

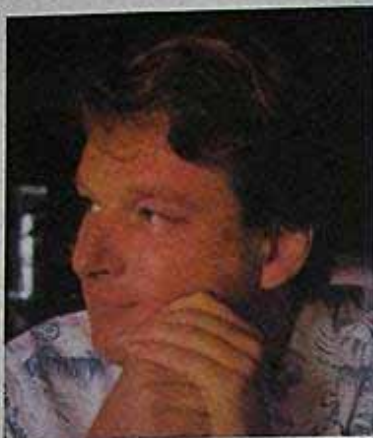


SOLAR HOME SYSTEMS

Clean, Renewable & Affordable
Electricity for the Countryside

A Documentation





FOREWORD

With the advance of the information age, we find the world becoming a smaller place as people get more interested in international affairs and seek their place and contribution to world developments. Yet many are still excluded from these developments as they are lacking in such simple services as electricity.

Fortunately, nations increasingly understand their responsibilities on an international scale and cooperate to jointly overcome development barriers. The Philippine-German Special Energy Programme is a bilateral cooperation between the Republic of the Philippines and the Federal Republic of Germany which was committed to improve the living conditions of rural households by introducing basic electrification.

Over a cooperation of more than eight years, the concept of Rural Photovoltaic Electrification was demonstrated, monitored and developed to a degree that can now be sustained.

My thanks go to the German Ministry for Cooperation for providing this consistent support, to the Government of the Philippines who saw the framework of this cooperation and encouraged the progress of the work on a widening coverage. Special thanks go to the partner organization NEA for being open to new strategies and for all the assistance rendered along the way, to the management of all Electric Cooperatives who provided their resources and their experience and most of all to the thousands of users who enthusiastically welcomed a new technology in their homes, for their trust and their cooperation.

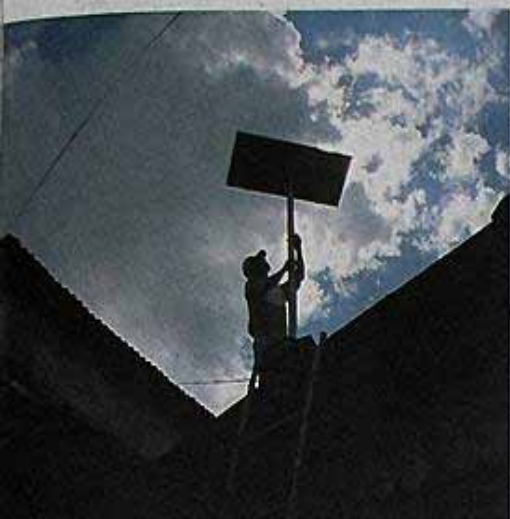
Salamat Po.

A stylized handwritten signature in black ink, consisting of a large 'H' and 'W' followed by a horizontal line.

Heinz-Wolfgang Bohnke

SEP Adviser

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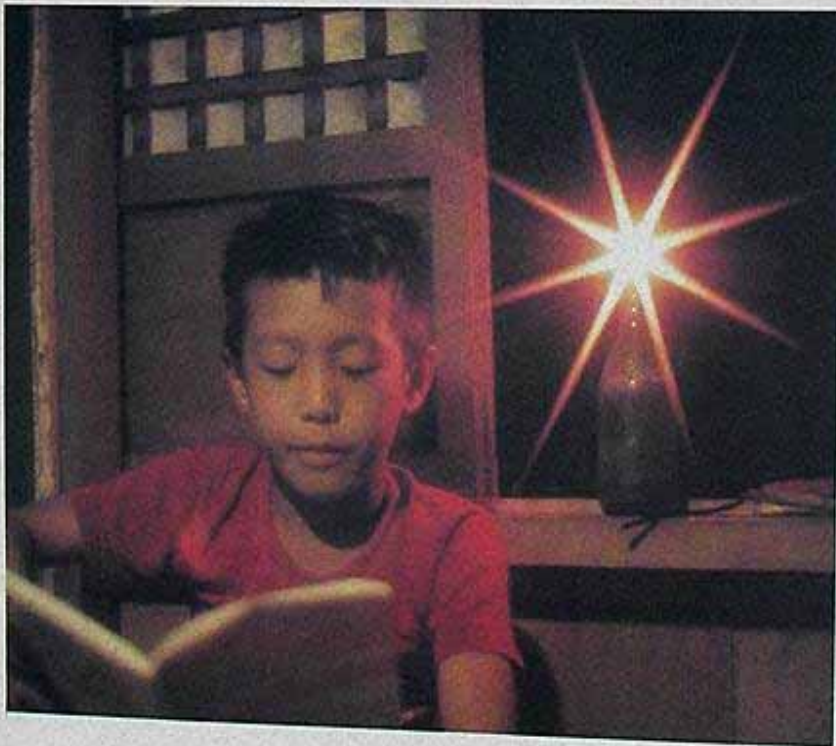
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Light and Progress

In the information age, many rural children still struggle with homework by flickering wick lamp.



