

RURAL ENERGY AND COMMUNICATIONS PROGRAM

Solar Electrification and Rural Communications as a Tropical Rain Forest Conservation Strategy in the Osa Peninsula, Costa Rica

EXECUTIVE SUMMARY

This program, started in 1991 on the Osa Peninsula, southwestern Costa Rica, seeks to introduce for the first time clean and renewable energy sources in the development of the buffer-zones around Corcovado National Park. The aim is to facilitate the installation of solar energy in the homes of resource-poor farmers and native peoples, so as to allow for basic illumination and radio-telephone communications. Without appropriate communications, the rural peoples of the tropics are always at a great disadvantage in catching up with the quick pace of development: access to market prices for agricultural and service-related products, legal advice against land-speculators, emergency health services, community information and others are a basic need for most people living here. Once available through solar energy, rural communications quickly widen the spectrum of opportunities and economic alternatives.

Rural electrification is almost always a subsidized activity and is a current priority for Latin American governments who seek to improve socio-economic conditions in the face of the rapid transformation of the rural populations within the global market economy. However, unlike small NGO's, governmental action is always very slow and there is little time to lose providing the basic services solar energy makes possible.

This program, in three phases (1996-1998), intends to introduce cheap and affordable, single panel domestic solar systems on marginal communities of the Osa Peninsula, utilizing several strategies for the financing of the systems: from linking solar systems as incentives to conservation efforts by exchanging when possible domestic photovoltaic systems with conservation agreements (easements, compensation for lack of access to resources, loss of animals to wildlife, etc.), to village banking schemes to straight donation to organized groups working in conservation oriented projects (eco-lodges, alternative medicine, non-timber forest products, organic agriculture, etc.) when needed. The 62 systems installed will enhance the quality of life for many families while helping to consolidate protection of more than 20,000 acres of critical primary rainforest habitats.

The availability of electricity in remote locations has immediate advantages including illumination, communications (the distribution of agricultural market information, health and emergencies), water pumping, schooling, land-tenure stabilization, and the overall improvement of the standard of living for rural populations. It is possible that by improving the quality of life of local residents, pressure on the primary forests can be reduced somewhat. Also, once electricity is available to rural families and basic needs like illumination and communications are covered, migration to crowded urban areas is expected to diminish. The geographic conditions in Central America, with an annual average of 1,500 to 2,000 Kwh/m², offer excellent opportunities to use simple, easy-to-install, low-maintenance, photovoltaic domestic systems. The demand for such systems is very high, but the availability of equipment and technical support is limited to the capital city of San Jose.

TUVA's Rural Energy and Communications Program started its first solar installations in 1991 with seed funding from private individuals. Currently there are 8 domestic systems installed in the Piro Valley and in the Osa Guaymi Indigenous Reserve. In 1992, a small forest sector along a critical wildlife corridor was put under protection through a pilot conservation agreement with two local owners. In 1993, TUVA helped organize a pioneer workshop on solar energy in the Osa, with the participation of 12 national, U.S. and Central American organizations involved in solar energy.

In 1996, the Turner Foundation granted \$20,000 to the program, and about 15 additional systems will be acquired and installed during 1997.

Currently the program needs financial backing to extend its operation in an already predefined and mapped wildlife corridor within the buffer zone forests southeast of Corcovado National Park. The disappearance of these tropical forests would affect the ecological viability of the nearby park and the socio-economic stability of the local communities. The rate of deforestation on the Osa is now the highest in the country and one of the highest in the world. The program could provide a viable model for linking conservation and development goals. In its review of integrated conservation and development programs in the tropics (ICDPs), the World Bank states that the establishment of these links is one of the most urgent needs for current rural development programs.

With additional funding required (\$25,000), about twenty additional domestic systems be installed, targeting farmers and two forestry cooperatives whose tracts of forest are situated along core sections of the Piro-Corcovado wildlife corridor. Also, a small rural electric coop will be formed, training two local entrepreneurs as solar-electric technicians to install and maintain the systems, as well as manage the conservation agreements or village loans with local farmers. At the end of this phase it is expected twenty rural families will benefit from having solar electricity in their homes, enjoying illumination, small appliances, two-way radio communications, recreation and overall improved access to information.

JUSTIFICATION

Energy production and consumption patterns are core to the relationship between society and the environment. Today, energy production is a critical issue to the country as a whole, and private power production together with decentralized energy systems is high on the governmental agenda. Sustainable rural development requires clean and renewable energy sources, as well as creating awareness of energy issues among the rural populations that do not yet display the high consumption patterns associated with living near the conventional power grid. If renewable energy and environmentally sound rural electrification programs are brought to the center of development policy, then the pressure of installing new mega-facilities to respond to demand levels of an increasing population can be reduced.

