Solar Power & Rural Development in Nicaragua

Kathy Dickerson

Agua Zarca women travel about two miles (3 km) roundtrip on the main road to fetch water.

Hurricane Mitch hit hard in the town of Agua Zarca in rural Nicaragua. It destroyed the crops which most people depend on for food and income. But in a country that continuously moves from crisis to crisis, Hurricane Mitch was not able to break the spirit that enables the people to endure hardship.

Following the hurricane, Agency for Environmental Health (AEH) installed a solar electric system in a health clinic in Agua Zarca. This clinic is the primary health center for not only the 150 families that live in the town, but also for twelve nearby communities.

Agua Zarca and surrounding villages are remote and do not have access to electricity. The solar electric system will improve health services by providing lights, vaccine refrigeration, and radio communication.

Non-Profit Agency

Agency for Environmental Health (AEH) is a non-profit organization that I founded in 1998 to improve human and environmental health in developing countries. This followed two years as a Peace Corps business volunteer in Nicaragua, and a summer of workshops in solar, wind, and water power at Solar Energy International.

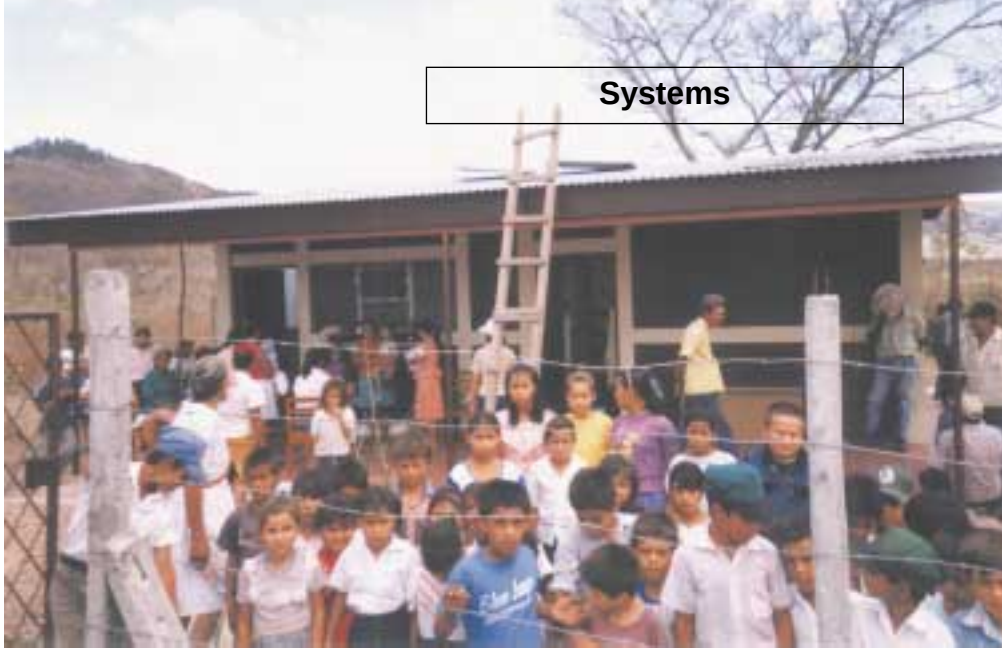
By updating health clinics with renewable energy (RE) technology, AEH helps to stop the vicious cycle of poverty, environmental degradation, and human sickness. It enables us to serve the most needy—those in rural communities. The solar electric system improves the services offered by the clinic and serves as a daily symbol and reminder of the sun's power. As this project succeeds, so does the notion that RE can be used for other community-enhancing projects.

Life in Rural Nicaragua

In my leisure time as a Peace Corps volunteer, I would hike through the mountains of Nicaragua. On these

trips I came across many rural villages. I was a novelty to the villagers at first. For some, it was their first encounter with a foreigner. What we might consider hardships are their everyday reality.

Women are physically challenged daily. Their day begins by cooking over a wood stove in close quarters. The smoke produced from the fire is thick at times and is inhaled by all family members, creating health risks. The women then make the trek to the community water source to haul water for the entire family. A large amount of water is needed for a typical family of five for bathing, cooking, and cleaning. The task of fetching water usually requires multiple trips, hauling 3 to 5 gallons (10–20 l) at a time.



Agua Zarca's schoolchildren came out to learn about solar energy, and to observe the installation of their community's first electric system.

The next few hours are spent cleaning and doing laundry. Laundry is washed on rocks at the nearest river, contaminating what may serve as their source of drinking water. Several hours are spent working in the fields with other family members to produce crops for food and income. At some point in the day, wood used for cooking must be gathered for the next day.