In any part of the world, lighting signals progress because it increases productive time, permits business to continue beyond daylight and provides security as well as opportunities for leisure and entertainment. In the last two decades, newly industrialized countries have made exceptional advances requiring substantial investments in the critical infrastructure of electricity. But despite the efforts, a vast potential of productive and creative time is lost for fully one third of the world's population living in rural areas where the day ends when the sun sets.

Since we've all experienced times without electricity it is possible to imagine the implications of living everyday without electricity at all. That's how one third of the people on this planet live all the time. Thus one of every three persons has limited options for improving his living conditions and contributing to economic growth. And the options keep decreasing as the world's population climbs at a frightening rate.

The following pages document the steps taken in the Philippines to bring basic electrification and its consequent advantages to rural areas where a public grid, for the present, is neither possible nor feasible.

Isla Verde.
Lushly green by day,
dark by night until
PV-Electrification
came ashore.



The Challenge of the Philippine Countryside

Countryside development in the Philippines is challenged with a strange contrast. On one hand, the country is one of the world's most beautiful—with seven thousand islands, flung like the jewels of a chieftain across the South China, Philippine and Sulu Seas. People from temperate zones yearn for their paradisiacal white-sanded beaches, rimmed with wafting palm trees, and days of endless sun.

On the other hand, this dispersed topography is a nightmare for any infrastructural development. In a nation where even the industrial centers have severe difficulties meeting the electricity demand, it is not surprising that the numerous islands and mountainous interiors are last in line for grid services.

As a consequence, more than twenty-five million people, of the Philippine population of 65 million, still live without a basic electricity service. Under the prevailing circumstances, they cannot hope to be connected to public power for many years to come. So they resort to other simply available sources of energy.

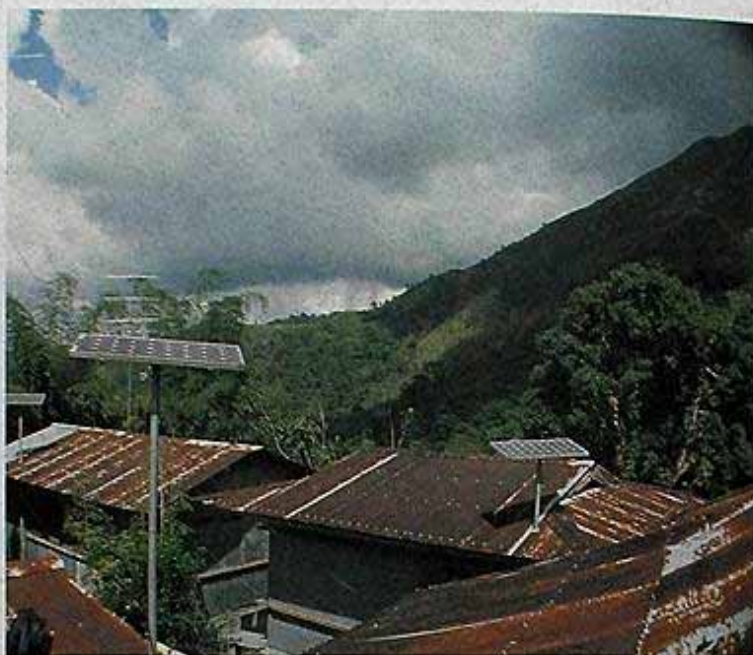
But all the present choices leave much to be desired: smoking candles or wick lamps, clumsy pressure lamps, or an occasional small diesel generator which will deliver its loud, erratic schedule three or four hours daily, barring breakdowns.

This situation contributes little to improve the living conditions and development in the countryside. Indeed, many decide to migrate to the cities and in the process, add to the swollen masses of the urban poor.

A power supply would be all it takes to integrate rural folks in national development, give them a window to the world, and provide the highly attractive services they continue to demand from a progressive government.

The Solar Advantage

Even on cloudy days solar panels gather enough energy for a household's daily needs



The concept of Solar Energy has been explored for centuries. The Nobel Prize winning French physicist Antoine Henri Becquerel first described the effect in 1839. A few years later, Albert Einstein also explained the theory which is known today as *photovoltaics*.

But it was the coming of the space age that accelerated the development of highly reliable converters of solar power, and soon scientists and engineers were exploring the technology to use the sun's free and readily available energy for worldwide application.

In recent years, the concern for sustaining the environment has stimulated a heightened interest in developing the clean power of photovoltaics—

also known as PV — for larger scale usage.

Experts agree that the most promising application of solar energy as the technology exists now, is as it is used in the Philippines, to bring lighting and information to many people who live away from the urban centers.

For this segment of society, the technology is no less than Godsent. Photovoltaic converters turn natural light into electricity and even on cloudy days, PV panels gather enough energy for a household's basic daily needs and store it in simple batteries for use at any hour of the day or night.

The Solar Home System is a household-size PV

generator and comprise of: a solar panel, a battery for storing energy, a charge controller, and a choice of energy efficient appliances.

