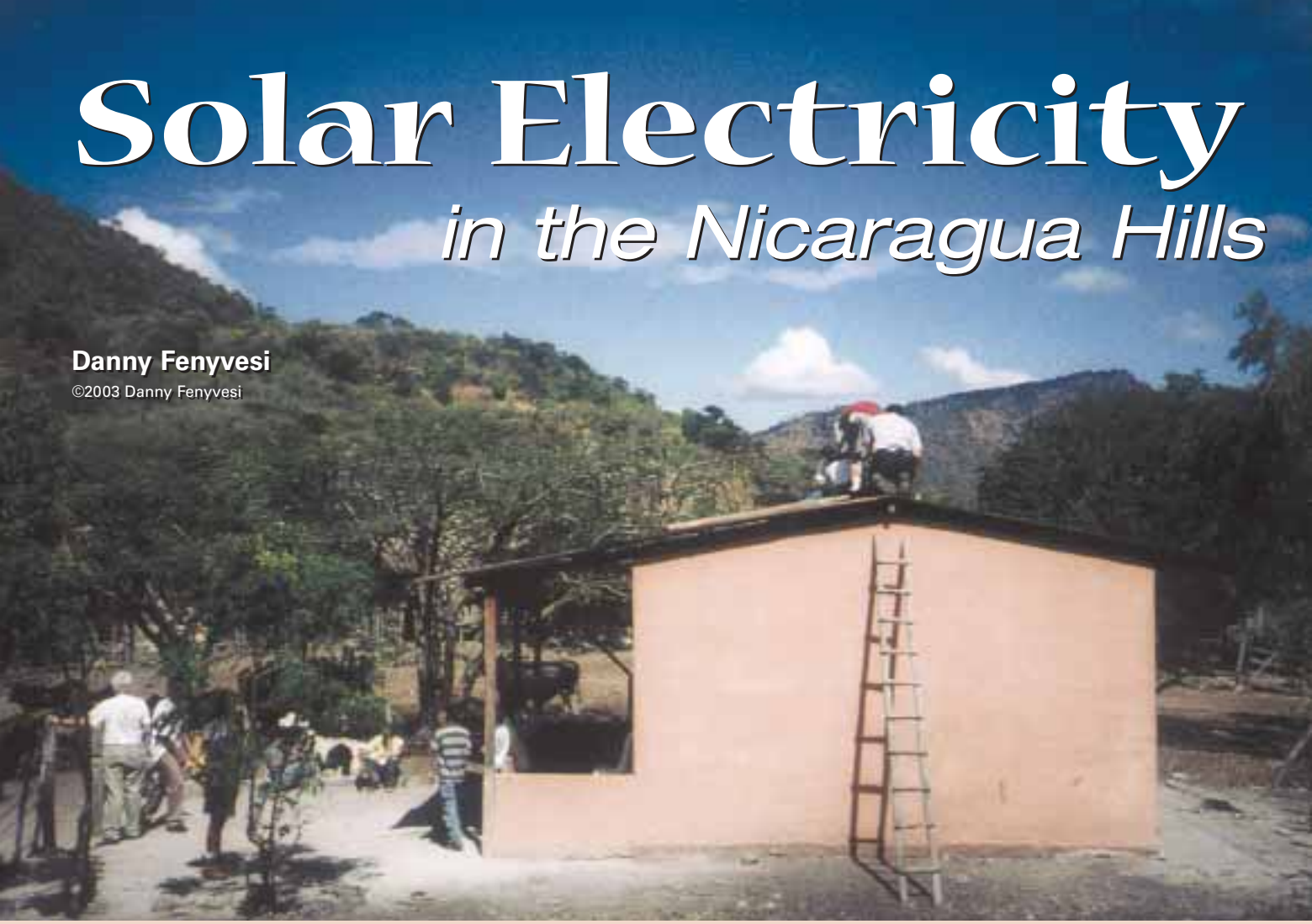
Solar Electricity
in the Nicaragua Hills

Danny Fenyvesi



Grupo Fenix workshop participants install a 50 watt photovoltaic panel for lighting on the health clinic in the little village of Las Pintadas, Nicaragua.

