

THE POCANTICO CONFERENCE CENTER
OF THE ROCKEFELLER BROTHERS FUND

SELLING SOLAR
FINANCING HOUSEHOLD SOLAR
ENERGY IN THE DEVELOPING WORLD

A REPORT BASED ON A WORKSHOP
AT THE POCANTICO CONFERENCE CENTER
OF THE ROCKEFELLER BROTHERS FUND

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PREFACE

In 1984 the Rockefeller Brothers Fund identified global climate change as an issue to be given increased consideration under its sustainable resource use program heading. Grantees supported by the Fund subsequently played leading roles in the negotiations that led to the signing of the Framework Convention on Climate Change at the 1992 United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro.

Based on a 1993 assessment of post-Rio priorities, the RBF decided to increase its funding for cost-effective solutions to the climate change problem. Trustees concluded that solar electrification was a particularly promising area for exploration. Shortly thereafter, the Fund made a grant to an innovative organization in Washington, D.C., called the Solar Electric Light Fund (SELF), to help capitalize revolving loan funds for the purchase of solar home systems by households in China, India, and Vietnam. Two years later, struck by the success of these initiatives, the RBF began to ask whether such relatively modest projects could be dramatically scaled up. These questions led to a year-long research effort that culminated in a meeting at the Pocantico Conference Center of the Rockefeller Brothers Fund on “Financing Household Solar Energy in the Developing World.” The following paper is a brief summary of the results of this research and discussion.

SELLING SOLAR

FINANCING HOUSEHOLD SOLAR ENERGY IN THE DEVELOPING WORLD

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. The lure of bright lights draws millions of these people each year to already overcrowded cities.

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 (at \$10,000 per km) 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 change and produce dangerous levels of acid rain and pollution.

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

Why, then, aren't private markets rushing to take advantage of the huge opportunity represented by the millions of developing world households that need and could buy these systems? There are several reasons,

Selling Solar was written by members of the RBF program staff, based on materials prepared for this workshop and on discussions that took place there. It reflects the views of the authors and not necessarily those of other conference participants.

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. Although model projects have demonstrated several appropriate delivery mechanisms for getting credit and solar household units to rural end-users, these relatively modest success stories have not been sufficient to raise the confidence of traditional investors.

To help jumpstart the process of developing new market mechanisms to finance and deliver household solar systems on a mass scale, 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 — initiated a year-long research and design process that culminated in a three-day meeting on October 11-13, 1995, at the Pocantico Conference Center of the Rockefeller Brothers Fund. Attending the meeting were experts from financial institutions and the solar industry, as well as individuals with experience in successfully piloting small-scale solar projects in rural areas (see list on page 17).

To analyze challenges to the development of a solar home system (SHS) industry, Environmental Advantage researched case studies of solar projects in Indonesia, Kenya, Sri Lanka, and Zimbabwe. These studies utilized what EA calls a “value chain” analysis (see figures 1, 2, 3, and 4). A value chain represents all the steps that occur in the chain of activities through which raw materials are transformed into finished products that are purchased by consumers. This chain of activities includes manufacturing, distribution, and retail sales, functions which are typically performed by different entities. Understanding how these activities and entities fit together is key to seeing how an industry develops. In addition, this type of analysis examines the financing an industry requires (from lenders, investment banks, and investors) to grow and prosper at each step along the way. Value chain analysis allows for the creation of a rigorous framework for thinking about the development of all parts of an industry as well as the necessary links between the various components of an industry.

Most nonprofit development organizations concerned with rural solar electrification have focused their attention during the last ten years on completing stand-alone 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 natural development of businesses by undercutting their ability to sell or finance equipment at market rates (see figure 5).

The value chain analysis also provided a useful framework for selecting workshop participants for Pocantico. At least one participant was chosen for each step of the value chain. Often in the past, key stakeholders from various parts of the value chain have been missing from such discussions. At Pocantico, by contrast, financing ideas could be tested out all along the potential solar product and finance value chains.

Based on the case studies and the combined experiences of the participants, broad consensus emerged around the conditions that would have to be met before a viable SHS industry could scale up to handle the need and demand for solar home systems. Three finance-related concerns stand out as being critical if the SHS industry is to grow successfully: First, *purchasers* of solar systems need to 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 the developing South with the purchase of an automobile by a household in the industrialized North. Both purchases represent costs equal to approximately 50 weeks of income. 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 is 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 by Enersol and others 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 allow another 50 percent to enter the market. Clearly, available credit is an important need if a market for solar home systems is to take shape.