The advantages of solar power are numerous. It eliminates the need to transport fuel or traverse distances to charge a battery because the energy source is as close as the dawn of each new day. It is silent, clean and odorless, convenient to use and relatively easy to maintain. It is also much safer than grid electricity and less of a fire and health hazard than kerosene lamps.

Furthermore, it costs less and has none of the environmental repercussions such as cadmium or mercury poisoning of the soil or water.

A Partnership to Bring Light to the Countryside

In 1987, the Philippines entered into a cooperation with the German Ministry for Economic Cooperation (BMZ) in a program entitled "Environmentally Friendly Electrification of Rural Households with Renewable Energy Systems". This partnership was to be executed by the National Electrification Administration (NEA) and the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) with the objective of developing strategies to provide remote Philippine communities with opportunities for improving rural living conditions. By introducing a viable electricity service with renewable energy, the SEP was to help rural families increase their productive time beyond sunset and open to them invaluable windows of information.

One of the early SEP projects was the solar electrification of Isla Verde, off the coast of Batangas at the mouth of Manila Bay. Until the project, the islanders suffered all the inconveniences and danger of the various expensive, health hazardous and environmentally destructive electricity substitutes. Now the island's ten thousand residents enjoy living in the nation's solar energy showcase.

Isla Verde was a community based approach. GTZ worked with the Verde Island Solar Power Association (VISPA) to help develop the island's

infrastructure including water supply, and trained the women to manage cooperative stores. This partnership encouraged confidence in self-help activities that in turn, led to confidence in the technology.

The Special Energy Programme demonstrated a variety of solar applications on Isla Verde. This included several battery charging stations, a central power supply system, and hundreds of Solar Home systems. The programme has significantly changed the lives of many and empowered people to take charge of their lives and improve their lot.

Dwarfed by banana leaves, this small solar panel lights up this beachfront at night.



Solar Power to the People

The demonstration at Isla Verde provided many valuable experiences about the acceptance, use and maintenance of PV technology. From there, the GTZ partnership began working to expand the program to the national level. Partners of SEP in this venture were a selected number from the one hundred and twenty Rural Electric Cooperatives operating in the country, under the supervision of the National Electrification Administration.

These utilities identified as consistent top performers pioneered the **Rural PV Electrification** concept in three pilot areas: Ilocos, Panay and Mindanao. These areas were chosen because they had different climatic and socio-economic conditions but are all known for their economic potential. Each step of this process was meticulously planned, consulting the partners along the way with the use of ZOPP, GTZ's internationally known participatory method of strategic planning and problem-solving.

Lighting that stays on through typhoon weather goes up in a mountain village street.



SHS

From all PV appliances demonstrated in the field, Solar Home Systems clearly emerged as best suited for the purpose of basic electrification. They proved significantly more manageable and economically viable than Battery Charging Stations and centralized PV supply. Thus, they were most popular with the rural families.

The results of the pilot phase were very encouraging and brought many important lessons on how to efficiently apply the RPE concept.

In expanding from the pilot phase to a nationwide application, the widest potential is seen in a dissemination involving the RECs.



Where wheels can't go, a household's entire power source is carried in under one arm.

However, the concept works best with the active participation of private enterprise to provide supply and service. Also, NGOs were found to be valuable extensionists when assisted, as in the case of Verde and Gregorio del Pilar in Ilocos.

Recently, the initiative ProSolar was formed to join NGOs and the private sector in developing PV electrification projects which complement the public projects of NEA. ProSolar aimed to introduce a target-oriented market approach and to establish product and installation standards.

The SEP did not only support and coordinate the roles of the various project implementors there was also a strong involvement in networking with national and international organizations, ranging from the German Development Service (BED) to the Asian Development Bank (ADB). In 1995 it was proud to witness the founding of the Philippine Section of the International Solar Energy Society which will bring the Philippines even closer to the international solar mainstream.

Meanwhile, SEP has earned international recognition for its success in making the Philippines the first country to implement a PV scheme which provides full cost recovery.

