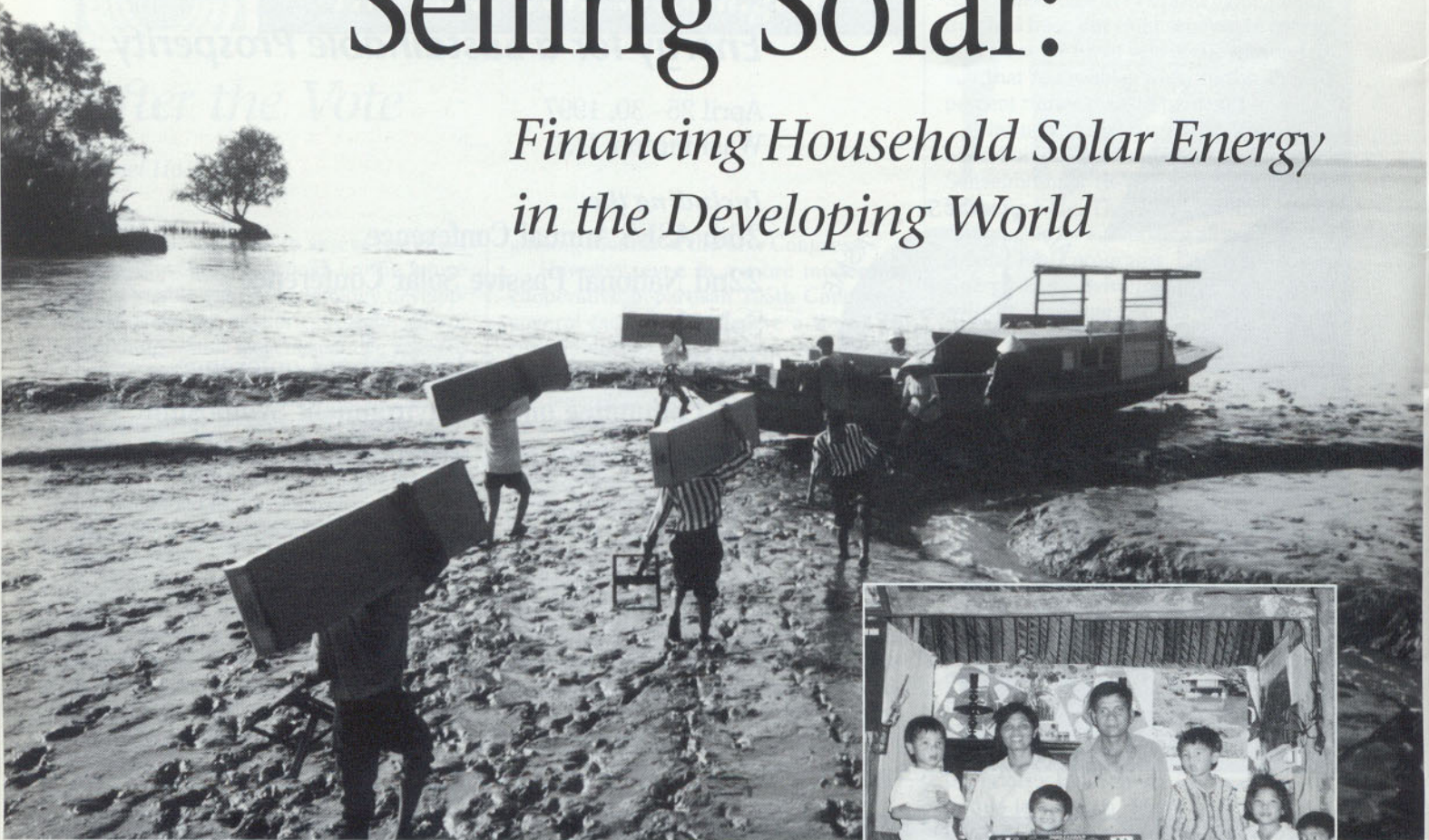


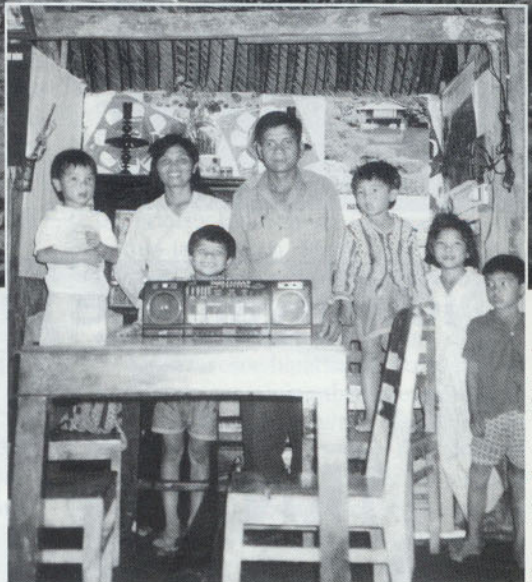
Selling Solar:

Financing Household Solar Energy in the Developing World



Household-scale solar photovoltaic systems can provide cost-competitive basic electric services to millions of households around the world.

BY MICHAEL F. NORTHROP



Photos: Solar Electric Light Fund

As the 21st century nears, some two billion people—70 percent of the population in the developing world—still rely on kerosene, fuel wood and batteries for light and power. In these 400 million households, noxious fumes are a serious health risk, families are prevented from engaging in home-based income-earning activities after dark and children who are unable to do homework at night are handicapped in school.

Many governments have responded to rural needs with aggressive electrification programs, only to find they cannot afford the massive power plants required or the cost of running wires to the thousands of villages that are off the electrical grid. Even if the grid could be extended to rural communities, most end users would not be able to afford the monthly tariffs for electricity. And extending traditional fossil fuel-based electrification to all those households would exacerbate global climate changes and produce dangerous levels of acid rain and pollution.

Household solar power systems represent a clean, climate-friendly alternative for rural electrification. Over the past five years, remarkable advances have been made in the economics and technology of solar photovoltaic (PV) cells. Costs have declined by more than two-thirds and efficiency has more

◀ **Unloading a boatload of solar home systems in rural Vietnam. Inset: After installing a small solar home system, this rural Vietnamese family enjoys the benefits of electric light, radio and TV.**

than doubled. Given these improvements, the widespread use of household solar units (which can operate several fluorescent lights, a television and a small appliance for up to four hours) is now a viable option. PV units are cost-effective relative to other available energy sources, far cheaper than grid extension and profitable for companies to provide. Model projects in several Asian countries and the Caribbean have shown that demand for these systems is high and that rural households can afford them if financing is available.