After a spring and summer installing PV in northern California, a fall getting lost in Europe and tinkering with the PV systems of southern Spain (see *HP91*), and a brief winter stint installing PVs in the horse country of Maryland, I decided it was time to get a new perspective in the Third World. A few weeks of searching for options yielded just the people I needed to talk with—Susan Kinne and Dr. Richard Komp of Nicaragua's Grupo Fenix.

Exchanging e-mails with Susan and Richard and reading articles about their group, I learned that Grupo Fenix is a nonprofit organization that has been able to aid the rural poor while educating Nicaraguans and foreigners alike. The objective is to promote renewable energy and bring sustainable technology to the poorest of the rural people.

Grupo Fenix works primarily with engineering students at Universidad Nacional De Ingenieriá (UNI) to design, build, and install solar hot water systems, solar cookers, and PV systems. Grupo Fenix has built a PV panel fabrication shop where they construct panels using donated, broken cells that are re-cut and soldered to make new panels.

Along with its year-round work, Grupo Fenix invites foreigners to participate in solar cultural courses in Nicaragua. Students are able to get a background in solar energy, participate in a rural installation, and get a taste of Nicaraguan culture. As the jumping off point for my two-month volunteer stint with Grupo Fenix, I took their January PV course. After a week of intensive classroom instruction and hands-on workshops, our group left for the village of Las Pintadas to install a donated PV system for its health clinic.

Las Pintadas

A poor village of around one hundred people, Las Pintadas was named for a painted, carved rock that dates back several thousand years (*pintadas* means paintings). The village is located in a remote area of the rugged, pine-topped mountains that border Honduras. During the civil war of the 1980s, the area was center stage for Contra-Sandinista battles. In addition to the death and destruction that war brings immediately, many land mines were planted by both sides, and there have been many land mine victims.

Perhaps the most important criterion for choosing the village for this project was the motivation of the residents. As many foreign aid workers know, projects often fall apart a few months after the aid workers leave because of a lack of follow-up by the aid group, and a corresponding lack of

understanding and willingness on the part of the villagers to adopt new technologies.

For this reason, Grupo Fenix requires potential aid recipients to prove that they will maintain the solar projects. Las Pintadas has a progressive, optimistic school teacher, Roosevelt Rodriguez, himself a land mine victim. Having researched solar electricity, he provided the educational support and the energy to unite the villagers behind the project.

Slow Down to Burro Time

Our group of sixteen American students and five Grupo Fenix members left Managua loaded with gifts, tools, and solar equipment. Our trip to the village was a bone-shaking but beautiful ride through the washed-out dirt roads of the tranquil countryside. Seeing hardly any other traffic, we traveled for hours on the flatbed of a 1950s German military truck without a windshield. On the last mile of our ride, we were forced to share the road with a muscular, stubborn burro who refused to let us pass, despite our driver's persistent honking.

When we arrived behind our burro, we were exhausted. But we found ourselves energized by the cool mountain air and the star-filled night of the new moon. Since we were the first foreign group that the village had ever had, our host families were as excited to meet us as we were to be there. For the next two nights, we bedded down in their simple, clay roof, dirt floor homes.

The following day began early. At 5 AM, the crowing of roosters, the oink-oink of pigs, and assorted snorts, hoots, and howls roused everybody. For the locals, who have never lived with electricity and are usually asleep within a few hours of the 6 PM sunset, a pre-dawn breakfast by the light of the moon is the norm.

Tropical Troubles

Many installers in the tropics have learned to install PVs without the traditional terminal boxes. Terminal boxes trap the ever-present humidity that can lead to terminal corrosion. Terminal boxes can also become infested with insects, mice, and other critters, which leads to breakdowns in the insulation and eventual open circuits.