The Osa Peninsula is now completely off the conventional power grid, and the government has no plans to connect anywhere other than the town of Puerto Jimenez. Jimenez, the biggest rural center, runs on a diesel-powered plant at an estimated monthly loss of US\$40,000. The proposed Osa solar energy pilot project would very quickly attain a high-visibility status, both from an economic and environmental point of view, thus bringing renewable energy solutions to the attention of decision makers. Rural photovoltaic systems avoid the extremely high costs of extending the power grid as well as the costs of operating at higher capacities during peak demand hours. At a local level, photovoltaic solutions eliminate the high costs of acquisition and maintenance as well as the noise and pollution associated with typical gas/diesel generators (from 1KW to 20KW).

Most rural areas of the Osa have not yet committed their future development to the expansion of the conventional power grid, and existing energy needs are relatively low. If the main consumers, probably the eco-tourism industry, decide to install solar and/or hydro systems, the Osa as a whole may have the chance to stay, for the most part, away from the power grid, offering an inspiring model of environmentally-sensitive rural development for the tropics. With a standard 80 watt/hour system (half the power of a standard light bulb in an American garage) a whole household can be electrified, providing electricity for radio communications, music, efficient lighting, small power tools, and ventilation fans. Existing patterns of low consumption are ideally suited for both the introduction of solar electrification and the training of potential end-users. Before other more expensive and non-renewable options are considered, which would only mortgage the future development of the area to the burning of expensive fossil fuels and high electrical bills, we have an excellent window of opportunity to promote clean, renewable energy sources while improving significantly the quality of life for the Central American rural peoples.

EXPECTED BENEFITS

1. To improve the economic conditions of the buffer zone forest residents by offering access to electricity and increased productivity options.

2. To diminish the pressure put on the forest as the sole source of resources in the area.
3. To diminish current outward migration tendencies by providing better living conditions to buffer-zone resident families. Rural migrants are increasingly crowding the bigger cities, resulting in increased social and economic tensions.
4. To create environmental education opportunities relating to core issues of energy and the environment.
5. To decrease demand for the extension of the power grid.
6. To protect up to 2,000 acres of primary rainforest within an existing biological corridor through five-year conservation easements.
7. To increase the efficacy of several existing sustainable development projects through the installation of a passive solar dryer for agricultural and forestry products.

GEOGRAPHIC LOCATION AND IMPORTANCE

The Piro Valley is located 6 miles southeast of Corcovado National Park on the Osa Peninsula. The Osa Peninsula contains the last large tracts of tropical rain forest remaining on the Pacific side of Central America. Due to its high biological diversity, Corcovado National Park is considered the crown jewel of Costa Rica's system of national parks. Its forests are considered a true evolutionary refuge, adding to the important conservation of genetic resources. However, for its ecological viability to remain intact, buffer zones need to be managed sustainably, both to extend the range of habitat and to integrate the rural populations living in these forests with the conservation efforts.

PROGRAM CONTEXT

There is already the need for alternative energy sources in the area, both for domestic and production uses. The ICE (Costa Rican Institute of Electricity) has no current plans to extend the conventional power grid to reach these populations. Most of the local residents own farms with substantial tracts of forest. In an attempt to earn an economic return from the land (often their only asset), they are frequently forced to resort to selling logging rights. Alternatives for obtaining concrete, sustainable returns that improve local living conditions are usually welcome.

Rural electrification has almost always been subsidized by governmental institutions in the world. Connecting these subsidies to conservation goals would be a viable strategy. By linking the individually owned tracts of forests through a network of reciprocal conservation easements, TUVVA's existing greenway (biological wildlife corridor) can be expanded and consolidated, thereby benefiting all the involved parties. Moreover, the solar-for-nature swap program would nicely complement several other projects managed by TUVVA along this greenway. For example, the passive solar convection dryer included in this proposal will allow several other sustainable development projects managed by TUVVA (fallen timber and vanilla cooperatives) to dry their products more efficiently. In doing so, it will increase the productivity of these existing projects with appropriate renewable technology.

Preliminary studies of the solar resource by the University of Costa Rica in the area show a high level of 5 sun/hours per day averaged throughout the year. Existing photovoltaic systems are performing very well under these favorable conditions.