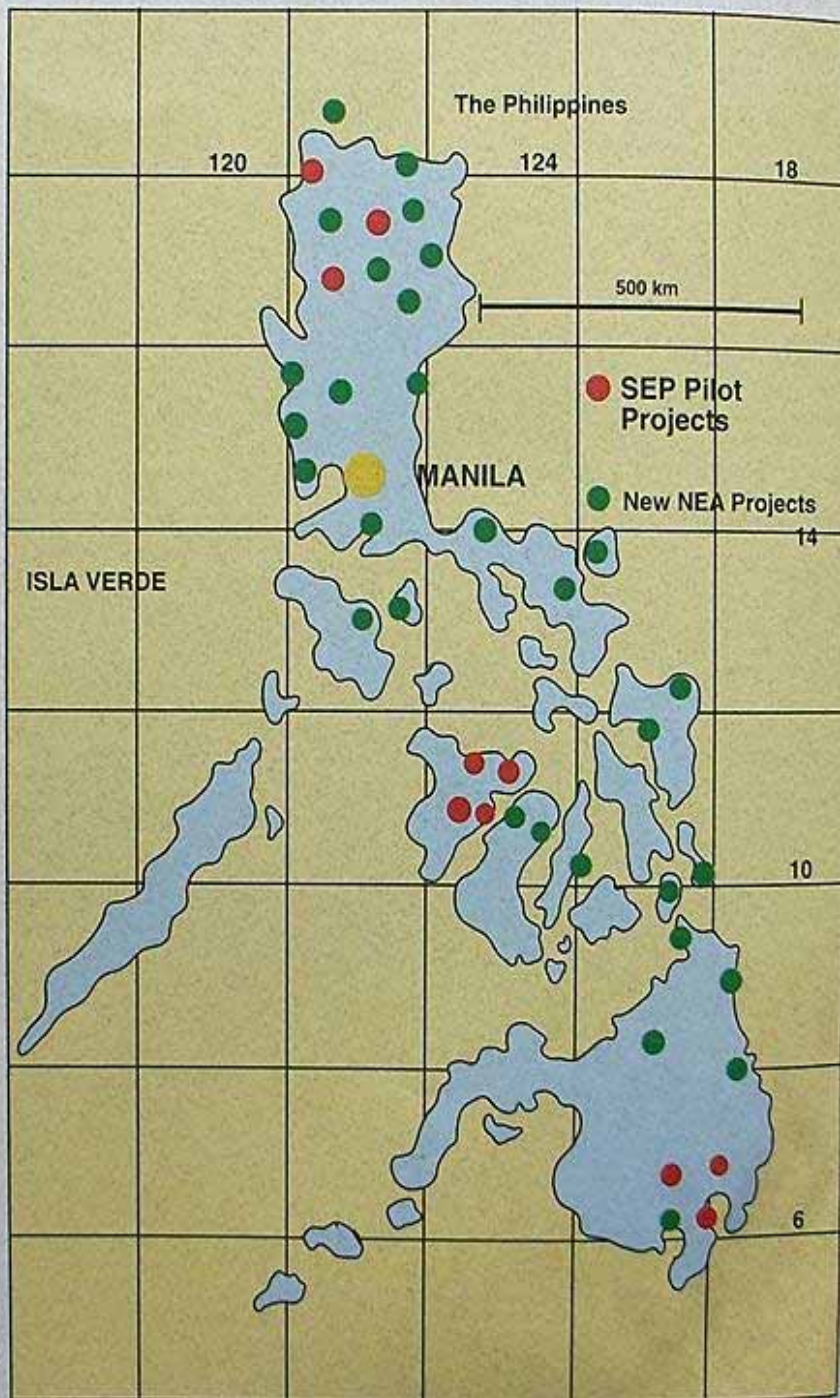
Achievements Through Cooperation

Rural Photovoltaic Electrification in the Philippines:

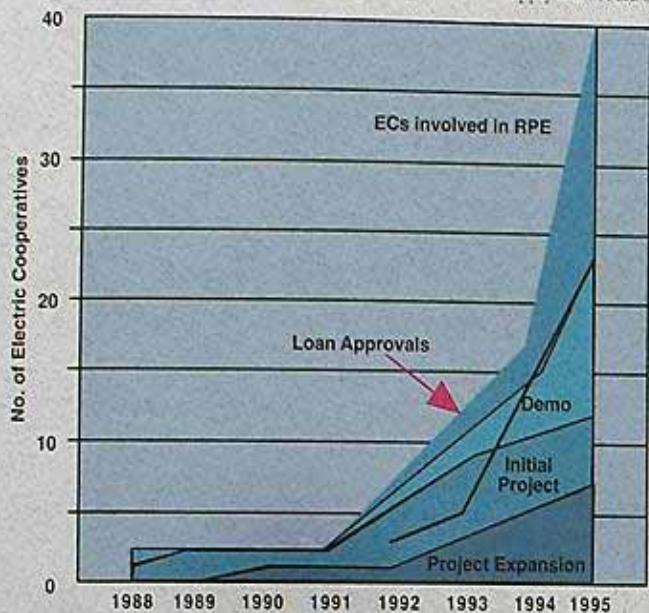
By the end of 1995 the cooperative endeavor can be considered to have established confidence in the PV electrification concept as it is widely adopted by the Electric Cooperatives. Pilot projects in three areas with an initial 10 ECs demonstrated the implementational feasibility and sustainability. PV systems have earned the reputation to work reliably and their service to be satisfactory and affordable to the users. As a consequence, PV electrification projects are now receiving additional national funding.

The Philippines is the first country to incorporate PV electrification as part of its mainstream electrification activities. The National Electrification Administration has already began its own extension of the solar electrification program to more remote areas. As of today, 41 ECs have proposed RPE projects to be replicated by NEA and pave the way for a full-scale Rural Photovoltaic Electrification program.