Creating Market Infrastructure

Why, then, aren't private markets rushing to take advantage of this huge opportunity? There are several reasons, but perhaps most important is the fact that no market infrastructure yet exists to handle the required capital flows. The current infrastructure, which supports the construction of multimillion-dollar power installations, relies on single-point lending and investment (where all the financing activity converges around a single large project). It is not an appropriate model for financing the purchases of small, inexpensive solar systems by millions of widely dispersed rural households.

To analyze challenges to the development of a photovoltaic solar home system (SHS) industry, Environmental Advantage (EA), a private finance and investment firm in New York, researched case studies of solar projects in Indonesia, Kenya, Sri Lanka and Zimbabwe. Over the last ten years, most nonprofit development organizations concerned with rural solar electrification have concentrated on completing standalone demonstration projects, not on developing a solar industry.

Many of these projects, as EA found in its case studies, have lacked the basic components of good business. Furthermore, the emerging industry—including manufacturing, sales, delivery, finance and maintenance—has been plagued by poor access to capital. EA also discovered that in areas where demand for solar equipment already existed, non-market driven projects dependent on subsidies or grants stifled the natu-

ral development of businesses by undercutting their ability to sell or finance equipment at market rates.

Three finance-related concerns stand out as being critical if the SHS industry is to grow successfully. First, purchasers of solar systems must be able to obtain credit from banks or from distributors. Second, manufacturers and distributors must be able to secure working capital if they are to provide credit to customers. And third, investors need credible financing opportunities to move capital toward the solar industry.