PROGRAM OBJECTIVES

Domestic uses:

1. Install 20 photovoltaic domestic systems to provide basic illumination, radio-communications, TV/radio, and ventilation. Washing machine capability (requiring one more panel and a DC to AC power inverter) would also be a desirable option to free rural women's time that could be dedicated to other productive or leisure activities.

2. Promote a solar electric cooperative to install and maintain the photovoltaic systems, thus training local people and creating new conservation-related jobs in the area.

Productive uses:

1. Install one passive solar convection dryer for agricultural and forest products. This community dryer will be owned by the existing OFTER (Osa Fallen Timber Extractive Reserve) cooperative and utilized by neighbors that will pay an annual or monthly fee into a capital fund to be used for maintenance of the facility. These fees could be derived as a percentage of the forest and agricultural products that utilize the drying equipment in their production.

FOREST CONSERVATION INCENTIVES

Usually either cash payments or tax credits have been used by the government in Costa Rica to promote reforestation. Debt-for-nature swaps have also been used in the country to protect the environment. Until recently, at least one NGO was developing a program of cash incentives (PROINFOR) in return for forest conservation in the Osa Peninsula (BOSCOSA, Fundacion Neotropica). Another recent development, known as Joint Implementation, aims to promote reforestation and conservation by selling carbon sequestration credits to utility companies in developed nations. Under the Osa Renewable Energy Program, TUVVA proposes a new type of incentive that links solar energy and forest conservation.

The current opportunity cost of one hectare (2.47 acres) of undeveloped forest land in this country has been estimated at \$50/yr. Using this figure as a baseline, alternative forest conservation incentives could be designed. Existing land classification systems also help determine specific values of different tracts of forest. Solar incentives have the advantage of assigning a concrete value to the forest, and thus help avoid its conversion to other uses.

SOLAR-FOR-FOREST INCENTIVES

The proposed solar-for-forest incentive would pay land owners the equivalent of \$15 per hectare per year, for primary forest land signed into five year conservation easements. Under Costa Rican law, conservation easements are "real rights" (derechos reales) and thereby transmitted with the property no matter who the individual owner may be. The payment will be given in the form of a subsidy towards the installation of a photovoltaic solar system. For example, an easement on a 10 hectare (25 acres) tract of forest will pay the owner \$150 per year, for a total of \$750 in five years. A System I solar installation (worth \$768) will be installed in exchange. Alternatively, the landowner may choose to protect 30 hectares (75 acres) under a five-year conservation easement in exchange for an upgraded System II photovoltaic installation worth \$2,347.

The Pilot Phase will aim at installing 20 domestic systems, protecting approximately 650 acres of forest, and one production system that will consolidate existing conservation projects.

TECHNICAL CONSIDERATIONS

A. Technical assistance:

The U.S. National Rural Electric Cooperatives Association (NRECA) office in Costa Rica has expressed its commitment to allocate funds to cover the costs of design, installation, end-user training and overall technical assistance to the program. Also the government's Instituto Costarricense de Electricidad (ICE) has expressed its desire to cooperate with the program. Invited by TUVVA, ICE made a preliminary visit to Puerto Jimenez and is developing a market study for the area.

Fundacion AMBIO, a legal environmental firm, will provide the assistance necessary to prepare the conservation easement contracts and legal framework to protect individual tracts of forest. In addition, they will help us link individual easements into a larger network of reciprocal easement obligations whenever possible. An example of the existing conservation easement contract is already approved by the National Registry of Costa Rica.

B. Technology suppliers

Sistemas de Energia Eficiente, S.A. (SEESA), currently imports all necessary photovoltaic systems components into Costa Rica and has ample experience working in this country and on the Osa. TUVa has already purchased and installed several systems from this company as part of the program start-up during 1992-1993, and to date, all are functioning well.

Attachment A: Solar radiation data

The Osa Peninsula, is located on the Pacific coast of southwestern Costa Rica, at 8 degrees north latitude. Data gathered in the past 10 years by the National Meteorological Institute indicates that most of the Osa's 800 square kilometers fall within zones 2 and 3. Following is a table summarizing average daily radiation, average annual radiation, and radiation intensity averages:

Zone	Average Daily Radiation	Annual Average		Intensity
	cal / cm ² x d	J / cm ² x d	KwH / M ²	W / M ²
Zone 1	<350	<1465	<1485	<170
Zone 2	350-400	1465-1675	1485-1700	170-192
Zone 3	400-450	1675-1885	1700-1910	192-218
Zone 4	>450	>1885	>1910	>218

PHOTOVOLTAIC SYSTEMS DESCRIPTION

I. Single Family Domestic System I

This system is designed to be a single family installation. It will provide enough electricity for:

- 2 or 3 high efficiency halogen lights (10W/hr.)
- AM/FM Radio (8W)
- Black and white TV (15W)
- VHF communications (marine band radio transceiver) (1W/25W)
- Small ventilation fan (12W)

* Domestic System I Components:

- 1 80 Watt PV module (6 amp/hr.)
- 2 6V 350 amp/hour storage batteries
- 1 power center (with main, solar and load disconnects and fuses, charge controller, and low voltage disconnect)

Cost: \$768

II. Large Family Domestic System II

This system is designed to be a large family installation. It will provide enough electricity for:

- 3 or 4 high efficiency halogen lights (10W/hr.)
- AM/FM Radio (8W)
- Black and white TV (15W)
- VHF communications (marine band radio transceiver) (1W/25W)
- Small ventilation fan (12W)
- Small power tools and appliances
- Washing machine

* Domestic System II Components:

- 2 80 Watt PV modules (6 amp/hr.)
- 4 6V 350 amp/hour storage batteries
- 1 power center (with main, solar and load disconnects and fuses, charge controller, and low voltage disconnect)
- 1 DC to AC power inverter

Cost: \$2,193.17

III. Community Production System

During Phase I of the project, we will install one Community Production System. This system is designed to dry commercial agricultural products such as lumber extracted under the Osa Fallen Timber Extractive Reserve (OFTER) project, vanilla harvested by a local organic cooperative, fish, mushrooms, and other Non-Timber Forest Products (NTFPs).

Its basic configuration will consist of:

- 1 53W PV module
- 2 6V batteries
- 1 ventilation fan
- 1 passive solar convection drying chamber

Cost: \$1,034

CHRONOGRAM OF ACTIVITIES

January-March 1996

- * Phase I (Pilot): TUVA elaborates and concludes map with first 20 installations along the buffer zone corridor.
- * Forest conservation monitoring baseline established.
- * Easement contracts are prepared by AMBIO.
- * Construction of Solar Drying System.

April-May 1996

- * NRECA/ICE/SEESA elaborate logistic plan for installations.
- * SEESA delivers first 20 systems to the Osa Peninsula.

June-December 1996

- * Training of the Osa solar cooperative (Coopesol).
- * First 20 installations by NRECA/ICE/SEESA/Coopesol.
- * 20 conservation easements signed by owners, protecting 650 acres of primary forest.

December 1996

- * Program review and evaluation.
- * Forest monitoring starts.

January-December 1997

- * Phase II: Installation of 21 more systems, protecting 675 additional acres of forest.

January-December 1998

- * Phase III: Installation of last 21 photovoltaic systems. The 62 installed systems will in turn protect 2,000 acres of forest for five years along the biological corridor. Total estimated cost of the 62 systems is \$75,000.

FINANCING SOURCES

Current financing:

- The U.S. National Rural Electric Cooperatives Association (NRECA) of Costa Rica.
- Instituto Costarricense de Electricidad (ICE)
- Fundacion TUVA (Costa Rica)
- GEO (Germany)

Sources being contacted for financing:

- Biomass Users Network
- W. Alton Jones Foundation
- Turner Foundation
- Rockefeller Foundation

APPENDIX I

FINANCING ALTERNATIVES: SOLAR ENDOWMENTS AND SOLAR FOR NATURE SWAPS

Bajo un programa de subsidios ligados a la conservaci3n forestal, se han instalado hasta el momento 5 sistemas solares dom3sticos como parte del proyecto Piro. Este programa de intercambio de energPa solar por bosque funciona como un incentivo forestal que permite financiar a la familias un porcentaje (50% usualmente)) de la instalaci3n del sistema solar a cambio de una garantPa de conservaci3n de bloques de bosque. Estos bloques de bosque propiedad de las familias se colocan bajo contratos ambientales a los que se le asigna el valor del monto del incentivo por un periodo variable de 5, 10 o 15 aZos. Los bosques familiares se conectan a la vez entre sP creando zonas verdes autogestionadas a nivel grupal que aumentan la viabilidad ecol3gica de los ecosistemas y de la base de recursos.

Este programa piloto ha despertado gran inter3s entre los finqueros locales, ya que contribuye a dar un valor concreto a la conservaci3n del bosque virgen, atendiendo al mismo tiempo la necesidad b3sica de disponer de fuentes alternas de energPa en zonas remotas. Por otro lado, ya que la electrificaci3n rural es siempre una actividad subsidiada, este programa puede resultar de inter3s a los organismos gubernamentales y no gubernamentales interesados en estrategias concretas que faciliten al mismo tiempo la conservaci3n y el desarrollo rural.