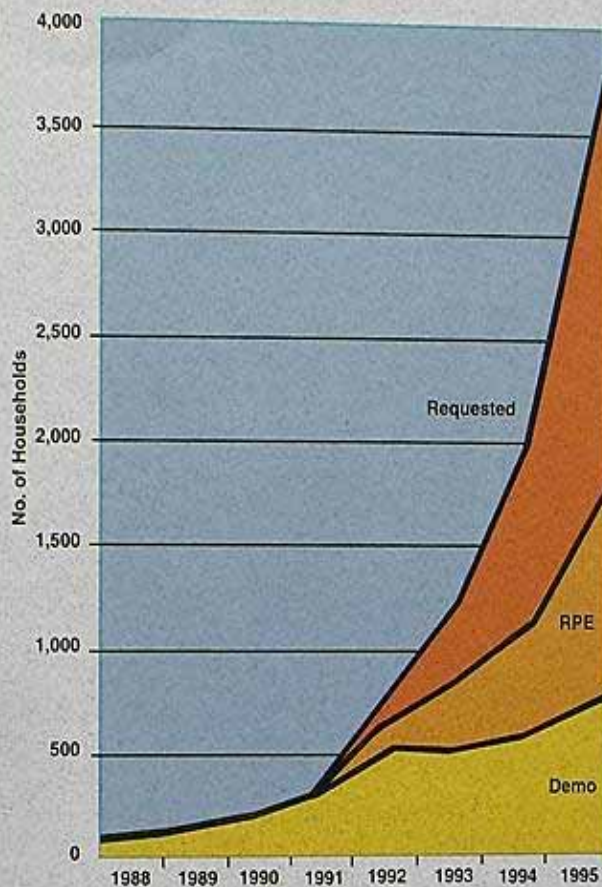
Following the example of the SEP Pilot Projects, there are now 41 Electric Cooperatives with new project proposals



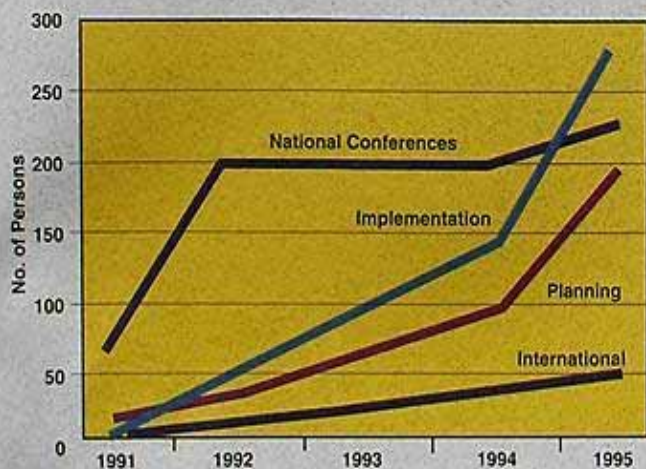
Rural Photovoltaic Electrification was found to be the most dependable option to serve small loads in remote, dispersed settlements. For the utility, this means cost recovery, so the concept is sustained and carried forth by the Rural Electric Cooperatives. For the user, this means they can avail of the experience and service of the power professionals and access to the energy sector's favorable financing conditions. For instance, the service fee for a PV system is less than \$ 75 which is no more than what the family would spend monthly on the dirty and hazardous fuels before solar energy became available. As a consequence, there were always more households requesting for the PV supply than could be met by a developing project structure.



The 41 ECs are in different stages of project development ranging from site appraisal to expansion. ECs independently procure, plan, install and operate PV electrification. NEA continues to provide the required financing.



To date, PV electrification systems for 1,716 households in 93 villages were provided under the SEP. In addition, requests for 1,918 installations were received in 1995. Ever since the beginning of the RPE in 1992, the installations and requests increased exponentially from the former levels.



In order to achieve and sustain this success, hundreds of people have to be trained, and technical, financial and institutional issues have to be addressed. The capacity building activities of the SEP included a total of 813 technical staff, implementors and executives. They participated in training programs, held regionally, nationwide and internationally.

The Technology

Applications

Photovoltaic cells are one of the most versatile power supplies as they cover the range from megawatt to milliwatt. The PV generators demonstrated in the Philippines ranged from 13 kWp down to 20 Wp and the supply concepts included centralized power plants to individual home systems.

The **centralized power supply** distributes AC electricity via a small grid to a clustered community. Significant improvements were achieved over time with the availability of efficient inverters, controllers and lighting. This resulted in smaller size generators and a simplified operation. Yet the recovery and the replacement of the batteries lead to power costs that can hardly be met by the users.

Battery charging systems are a centralized service to pay-charge automotive batteries of individual consumers. SEP found that the most efficient design is a 200 Wp generator which can charge one battery a day and can serve a small community of up to fifteen households. Payment would be based on an Ah counter which would meter the actual energy charged. Although this concept allows a commercial operation, the risks of costs recovery are still perceived high.

Solar Home Systems provide an individual energy supply for the household. A solar panel of about 70 Wp was found sufficient for the needs of most families with 3-5 lights, radio and TV. SHS turned out to be the most popular supply concept and with the various financing models developed, were found to be within reach of a large number of rural consumers.

Solar lanterns are a recent addition to the above supply concepts and are affordable to most rural households. They offer one efficient light and an optional radio plug. Lanterns last for up to four days and can be recharge commercially on a single panel facility at costs which are even lower than those for kerosene lanterns. Since solar lanterns are mobile, they can be used all over the house and outdoors for garden work and fishing.