By evening, they are preparing dinner, which puts them back at the wood burning stoves, inhaling more smoke. After cleaning up, time is spent helping children with homework, preparing them for the following day, and putting away the laundry that is now dry. Rural life is physical for everyone. By the end of the day, the energy expended is sometimes more than the energy they get from the food they eat.

Homes are built from wood, mud, plastic, bamboo, or some combination of these materials. The houses are not sealed, and exposure to disease-carrying insects poses the risk of malaria, dengue fever, and chagas disease, among others. Latrines are a luxury that many households cannot afford, creating additional health risks.

Lack of technology and resources leaves these people repeating the same routines day after day. Introducing renewable energy can ease workloads by making daily tasks more efficient. RE technology can improve both their standard of living and their productivity in farming.

Project Components

First and foremost, the success of any development project depends on the community's *desire* for the project. The community must want to change and the project must allow the community to change in the direction that they want to go. Sustainability of the project relies on local availability of materials and resources, local know-how, and community participation.

Local Materials and Know-How

Introducing technology to a poor country is not sustainable or long term unless materials are available locally and people know how the technology works. Local availability of materials ensures that replacement parts and components are accessible and affordable. Equally important, using local materials and labor contributes to the local economy. Supporting local industry is one way of insuring that materials will always be available. It also provides jobs.

The RE industry in Nicaragua is growing. ECAMI, S.A. is a private company based in Managua that has been in operation since 1988. They offer hydro, wind, and solar electric systems, as well as appliances and tools

ECAMI technicians Jairo Velazquez and Orlando Heradora supervised the installation.

Ministry of Health technicians Jorge and Rafael working side by side with community members.

for these systems. In the last several years, ECAMI has received grants for large-scale government and internationally funded projects.

Additionally, the UNI (Engineering University) in Managua offers a course of study and mini-courses about renewable energy. Susan Kinne and Richard Komp have been the driving force behind renewable energy education in Nicaragua (see *HP61).* Susan is working with FENIX, a group of students who manufacture a variety of solar panels, including solar charging stations for laptop computers. Nicaragua has both materials and know-how to implement and sustain current and future RE projects.

Ken Olsen, founding Director of Solar Energy International, has trained Ministry of Health technicians in the design and installation of solar electric systems for rural health clinics in Nicaragua. In fact, two technicians who attended his workshops—Jorge Herrera and Rafael Morales—both work out of the Ministry of Health office that services the region of Matagalpa. This is where AEH is working. Jorge and Rafael assisted ECAMI in the Agua Zarca PV system installation, and they will install future health clinic systems for AEH.

Community Participation

In any rural development program, the successful installation of solar energy in rural health clinics demands community participation. Our program is fortunate to have community support at two levels—the Ministry of Health and the rural villages. The Ministry of Health will be ultimately responsible for the repair, replacement, and technical maintenance of the system and its components. Their acceptance of this role and involvement in the process will strengthen their commitment to the success of the project.

The villages participate by demonstrating their interest and need. They also identify two members of the community who will be responsible for basic system maintenance, and they provide food and shelter to the installation team. This involves the community from start to finish, and they feel a sense of ownership in the project.

Initially, the community leaders are asked about the needs of their community clinic and how they feel energy could improve the services it provides. In this way, the community designs and sizes the system by identifying the loads it will support. A few eager citizens ask for X-ray and sonogram machines, but most are realistic in their request for clinic enhancement. The community of Agua Zarca identified the need for lights, vaccine refrigeration, and radio communication.

When I first met with Dr. Francisco Lopez, Municipal Director of the Ministry of Health, he was deeply concerned about Agua Zarca. The town is roughly 20 kilometers from the nearest urban hub via a road that is impassible during the rainy season. This means that five months out of every year, the town is isolated from outside help.

The women were just as interested as the men—Doña Reina receives system maintenance training.

Radio communication was immediately identified by the community members as a useful tool in the community. And the women were quick to request lights in the clinic. When a woman goes into labor after dark, the birth takes place by candlelight. While this can be perceived as quaint or tranquil to most of us, the lighting is not sufficient. In the unfortunate instances of complications, flashlights are brought out to improve visibility. The solar electric system will ensure that new lives will safely enter the village of Agua Zarca.

Additionally, Dr. Lopez asked AEH for the system to include vaccine refrigeration. The village is isolated for five months out of the year, so the benefits of having ready access to vaccines is obvious. But Dr. Lopez's request was more personal. The previous health worker was a hemophiliac and had severely cut himself several months earlier. Complications arose, and there was no way to maintain the refrigerated blood products he needed. The combination of no radio communication, no vaccine refrigeration, and being isolated from the nearest town with updated health facilities resulted in the man's death. Dr. Lopez wanted to ensure that a tragedy like this did not happen again.