INCENTIVOS A LA CONSERVACION FORESTAL COMPARADOS

Option A: After 5 years = 50 installed systems / 1000 Ha. of conserved forest

Option B: After 5 years = 125 installed systems / 2,500 Ha. of forest conserved

Option C: After 5 years = 250 installed systems / 5,000 Ha. of forest conserved

(Systems are purchased with interest of trust fund, capital remains untouched)

SOLAR FOR FOREST SUBSIDIES PER HECTARE/YEAR TABLE

SC TABLE						
# Ha.	Per Ha.	Per year	5	10	15	20
10	1000	10000	50000	100000	150000	200000
20	1000	20000	100000	200000	300000	400000
50	1000	50000	250000	500000	750000	1000000
70	1000	70000	350000	700000	1050000	1400000
100	1000	100000	500000	1000000	1500000	2000000
150	1000	150000	750000	1500000	2250000	3000000
200	1000	200000	1000000	2000000	3000000	4000000

INCENTIVES FOR FOREST CONSERVATION COMPARED						
PROINFOR	15	300				
Ha	Initial	Remaining	YLump	YEscrow	Tlumps	Tescrow
10	150	3000	210	210	1680	1680
20	300	6000	420	420	3360	3360
50	750	15000	1050	1050	8400	8400
75	1125	22500	1575	1575	12600	12600
100	1500	30000	2100	2100	16800	16800
150	2250	45000	3150	3150	25200	25200
200	3000	60000	4200	4200	33600	33600
SOLAR FUND	Interest	Number of Systems II under SC-2005 per year				
14000000	1960000	10	OPTION A			
35000000	4900000	25	OPTION B			
70000000	9800000	49	OPTION C			

APPENDIX II

System options and Installed Systems

SOLAR FOR NATURE PROGRAM			
Basic System I	Qty	Price	Total
PV 51 W	1	48928	48928
Trojan 105	2	12788	25576
Power center	1	27800	27800
Cables	2	695	1390
Appliances	n/a	n/a	n/a
TOTAL			103694
System II			
PV 51 W	2	48928	97856
Trojan 105	4	12788	51152
PC 800 W	1	150000	150000
Cables	2	695	1390
TOTAL			300398
System III			
PV 51 W	4	48928	195712
Trojan 105	8	12788	102304
PC 2500W	1	275000	275000
Cables	2	695	1390
TOTAL			574406
PIRO RIVER RESERVE INSTALLED SYSTEMS			
Miguel Sanchez			
PV 51 W	1	49067	49067
Trojan 105	1	21500	21500
Power center	1	27600	27600

Cables	2	690	1380
Lights	2	5004	10008
TOTAL			109555
Personal			0
SC-2005			100000
Balance			-9555
Porfirio Sanchez			
PV 51 W	1	49067	49067
Trojan 105	1	11537	11537
Power center	1	29885	29885
Cables & misc	2	695	1390
Lights	2	5004	10008
TOTAL			101887
Personal			40000
SC-1005			50000
Balance			-11887
Manuel Alonso			
PV 51 W	4	49067	196268
Trojan 105	6	12788	76728
Power center	1	151938	151938
Cables	1	2085	2085
TOTAL			427019
Personal			425040
SC-2020			0
Balance			-1979
Don Fidencio Sanchez			
PV 51 W	2	49067	98134
Trojan 105	4	12788	51152
Power center	1	100000	100000

Cables	1	2085	2085
TOTAL			251371
Personal			250282
SC-20020			0
Balance			1089

The TUVA Foundation

The TUVA Foundation is a Costa Rican non-profit organization working in the Osa Peninsula since 1990. It has received the support of national and international organizations like GEO, Greenpeace, Patagonia, Rockwood Fund, Robin Wood, Spanish Office for Indigenous Affairs and others.

The organization was founded by anthropologist Manuel Alonso, Ph.C., now Executive Director, and environmental attorney Eugene Brickleyer. Its Sponsors Assembly (12 members) elects the five-member board of directors and the executive director. It employs currently 7 people and has its central office in Puerto Jimenez de Osa. A certified public accounting firm and two attorneys on retainer handle the foundation's administrative needs.

The Fundación Tierras Unidas de Vecinales por el Ambiente (United Lands of Neighbors for the Environment) seeks to facilitate buffer-zone community conservation models by sponsoring integrated conservation and development initiatives that enhance the national capacity to initiate and carry out programs which deal effectively with the tensions between conservation and development.