A popular and very simple solar appliance are **streetlights**. As a public service they give safe lighting e.g. in the village center and were found to be very popular for community activities.

A very attractive application for solar systems is **television**. This ranges from simple B&W TV sets accessing the national TV networks up to satellite receiver units bringing the world's events to the most remote places in the country.



Central PV Plant, San Agapito, Isla Verde. 6000 Wp serve 220 VAC to 28 households via a 1 km grid. Later improvements rendered the same service level with a 2000Wp generator.



Battery Charging Station in Baccara, Ilocos Norte. The simple 200Wp unit is a neighborhood concept and operates commercially at \$1 per battery charge.



Solar Lanterns in Apid Island, Leyte.

A single panel can charge 6 lanterns a day which then are used by the fisher folk in and around the house for up to four days.

Solar Home Systems in Gregorio del Pilar, Ilocos Sur. The 70Wp system with five lights is the pride of the tobacco farmer's household.



Community streetlight in Sablayan, Mindoro. A 53 Wp panel operates 11W compact fluorescent lights all night. The simple design combines all electronics in the sealed light casing.

Caption: The television set signifies that for this family in **Malangabang, Iloilo**, development has at last, reached their home. Some even invest in a satellite receiver to enjoy a window to the world.



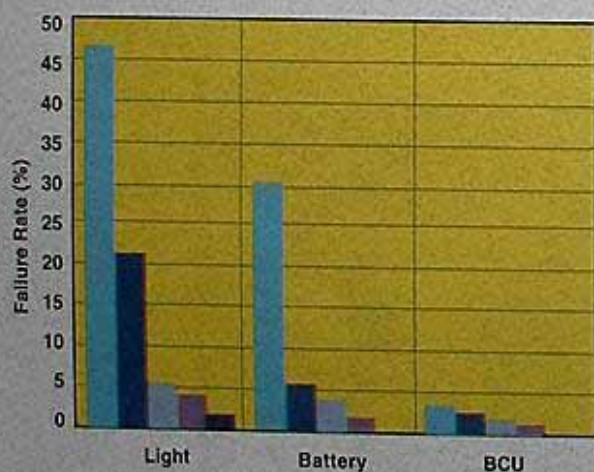
Components

The quality and reliability of all the components of solar systems is of utmost importance because in remote locations, the failure of the smallest part may cause long service interruptions, and replacement may become very expensive. Immature components can eventually jeopardize an entire project. The SEP made it a point to test every part before installation and set up a full-scale monitoring programs to stimulate continuous improvement by identifying technical problems as they were reported from the field.

The result is very positive. While there are still striking differences in the performance of the components, all turned out more reliable and longer-lasting than originally expected. Monitoring revealed that unharmed by severe rural conditions, even the sensitive batteries and lights showed higher than 90% availability after more than 24 months of operation if quality components were used. Unquestioned is the high performance of PV panels. They are guaranteed for ten years, but may last much longer.

An important consequence of this material scrutiny is that the spin-off of local manufacture is encouraged. In the last three years alone, SEP purchased over P28 million worth of solar equipment from Philippine suppliers providing a significant market stimulus. Meanwhile all PV system components except the solar panel are manufactured locally and the quality matches international standards.

The SEP was able to significantly contribute to the standardization of PV components and the improvement of product quality in the Philippines. To sustain this standard, test procedures were developed jointly with the Fuel and Appliance Test Laboratory (FATL) of the Department of Energy which will be available to perform compliance testing of PV components.



Component performance after 24 months for different brands.



Solar batteries manufactured in the Philippines. Old batteries are returned with a \$4 deposit and recycled.



Battery charge controllers tested in the Philippines.



Solar lantern manufactured in the Philippines.



Solar grade light fittings manufactured in the Philippines.



Solar lights tested in the Philippines.

Dissemination Models

When the technology has been proven reliable, the key to widespread dissemination is to make the technology accessible to the users. This addresses the organization and the financing of PV electrification projects. The SEP was in the rare and fortunate po-

sition to help implement a number of projects which would differ from the international setup and the financial parameters. Observing these models over some time helped to find the organizational requirements and the terms of financing which are accept-

able and affordable to people. The projects carried out with the NEA and the Electric Cooperatives (ECs) and with various NGOs and commercial suppliers (CS) can be categorized under the following models:

Function	Actor	CP	BCS	A	B	C	D	E	F	G
Financing	NEA	X	X			X	X	X	X	X
	CS User			X	X					
Operation	EC			X	X				X	X
	CS NGO	X	X			X	X	X		
Ownership	EC User	X	X	X	X	X	X	X	X	X
Payment	Terms									
BOS	COD	187	158	158	158	- / -	158	158	158	158
Generator	Loan	1,113	397	538	538	619	462	462	462	- / -
	Interest	12%	12%	- / -	22%	12%	16%	16%	12%	12%
	Period	120 m	120 m	- / -	36 m	36 m	36 m	3 a	120 m	120 m
	Payment	16	11	COD	20.6	20.6	15.4	169	6.5	2.0
<i>Life Cycle Cost (based on 10 year operation, discount rate = price increase = 8%)</i>										
Service-Cost	0.77 / m	1,950	1,415	1,091	1,212	1,055	1,043	1,016	1,065	690
	2.30 / m	2,042	1,497	1,275	1,397	1,239	1,222	1,192	1,192	817