In place of a terminal box, the leads are cut very short and are usually connected to the small, plastic, screw-in, European-style wire connects. In our installation, we used these, and then fed the other end into a large, heavily insulated, insect-proof black cord.

Batteries are another matter in Nicaragua. When Grupo Fenix started in 1996, there was no place they could find in Central America that built deep-cycle batteries. They were all imported, which meant they were expensive and hard to get.

Susan was able to talk a small, local shop that built truck batteries in Masaya, Nicaragua into making 12 volt deep-cycle batteries. These batteries are 70 AH capacity. Although they can't compete quality-wise with the better foreign batteries, they are cheaper, and help to support local workers.

Grupo Fenix uses Solom 8.8x controllers for small systems because it is the smallest controller available in Nicaragua. However, Grupo Fenix's engineers are now designing and starting to build their own charge controllers specifically designed for small systems.

The author in front of the clinic, which has become an evening gathering place for the community due to the electric lights.

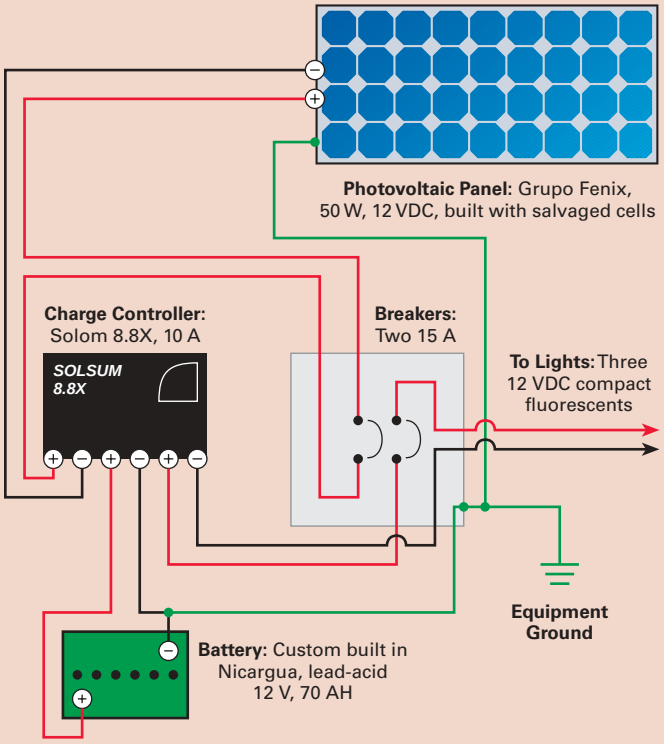
After clearing our heads with strong, locally grown coffee, we broke into two teams. One team would build solar cookers with village women and explain their uses and design. (See the sidebar on solar cooking by Eric Fedus, another Grupo Fenix student from the U.S.) My team began the PV installation.

The Installation

Our first step was installing a 50 watt Grupo Fenix-built photovoltaic panel on the roof of the small, salmon-colored adobe health clinic. Using semiflexible metal straps, our leader, Alexis Martinez, and his assistants, Aín Rodriguez and Maria Teresa Castillo, showed us how they build a makeshift rack. Because the roof is made of thin sheet metal, only a few of us could be on the roof at the same time to watch them bend and twist the rack into a sideways U shape.

The completed rack was bolted to the roof, and the panel was screwed onto the rack. For a lightning ground for the panel and rack, we ran a wire from the panel frame to a 1 1/2

The Las Pintadas Clinic's Solar Lighting System



Note: All numbers are rated, manufacturers' specifications, or nominal unless otherwise specified.

meter (4.9 ft.) brass rod sunk into the ground. The panel faced south at a 13 degree angle so that rainwater would run off easily.

A modified, thick, black construction-style extension cord was attached directly to the panel leads and then run down to the area of the circuit breaker box, a distance of about 7 meters (23 ft.). Instead of penetrating the roof for the cord, we slipped the thick cord between the overlap of two of the flimsy sheet metal roofing sections.

