAMI tries to go beyond its contractual obligations to customers. For instance, an ECAMI engineer noticed that the mobile phone mast used halogen security lights which stay on all night, adding over 7 kWh to the daily electrical load. ECAMI provided efficient CFL substitutes, which will save about 5.5 kWh per day, and thus further reduce the consumption of diesel.

## **Benefits**

### **Numbers**

ECAMI has installed about 5,000 renewable energy systems over the past ten years. Since 2004 (the period for which detailed records are available) a total of 400 kWp of PV capacity has been installed, including about 2,100 SHS; over 400 PV systems for health centres, schools, community buildings and offices in rural areas; 70 systems for telecommunications and 40 for urban houses and tourism. In addition, about 170 solar-water-heating systems have been provided for homes, swimming pools and hotels, and over 40 wind turbines.

People benefit from these systems in different ways, so the total number of beneficiaries is difficult to estimate. About 10,500 people benefit from the domestic SHS, with an average of five people per house. For health centres and water pumps, around 500 people can benefit from each installation, and typically 200 per school. Assessed in this way, the total number of beneficiaries exceeds 100,000 people.

### **Environmental benefits**

The use of PV systems in homes and clinics replaces kerosene for lighting. Other systems, like those for the mobile phone mast and island mini-grid, replace diesel-generated electricity. Such replacement undoubtedly reduces the emission of CO<sub>2</sub>. However, the amount is difficult to quantify because the systems sold by ECAMI are used in so many different ways.

A PV/battery system in the tropics supplies about 1,000 kWh/year electricity per kWp of PV. If it replaces diesel generation which emits about 1 kg CO<sub>2</sub> per kWh, then the saving is about 1 tonne/year CO<sub>2</sub> per kWp. The saving for directly replacing kerosene is much greater, because a kerosene flame is such an inefficient way of producing light. Studies elsewhere suggest that the emission reduction for replacing kerosene lighting is about 0.5 tonnes/year CO<sub>2</sub> for a 50 Wp SHS, or about 10 tonnes/year CO<sub>2</sub> per kWp. Thus the 400 kWp of PV

installed by ECAMI over the past five years probably save between 400 and 4,000 tonnes/year CO<sub>2</sub>.

### **Social benefits**

Solar home systems reduce the local air pollution which comes from kerosene lamps, and also the fire risk from lamps being knocked over. Good quality light and the opportunity to use music systems and TVs make life easier and more enjoyable.

Health centres with PV lighting have the potential to provide 24 hour emergency service, in addition to enabling longer opening hours for consultations. Good quality light makes minor surgical procedures easier and safer. PV power is also used to run nebulisers for asthma sufferers, a problem which is widespread in Nicaragua. Solar-powered refrigerators for vaccines are an essential part of immunisation programmes in off-grid areas. Radio communications equipment in health centres helps in arranging the transfer of seriously ill patients to hospitals.

Solar-powered water pumps have brought fresh, clean drinking water to communities. This has brought demonstrated health benefits to the village of Valle Centro near Leon. A government health survey has shown that this is the healthiest community in the area: cholera has been eradicated, gastro-intestinal sickness greatly reduced, and less visits to the clinic are needed. In addition the community as a whole has been involved in building the system, sharing the management work, and contributing to a fund for maintenance and repair through monthly water bills. They are so enthusiastic that they are working to get a second pumping system for sanitation, and would like to have enough capacity for irrigation as well.

PV systems for schools provide lighting and radio receivers, and some will soon get satellite internet. In several communities, schools with PV lighting are now used for adult literacy classes in the evening, with up to 400 adults attending. This is a real benefit, particularly for people who lost out on schooling because of the civil war.

### **Economic and employment benefits**

The provision of better lighting helps people to work longer hours or to work in the cooler parts of the day. This is also of benefit to livestock farmers because pigs and poultry eat more when it is cool, but will only eat when there is light. The PV systems which ECAMI installed for the FEM cooperative were specifically intended to give single women, mainly single mothers, more opportunities for income generation. Activities which have benefitted include the production of dried *Rosa de Jamaica* to make herbal tea, jam and wine; and coffee drying and sorting. Some people run phone-charging businesses from their SHS.

Solar water pumping for irrigation enables more people to make a living from the land. The hotels on the island of San Fernando are hoping for increased visitor numbers now that they have good lighting, power for fans and refrigeration and mobile phone charging.

Homes and hotels in Managua which have installed solar water-heaters find their investment is paid back within about three years, after which they make considerable savings. The operator of the mobile phone mast anticipates a similar payback time, because of the cost of providing diesel in a very remote location. The payback is longer for SHS, since the saving from purchasing kerosene for lighting is only about US\$2/week from a SHS which costs US\$600. The main benefit of the SHS is improved quality of life, and income-generation opportunities.

ECAMI provides employment for 28 people, but finds it quite difficult to recruit skilled engineers and technical staff. The training which ECAMI provides to local communities in the management and repair of the systems has provided valuable skills and employment to the

villagers. This has motivated younger people, including girls, to consider working as solar electricians.

### **Potential for growth and replication**

Over 30% of the population of Nicaragua lack access to mains electricity. Many of them are in rural areas which are unlikely to have grid connection in the foreseeable future. There is therefore a large potential market for solar-home-systems. A high demand also exists for community installations such as PV powered water pumping, schools and clinics in rural areas.

To meet these requirements more effectively, ECAMI aims to establish a network of regional branches. One has already opened in Esteli, where ECAMI had already carried out a successful SHS installation programme, and three more are planned for this year. Some sales of equipment are made through local dealers. This has been successful, and ECAMI may upgrade some dealers to become branches.

ECAMI is also pro-active in looking for new opportunities for PV technology, like the mobile phone masts and PV systems for tourist facilities. A grid-connected PV system will soon be installed for the National Energy Institute.

### **Management, finance and partnerships**

ECAMI is a family business, founded by engineer Luis Lacayo in 1982. He steered it through the civil war and subsequent economic blockade of the 1980s. His wife Claudia, a lawyer, joined in 1997 to manage the administration and contracts, and their son, Max is now the marketing director and actively expanding the business. Turnover has increased rapidly over the past three years. ECAMI deliberately works with different types of customer and on a wide range of PV and other renewable energy systems, so that it is not heavily dependent on a single income stream. Installations are undertaken by individual teams, each with an engineer and two or three technicians. The intention is that each team is able to install any system that ECAMI offers.

Until recently all funding was from the family with no external investment or loans. However, last year ECAMI negotiated a loan from E+Co, which is being used to expand the business by setting up the regional branches, which will bring ECAMI much closer to rural customers. E+Co are also buying all carbon credits from ECAMI installations. Another valuable partner is the PV manufacturer Kyocera. ECAMI has become the local Kyocera dealer which had guaranteed the supplies of PV modules: in the past ECAMI, like many other small PV installers, had great problems in securing module supplies. Kyocera also provides ECAMI with a credit facility, which enables the business to undertake increasingly large PV projects.

Luis Lacayo actively supports educational projects concerning renewable energy by giving talks and lending demonstration equipment to schools and universities.

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This report is based on information provided to the Ashden Awards judges by ECAMI, and findings from a visit by one of the judging team to see their work in India.

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