Table 1: Institutional and Financial Dissemination Models

For comparison all models are based on equal level of service (3 lights, 4 batteries daily). The first columns represent a Centralized Plant (CP) of 6.2 kWp with 1 km distribution line serving 40 households and a Battery Charging Station (BCS) of 230 Wp serving 3 households. Columns (A) to (G) represent SHS: (A) is a simple commercial cash sale, (B) a commercial loan, (C,D,E) show soft loans at three years, (F,G) at 10 years duration. (C) would require no downpayment for the BOS. (E) has yearly advance payments at one-month discount. For (G) the first generator cost comes from a national subsidy. Amounts are in US\$.

The Rural Photovoltaic Electrification Scheme (RPE) finds the widest application in the Philippines. It is implemented by the NEA and the Electric Cooperatives.

The main RPE feature is that the ECs own and operate the solar generators, finance them on long-term loans and offer them to consumers as an electricity service for a flat fee. Financing involves \$462 for the solar panel, mounting, controller and house-connection loaned for 10 years at 12%, resulting in only \$ 650 monthly amortization. Plus \$ 0.77 for operation and maintenance. The household pays a service fee of \$ 7.27 monthly and runs typically three lights, a radio and often a TV set. The service fee offers full cost coverage and

requires no subsidization. It is mostly lower than the equivalent expenses of kerosene for the commonly used pressure lamps. ECs in some depressed areas can avail of a national subsidy which allows for even lower fees as it does not need to serve debt payments but only cost recovery.

The lower table shows the financing terms applied and the depreciated life cycle cost. This shows how much a household, in today's money, would pay for the electricity service over a period of 10 years. The most favorable financing are short term soft loans (D, E) which are offered by the Development Bank of the Philippines. They show good collection efficiencies and are popular in areas where users would not expect line electrification. These loans

are at an advantage as long as the service cost is low. Higher service cost favors the RPE: at \$ 2.30, (F) breaks even with (D). When service becomes more expensive in difficult terrain and dispersed installations, the RPE is the least cost model.

RPE is a service concept as the operation cost is already covered by the monthly fee. This facilitated the implementation and is the reason why RPE counts for the majority of the Philippine installations.

In conclusion, projects with low service requirements will prefer short-term loans which can be managed by commercial suppliers or NGOs. Projects in difficult areas will prefer RPE schemes operated by the ECs.

USER SATISFACTION

Few development activities have such an immediate impact on the life of rural citizens as PV electrification. The technology becomes part of the household and the day-to-day life. This brings about freedom and responsibilities. The freedom of having electric lights was found to move daytime chores to evening and free more time for productive tasks. Women in particular appreciate the benefits because looking after the family becomes easier and children were observed to devote more time to their studies. The enhanced availability of information also contributes greatly to the education of mature citizens. TV provides a true window to the world with news and children's programs receiving clear priority over sports and entertainment. However the responsibility of operating a new technical device is not within everybody's range of talents. Simple operations and maintenance needs, and proper information were therefore identified as critically important. This task of providing practical information to each and every participating household is huge and should not be underestimated.

The responsibility to pay for the electricity was generally taken seriously. Even less affluent households would willingly spend more than 10% of their cash budget if the service is satisfactory. For most of them the SHS was the first public service they have ever enjoyed. With options limited to awesome and expensive conventional energy means, and the electrical grid out of reach, the PV service was appreciated for its all-day availability and its safe and reliable operation. In addition, PV was considered cleaner, healthier and less dangerous than line electricity. As an encouraging result, PV-users were more satisfied with the service than the grid-users.

UTILITY SUPPORT

PV technology offers the power sector a tool to push the limits of rural electrification. Where grid connection of remote places used to incur substantial losses both for the installation and the all-over operation, PV electrification now provides

the least cost option.

The sector's favorable financing options and experienced electrification professionals are valuable assets for successful dissemination. Rural power companies subscribing to the responsibility of electrification services and customer satisfaction can greatly enhance the coverage. This will not preempt extension. Since the PV generators are owned and operated by the utility, they can easily be transferred to farther areas should a community receive access to the main grid.

PV electrification adds new tasks and responsibilities to the utility's services but the staff was found to go to great lengths with these duties if backed by management and properly trained. This requires that tools and materials are available, and that comprehensive training is conducted on all management levels down to the electricians and service technicians in the villages. With the training and capacity building offered by the SEP, utilities could manage the technology efficiently and solve problems of electricity supply to remote locations.