For our safety as well as the health of the charge controller, Dr. Komp explained that the order of the wiring must be carefully followed. First, we ran the negative wire from the charge controller to the circuit breaker box where it met a wire that provided an equipment ground for the box. We ran a wire from the battery's negative terminal to the brass ground rod. Then, from the positive terminal of the controller, we ran a wire to the positive terminal of the 12 volt battery.

For the panel wiring, the PV negative is connected to the negative terminal of the charge controller's panel circuit. And the positive from the panel runs to the top of the 15 amp circuit breaker. We then wired the bottom wire of the breaker to the positive terminal of the charge controller. Finally, the load negative from the controller was wired to the negative bus bar in the box. From the bus bar and the top of the 15 amp circuit breaker, the two wires run to the clinic's three, 20 watt, DC fluorescent lights.

All the wires were #14 (2 mm^2) stranded except for the wires from the breaker box to the battery, which were #12 (3.3 mm^2). The small wires from the charge controller to the breaker box were #16 (1.3 mm^2), but this was a short, 1 foot (0.3 m) distance, so the small size doesn't matter. The distance between charge controller and battery is 5 feet (1.5 m), and the total distance from panel to battery is less than 20 feet (6 m).

Although it results in a slight waste of wire, most connections were made in the breaker box, to add a layer of security against insects, mice, and other incidental contact. Both the circuit breaker box and the charge controller are mounted on a 2 centimeter (3/4 inch) board, and the battery sits 1 meter (3.3 ft.) below on a wooden platform. While we were wiring up the PV system, the other half of our group worked on wiring the three DC fluorescent lights—two overhead and one porch light.

The Fiesta

In Nicaragua, as elsewhere in the tropics, it feels like there's no afternoon. The sun goes from its midday position to a brief twilight with startling speed. As daylight rapidly disappeared, we were racing with the sun to complete the PV installation. To place the final wires, we had to hook up a 12 volt bulb straight to the battery to see.

During this time, the villagers, returning from their farm work, gradually clustered around us. Several farmers took a

Aín Salinas, Maria Teresea Castillo, and Alexis Martinez—members of the Grupo Fenix photovoltaic installation team.

Solar Cookers for Nicaragua

Eric Fedus

In Nicaragua, the source of energy for most cooking is still wood. But as the forests have thinned over the years, *campesino* (farmer) families find themselves spending more and more time searching for wood to burn in their clay stoves. Another problem is that the stoves spew smoke inside homes, affecting the health of women. So the women of the village of Las Pintadas were eager to try out the solar ovens. Unfortunately, the day for the tryout happened to be a mostly cloudy day, demonstrating the oven's reliance on sunlight.

Undeterred, the village women eagerly watched and participated as we showed them how to build small sun powered ovens. Our materials were cardboard, tape, glue, glass, cornhusks, a black-painted metal sheet, and aluminum foil. With one larger cardboard box serving as the shell, we placed a smaller box inside and insulated the space in between with cornhusks, a locally available product.

To reflect heat into the center of the box, we glued aluminum foil on the insides of both boxes. Then we placed the black metal sheet inside the oven, glued a plate of glass onto a cardboard cover piece, and the solar oven was complete. These ovens are capable of reaching 250°F (121°C) in full sun—enough to boil water or perhaps cook an egg and a few plantains.

If the women demonstrate that they have learned to use the cookers in the weeks to come, a few of them will have the opportunity to build their own more permanent cookers. An important part of this process will be the follow-up by members of Grupo Fenix to ensure that the women learn the strengths of solar cookers, and continue to use them.

As for myself, I can't wait to build my own solar cooker and try it out at my home, in the New England sun. Now I know that people haven't really tasted a good plantain until they cook it in a solar cooker. Information on solar cookers is available from Solar Cookers International (see Access).