Thanks to a small grant and charitable donations, AEH was able to provide the solar electric system. The Regional Office of the Ministry of Health agreed to provide the radio communication system. The donations included US$3,000 cash from the Trull Foundation, a US$1619 Sun Frost vaccine refrigerator (including shipping within the USA), and US$152 from Grupo Taca for shipping the refrigerator to Nicaragua from the USA.

Systems Overview

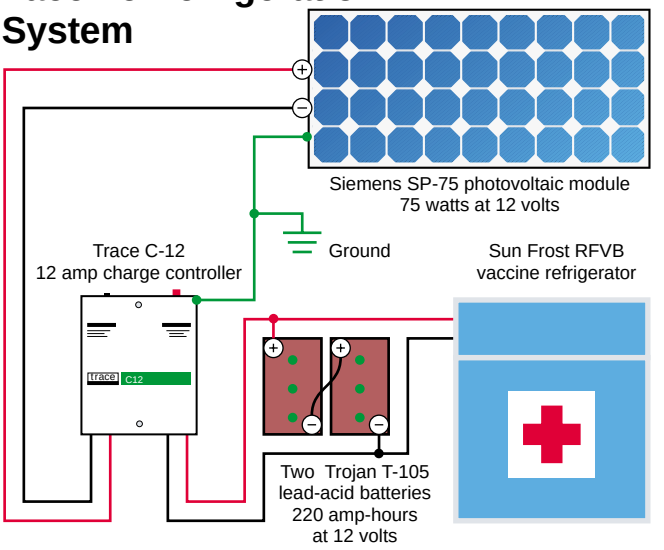
All system loads are DC, eliminating the need for an inverter. The system can be modified later if additional medical equipment is desired by the community and the Ministry of Health.

Two separate systems were installed in the clinic. One system supports only refrigeration—an RFVB Sun Frost vaccine refrigerator, which draws 50 watts. The other system powers four fluorescent 20 watt Thinlite lights. A two-way radio will be installed on this system in the future. The entire concept of having electricity is new to the people in Agua Zarca. For some, this was their first encounter with electricity. The two independent systems will insure that there is always power for the vaccines, even if the other loads are overused.

Installation and Training

Prior to the system installation, I visited with the community to introduce the concept of solar energy. I explained how the system works by drawing schematics, detailing each system component and

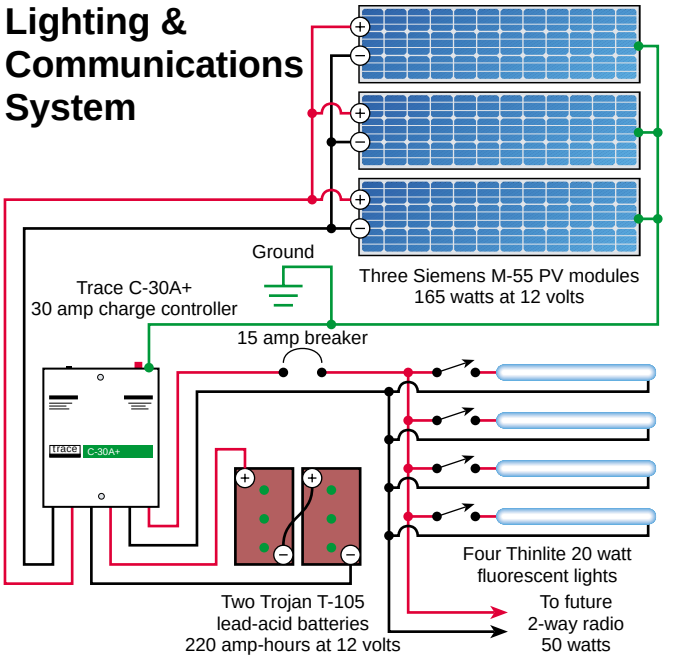
Vaccine Refrigeration System



load. I also explained maintenance of the system and asked the community to select two people to be responsible for basic system maintenance. Women were encouraged to participate. In the case of Agua Zarca, two women, Reina Rodriguez and Marcia Ocampo, insisted on participating in addition to the three volunteer health workers.

Early on the installation day, only the Ministry of Health and ECAMI technicians and the three community health workers were on hand to begin the project. Slowly, people began arriving to watch. Before long, the men arrived to lend a hand and to learn about electrical systems! With the local expertise and community labor, the installation of the two systems took place in less than five hours.