Purchaser Credit

The need for purchaser credit becomes clear when one compares the purchase of a solar home system (at \$350-\$700) by a rural household in a developing country with the purchase of an automobile by a household in an industrialized country. In the case of the car purchase, a well-established financial infrastructure links customers to manufacturers to capital markets and a wide array of financing choices are available from banks, leasing companies and dealers.

But in the SHS market, financing is unavailable and a customer typically must pay the full price up front. Imagine the negative effects on the automobile industry if every customer had to pay the full cash price. And imagine the positive effects on the SHS industry if the same financing options available to car purchasers were available to solar home system buyers. Although the situation varies a great deal from country to country, studies indicate that only about 5 percent of rural households in developing countries have the ability to purchase a system outright with cash and that various forms of financing would allow another 50 percent to enter the market.

A broad-based credit operation already exists in Indonesia. An Indonesian SHS company called Sudimara Solar provides 5000 customers with financial assistance. In spite of Sudimara's 100 percent payback rate from customers, it has been unable to get Indonesian banks to provide credit independently because the SHS industry is still so new that banks remain wary. Other solar business developers, including New World Power (in Lime Rock, Connecticut) and Enersol (in Chelmsford, Massachusetts) reported encountering the same reluctance from bankers. Lenders are not likely to become involved on a broad scale until more projects like Sudimara expand and are replicated elsewhere, building greater lender awareness and confidence.

Soluz, a for-profit entity affiliated with Enersol, is experimenting with a different kind of financing technique—a leasing scheme—in the Dominican Republic. Nearly 1000 poor rural households will be hooked up to solar systems tailored to their individual needs. Households will pay just a few dollars each month for the service, even less than they would owe if they had purchased a system on credit.

This is an unusual arrangement because conventional wisdom holds that households that purchase systems will take better care of them and pay for them in a more orderly manner than households that lease systems. So far, however, Soluz's collections on its leased units are at 100 percent and there have been no major care and maintenance problems. Within a year, Soluz hopes to have gathered enough financial data to approach investors for capital to replicate this model. Some solar commentators are now speculating that leasing could be the distribution model of the future, especially in poorer countries, and that it will make solar home systems even more available to the rural poor. In fact, it is comparable to how most end users pay for electricity—not with a large upfront outlay of cash for a new power plant, but through small monthly usage fees.

Working Capital for Manufacturers and Distributors

From the point of view of manufacturers and distributors, growth in sales has been slowed by the lack of working capital needed to provide more systems and more credit to customers. Sudimara, for example, is ham-



A family in Sri Lanka shows off its solar home system.

Solar Electric Light Fund

pered in its ability to finance customers' purchase of more systems by the fact that its own capital is tied up in solar equipment. In addition to being reluctant to provide credit to individual solar purchasers, banks have generally also been unwilling to provide working capital to the SHS industry. This has limited the growth of for-profit enterprises like Sudimara and others.

Nor are more sophisticated financing schemes available—like the purchase of loans by third parties, which is common in U.S. debt markets. To develop alternative financing options that could provide SHS manufacturers and distributors with working capital, companies like Sudimara might bundle and sell its receivables to a factor or outside investor. The investor would be given a percentage of the interest paid by purchasers and Sudimara would be able to provide financing to another round of customers. If payback rates remain as high as they have been for Sudimara in the past, this arrangement could provide an almost limitless source of capital with which to expand SHS sales. As the amount of bundled receivables from the SHS market grows, a debt fund mechanism might be developed that holds receivables from many projects, into which many investors could buy. This would help achieve the economies of scale that are available in the automobile, credit card and bank debt markets.

Financing Opportunities for Investors

At the investor level, one significant development is that insurance companies are becoming interested in financing solar energy because they recognize that fossil fuel-caused climate change is having a negative impact on their core insurance businesses. Munich Re, the huge German reinsurance company, recently attributed the surge in the cost of natural disasters (\$180 billion in 1995) to climate change and has urged the insurance industry to take an active part in solving the global climate problem.