At another Grupo Fenix solar cooker workshop in Managua, Nicaragua, participants pose with their cardboard ovens.

Grupo Fenix instructors, students, and residents of Las Pintadas gather for a celebration in front of the newly electrified health clinic.

great deal of interest in what we were doing, and were soon turning screws and learning the basics of the system. In front of a crowd of excited children and farmers, we turned the breakers on, flipped the light switch, and illuminated the health clinic. Applause and laughter followed, and people scattered to prepare for the party.

We didn't understand what an important event this was to the village until we attended their fiesta. Everybody from the village and quite a few people from neighboring villages gathered around the porch of the clinic. School teacher Roosevelt opened the festivities with a flowery speech explaining the benefit to the community and thanking the visitors for their help, while Susan Kinne translated.

Las Pintadas System Costs

Item	Cost (US$)
Grupo Fenix panel, 50 W	$300.00
CMG custom battery, 70 AH	133.90
3 Lamps, 15 W, 12 V	105.80
Solom 8.8x controller, 10 A	80.50
Installation accessories	80.00
Installation & follow-up	70.00
Total	$770.20

Then a group of young girls performed a barefoot dance, the local pastor gave a lengthy blessing, and there was some heartfelt solar poetry. We pitched in with juggling and a colorful story or two. Next, the ranchero band took over, playing a style of music that can only be described as soulful mountain music, perhaps a bit like an old Bill Monroe ballad.

With my guitar in tow, I was taught countless classic ranchero songs, including some new songs composed to celebrate solar electricity. In return, I tried feverishly to teach the band some American classics and was met with polite contempt. But unexpected enthusiasm greeted "Friend of the Devil," which I played over and over again until the band got it right. Fortunately, the party ended before daylight, and we did get some sleep that night.

Spreading the Light

A few weeks later, I returned to Las Pintadas to work on a second installation. I was excited to talk to the locals and find out how they were doing with the solar powered health clinic. They told me that the newly lighted porch of the health clinic had become a gathering place for reading and talking.

I heard news that some nearby villagers, who had earned good money selling organic coffee beans, were planning to invest in solar electricity for their own homes. I was impressed that there were now more sophisticated questions about the prices of panels and batteries, and the durability of these systems.

However, I did find some confusion concerning the warning lights of the charge controller. People were a bit disappointed that even though there was electricity left in the battery, they had to refrain from using it when the controller's light was red. This confusion originated from the previous experience of the locals running DC televisions off car batteries—they used the batteries until they were dead.

After some conversations concerning long-term battery health, I left the village with the confidence that the locals were up to the job of maintaining the system, and that solar electricity would thrive in the rugged hills of Las Pintadas.

Access

Danny Fenyvesi, Sustainable Village/Sustainable Resources • Boulder, CO • dfenyvesi@hotmail.com

Eric Fedus, 369 East Shore Dr., Colchester, CT 06415 • efedus@hotmail.com

Grupo Fenix, William L. MacDowell, Grupo Fenix Chicago representative, c/o Skyheat Associates, 27W710 Windermere Rd. #3206, Winfield, IL 60190 • 630-876-3456 • info@grupofenix-nicaragua.org • www.grupofenix.org

Susan Kinne, Coordinadora, Grupo FENIX; Directora, Proyecto de Fuentes Alternas de Energia Universidad Nacional de Ingenieria, Managua, Nicaragua • 505-278-3133 • Fax: 505-270 5125 • skinne1@juno.com

Dr. Richard Komp, 17 Rockwell Rd. SE Jonesport, ME 04649 • 207-497-2204 • sunwatt@juno.com

Baterias Medina, Ceaser Medinas, Cuerpo de Bomberos, 75M al sur, Masaya, Nicaragua • 505-522-2417 • Batteries

Solar Cookers International, 1919 21st St. #101, Sacramento, CA 95814 • 916-455-4499 • Fax: 916-455-4498 • info@solarcookers.org • www.solarcooking.org.