Lighting & Communications System



Throughout the day, community members stopped by to express their appreciation for our assistance. The women were just as curious about the system as the men. Given their equal stake in the health clinic, the women wanted to be included in the orientation of the finished system.

At one point, the professor of the village school brought his entire class out to observe the installation! This planted new seeds of learning in the youth of this town and gave us a chance to talk about the benefits of RE.

When we had finished the installation, Ministry of Health technicians Jorge and Rafael led a training session on system use and maintenance. Many community members participated, but the training was directed to the community health workers Francisco, Julio, and Luis; Dr. Francisco Lopez, Municipal Director of the Ministry of Health; Pedro Hernandez, Agua Zarca's mayor; and two women volunteers, Reina Rodriguez and Marcia Ocampo.

After four months of operation, the Ministry of Health in Matagalpa reported that the system is functioning perfectly, and that other rural clinic directors are requesting systems for their communities.

Obstacles

When we first went to the Ministry of Health to propose the project, we were told that solar energy doesn't work in Nicaragua. I personally had assisted in several solar energy installations when I lived in Nicaragua before, so I was familiar with potential problems. It was agreed that the main reason for unsuccessful solar electric projects is that no one checks the water level in the battery, and it subsequently dies.

Agua Zarca Systems Costs

Vaccine Refrigerator System

Item	*Nicaraguan Cordobas**	*U.S. Dollars*
Siemens 75 watt panel	5,823.40	507.26
Two 6 volt T-105 Trojan batteries	1,837.76	160.00
RFVB Sun Frost vaccine fridge	26,986.84	2,350.77
Trace C-12 charge controller	1,066.13	92.87
Misc. wiring, cables, & materials	1,640.17	142.87

Main System

Item	*Nicaraguan Cordobas**	*U.S. Dollars*
Three Siemens 55 watt panels	13,369.70	1,164.81
Two 6 volt T-105 Trojan batteries	1,837.76	160.00
Four 20 watt Thinlite lights	2,800.28	243.93
Trace C-30A+ charge controller	1,309.40	114.06
Misc. wiring, cables, & materials	2,257.43	196.64
Labor costs for entire installation	3,445.80	300.00
Total (before 15% tax)	C$62,374.67	$5,433.21

*Conversion factor: C$11.48 = US$1.00

This is where AEH's approach is different. It is vital to teach the community the importance of checking the water in the battery. The combination of working with trained technicians and setting a maintenance schedule for the two responsible parties will help form the habit of regular, basic system maintenance, thereby avoiding the problem.

The second problem involved the charge controllers. The Trace units we used for this installation only show when the batteries are charging and when it is completely charged. However, there is no way for the people to know when the batteries are low and energy needs to be conserved. This will be remedied in future installations by using a different model Trace charge controller.

Dr. Francisco Lopez, director of Municipal Ministry of Health (third from left), Pedro Hernandez, Mayor of Agua Zarca (second from left), and community volunteers who helped install the systems.

Where We Go From Here

Aqua Zarca is an arid region and the livelihood of the people is agriculture. Using RE for irrigation, milling, and grain drying could improve local production. This would increase both household food security and family income. In addition, women currently walk more than two miles (3 km) to fetch water. Community leaders have asked us to help them address this problem. Water pumping, solar cooking, and solar water disinfection are all projects we would like to initiate in Agua Zarca.

Community health workers Luis Castro, Julio Palacios, and Francisco Ruiz are part of the maintenance staff.

In addition, AEH is working to initiate an internship program between university students in the United States and their Nicaraguan counterparts. Together, these students can provide technical assistance to rural communities. The Agricultural Department of Louisiana State University and the Renewable Resources Department of University of Southwestern Louisiana have already expressed interest in involving their students in this program. We hope to secure funding for this program in order to present it to Nicaraguan students on my next trip down.

Renewable energy contributes to social and economic development. When people are healthier, they are more productive. When they are more productive, they can grow and harvest more crops, and bring them to market. Renewable energy can have a key role in this process.

When a community has better access to health care, the entire social foundation improves. AEH is fostering an understanding of the relationship between health and environment by implementing RE projects. This helps rural communities in developing countries have a chance at achieving healthier, cleaner, and more productive lives.

Get Involved

You can help make this a reality for underserved rural communities like Agua Zarca. In September, I went to Nicaragua with funding to install the same PV system in another rural health clinic. The system components were purchased from ECAMI to support local RE commerce. Jairo Velazquez, ECAMI's head engineer, lead the installation team that included Ministry of Health technicians Jorge and Rafael. If you speak Spanish and have experience with solar cooking or other projects mentioned in this article, working vacations can be arranged. Monetary support is tax deductable. See our new Web site for other ways to become involved.

Access

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