POLICY PROMOTION

The Philippine Government promotes renewable energy as an auxiliary supply source and has, very early, decided to pursue photovoltaics for rural electrification. Solar energy is indigenous, non-depletable, and environmentally benign. PV household electrification in particular, sustains a sound environment as it avoids alternative emissions from small diesel sets and kerosene lamps.

The economic advantages of the utilities translate to even more benefits on the macro-economic level. Targeting 80% electrification in the Philippines would require substantially less foreign currency for PV electrification than for conventional electrification. On the other hand it will demand more management skills and higher input of local labor. The Government can thus substitute expensive power facilities with local knowledge. Committed to rural development, Government has an option to offer a basic service to the 25 million people who are waiting to be energized.

Without access to electricity, the disadvantaged are left hopelessly behind in an information society that continues to advance at breakneck speed. But by bringing basic electricity to rural homes, we can further the education of citizens and make them aware of their role in the planet, no matter the fact that they live in physical isolation. Education in general takes a quantum leap forward as distance becomes irrelevant.

When the modern world enters the modest homes of simple rural folks, it connects them with the rest of society, interests them in things they have never imagined such as art, history, world trade, and politics, or simply makes them aware of global issues that affect them personally, such as the greenhouse effect or population control.

Through the power of solar energy, we can witness the birth of a real global village and transform the "development" into more than just a word.



Literature

During the recent five years, the SEP has commissioned numerous studies on the subject of renewable electrification, has presented and published the results on an international level and has developed manuals and training materials, in print and video, to help further sustain the program.

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- SEP (7/94)** Proceedings, RPE Project Monitoring, and Evaluation Workshop, Manila
- Bohnke HW (3/94)** PV-Verbreitung im kommerziellen Umfeld, Energie Aktuell No. 14, Eschborn
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- Bohnke HW (10/95)** The Solar PV Solution in rural Electrification, Proceedings, Course on Evaluation, Development and Financing of Renewable Energy Projects, Preferred Energy Investments, Manila
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- SEP (12/95)** Fostering RPE Sustainability, Proceedings 3rd Evaluations/Planning Workshop on RPE, Baguio
- SEP (12/95)** Guide to Project Financing, Manila
- SEP (12/95)** Guide to PV Project Development, Manila
- SEP (12/95)** The Philippines-German Special Energy Programme Accomplishment Report, Manila
- SEP Special Energy Update, The Newsletter of the SEP**
- (2/95) 1.1 - Background on SEP's PV and Mini-Hydro Projects**
- (5/95) 1.2 - Rural Photovoltaic Electrification Scheme**
- (7/95) 1.3 - Private Sector and NGO Involvement in PV Dissemination**
- (10/95) 1.4 - International Conference on RPE in Iloilo**
- (4/95) 2.1 - Mini-Hydro Projects**
- (10/95) 2.2 - Special Projects**
- (6/94) 3.1 - Training Activities**

VIDEO PRODUCTIONS

- Probe Team (10/92)** Rural PV Electrification
- BMZ (12/93)** Hope for Millions
- S&T (4/94)** Isla Verde Story
- SEP (8/94)** A Technician's Guide to SES Installation Training Video NTSC/PAL, Manila
- Inside Story (3/95)** A Ray of Hope
- SEP (9/95)** First There was Light, Promotional Video, Manila

Phillipine-German Special Energy Programme Project History

- 1971** The Government Agreement on Technical Cooperation between the Republic of the Philippines and the Federal Government of Germany was signed.
- 1981** The agreement on the *Philippine-German Solar Energy Project* was signed. Objectives were R&D on centralized and decentralized photovoltaic village power supply and demonstration installations.
- 1986** The agreement on the *Philippine-German Special Energy Programme* was signed with the National Electrification Administration and Deutsche Gesellschaft für Technische Zusammenarbeit as implementing partners.
- Phase 1** Started in 1987 and aimed at demonstration installations. Projects done in the '87-'91 period were the Solar Electrification of Verde Island and the Mini-Hydro Power Plant in Matutinao.
- Phase 2** Started in January 1991 with new advisory and accomplished the development of the Rural Photovoltaic Electrification scheme in cooperation with the ECs. In November 1991, the Programme was formally endorsed by the NEA Board of Administrators which opened the door for a nationwide implementation with the ECs. RPE was first implemented in Iloilo and Guimaras.
- Phase 3** Started in January 1993, focusing on further pilot dissemination projects with selected RECs, NGOs and the private sector in focal areas. The main objective was to obtain proven strategies for using photovoltaic systems in rural electrification. Accomplishments in the three-year period involved more than 1,700 remote households energized and 42 ECs ready to implement Rural PV Electrification projects in their area of responsibility.

IMPLEMENTORS



PARTICIPATING ENERGY SERVICE PROVIDERS

Capiz Electric Cooperative • Cotabato Electric Cooperative • Davao del Norte Electric Cooperative • Del Pilar Solar Power Association •
Gulmaras Electric Cooperative • Ilocos Norte Electric Cooperative • Iloilo II Electric Cooperative • Iloilo III Electric Cooperative • Kalinga
Apayao Electric Cooperative • Verde Island Solar Power Association • Zambales I Electric Cooperative

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