According to Carlos Joly of Uni Storebrand, Norway's largest insurance company, however, the scale of investment opportunity must grow before most insurance companies or other large investors will show much interest. A related obstacle is the absence of credible vehicles for such investments, because insurance companies, pension funds and other large institutional investors typically invest in registered debt and equity securities. Although Joly indicated his company might be willing to make some small,

Promising Developments

- Grameen Trusts, a pioneer in small-scale community lending in Bangladesh, and E&Co, a U.S.-based nonprofit whose mission is to encourage the development of renewable energy enterprises in developing countries, have undertaken a joint venture. With support from the Rockefeller Brothers Fund, Grameen and E&Co are forming a standalone rural electrification company that will pair Grameen's widely decentralized credit operations (operating in one half of Bangladesh's villages) with E&Co's expertise in renewable energy.
- In a similar effort to pair solar distribution with credit finance, the Syndicate Bank in southern India has launched a solar lending program for rural households in Karnataka and Andhra Pradesh that provides solar home loans through its 1600 branches. An India-based solar energy service company that is a subsidiary of the Solar Electric Light Fund (SELF) supplies and maintains the solar home systems and is developing a network of solar service centers to install 10,000 systems a year.
- E&Co is in the final stages of developing a broad-based solar electrification industry in Morocco. Using a franchise model it has nicknamed MacSolar, E&Co is building a centralized acquisition, distribution and finance entity that will encourage the development of dealerships by individual solar entrepreneurs throughout the country. E&Co anticipates that over 40,000 households could be served in the first three years of MacSolar's operation.
- SELF's industry-creation efforts in India and in China are expanding rapidly. Both countries now have well-established credit networks and indigenous manufacturing capability. SELF has also initiated an expansion of its work in Vietnam, with support from the Rockefeller Brothers Fund. SELF's partner in this effort, the Vietnam Womens Union, is the world's largest national women's organization, with over 11 million members.
- SELF has also developed a commercial affiliate—the Solar Electric Lighting Company, or SELCO—to provide solar home systems and maintenance to its projects worldwide at the lowest possible cost. SELF founder Neville Williams is raising a capital fund for the new venture.
- Environmental Enterprises Assistance Fund (EEAF) has established Corporacion Financiera Ambiental (CFA), a \$10 million fund for environmental investment in Central America. Investors in the CFA Fund include the Multilateral Investment Fund of the Inter American Development Bank, the Swiss government, Citizen's Energy and Triodos Bank.
- Solarex, a U.S. manufacturer of solar panels, has begun to urge its dealers to provide credit to their customers as a vehicle for expanding sales and is exploring its ability to offer a secure line of credit to its dealers to encourage these financed purchases.
- The World Bank Group and four private foundations (Rockefeller Foundation, Rockefeller Brothers Fund, W. Alton Jones Foundation and MacArthur Foundation) are collaborating to develop a new institutional credit facility—a solar bank—that could deliver between \$500 million and \$800 million over the next five years, principally from private financial markets, for working capital and end user financing.
- With support from the Rockefeller Brothers Fund, Environmental Advantage (EA) is actively seeking investors and lenders to buy receivables from Sudimara Solar, Soluz and New World Power. Working with bankers at Solomon Brothers, EA is also exploring the creation of receivables financing as well as equity and debt fund vehicles in which large insurance companies could invest. To continue these efforts in the long run, EA is developing an investment banking subsidiary, called Sun Capital, to provide financial services for solar companies.

nonconventional investments to help the SHS industry get past this chicken-and-egg problem, that is likely to be the exception rather than the rule among large investors.

THE SOLAR HOME SYSTEM INDUSTRY WORLDWIDE seems to be reaching a critical mass and momentum, and the technical breakthroughs of the last few years may now be matched by market innovations. As the industry becomes better developed and more visible, as financing mechanisms for its various components become more familiar and accepted, as lenders and investors become more confident and as econo-

mies of scale inevitably develop, it is likely that the use of solar home systems will become significantly more widespread. ☼

This article is an edited version of a report of the same name written by Michael F. Northrop, Peter W. Riggs and Frances A. Raymond and published in 1996 by the Rockefeller Brothers Fund, 1290 Avenue of the Americas, New York, New York 10104. The report reflects a year-long research and design process initiated by the Rockefeller Brothers Fund in collaboration with the Solar Electric Light Fund (SELF) in Washington, D.C., a pioneer in solar home projects, and Environmental Advantage (EA), a private finance and investment firm in New York.