Because issues of affordability and credit-worthiness remain obstacles for lenders in the developing world, conference participants recognized the need to create broad-based credit operations that service large numbers of SHS purchasers simultaneously. Such an operation already exists in Indonesia, where 5,000 customers are currently receiving financial assistance to purchase solar home systems from an Indonesian SHS company called Sudimara Solar, which provides customer financing in addition to distributing the products. Sudimara has a 100 percent payback rate from customers but has been unable to get Indonesian banks to provide credit independently. Discussing the Indonesian case study at Pocantico, Rob de Lange, founder of Sudimara, expressed frustration that banks have not been willing to step in to help purchasers directly, but noted that 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 Somerville, Massachusetts) reported encountering the same reluctance from bankers. All present agreed that 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. Participants also urged that more exploration be undertaken to identify bank partners willing to be linked to solar distribution efforts.

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 1,000 poor rural households are to 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 which purchase systems will take better care of them and pay for them in a more orderly manner than households which 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 up-front 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 the manufacturers and distributors at the conference, growth in sales has been slowed by the lack of working capital needed to provide more systems and more credit to customers. Sudimara, for instance, is hampered 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. Seeking to develop alternative financing options that could provide SHS manufacturers and distributors with working capital, conference participants suggested that 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, participants noted that insurance companies are now more 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. Rolf Gerling, chair of the Gerling Group, is co-hosting a meeting in Oxford in December 1996 on building a global solar industry. Carlos Joly of Uni Storebrand, Norway's largest insurance company, indicated at Pocantico that his company shared this interest, but that the scale of investment opportunity must grow before most insurance companies or other large investors could move ahead. A related obstacle is the absence of credible vehicles for such investments, since 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, 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. All present agreed that as the market for SHS increases, the scale of investment opportunity will likewise increase, allowing for creation of the kinds of vehicles common in other markets. Conference participants urged that potential investment vehicles be investigated by legal and financial experts, and noted that if such instruments — including secured pools of receivables, debt funds, and equity partnerships — prove viable, an investor education program would be necessary to hasten financial innovation and encourage investors to add these kinds of investments to their portfolios.

SINCE POCANTICO, SOME PROMISING DEVELOPMENTS

The Pocantico meeting appears to have encouraged an increased focus on market solutions among conference participants and others in the solar energy field. Since the conference, a number of promising activities have gotten under way.

- A joint venture has been undertaken by the 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. With RBF support for soft costs, Grameen and E&Co are forming a stand-alone 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. Because of Grameen's stature in international development circles, its success in distributing solar systems throughout rural Bangladesh would go far toward promoting the viability of solar home systems. The pairing of solar system distribution with Grameen's credit capability will not only speed the diffusion of solar units through Bangladesh but should also help other banks see the potential business opportunities available in solar financing.

- In a similar effort to pair solar distribution with credit finance, the Syndicate Bank in southern India, another Pocantico conference participant, has launched a solar lending program for rural households in Karnataka and Andhra Pradesh that provides solar home loans through its 1,600 branches. An India-based solar energy service company that is a subsidiary of SELF supplies and maintains the solar home systems for Syndicate Bank customers, and is developing a network of solar service centers to install 10,000 systems a year.
- E&Co is now 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. The International Finance Corporation (part of the World Bank Group) has expressed interest in providing financing.
- The Solar Electric Light Fund'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 RBF support. SELF's partner in this effort, the Vietnam Womens Union, is the world's largest national women's organization, with over 11 million members. Vietnam's rural population appears to be extremely receptive to solar systems and this project, like Grameen and E&Co's efforts in Bangladesh, could become a case study in large-scale solar home system diffusion.
- Environmental Enterprises Assistance Fund (EEAF) has established Corporacion Financiera Ambiental (CFA), a \$10 million fund for environmental investment in Central America. EEAF will be the manager of this fund, and hopes to identify several renewable energy investment opportunities, including "off-the-grid" SHS companies. Investors in the CFA Fund include the Multilateral Investment Fund of the InterAmerican Development Bank, the Swiss government, Citizen's Energy, and Triodos Bank. EEAF, with funding from USAID, has also begun efforts in Mexico to identify, evaluate, and invest in renewable energy and other environmental projects throughout the country.
- In response to suggestions made at Pocantico, Solarex (the largest U.S. manufacturer of solar panels, owned jointly by Amoco and Enron) has begun to urge its dealers to provide credit to their customers as a vehicle for expanding sales and is explor-

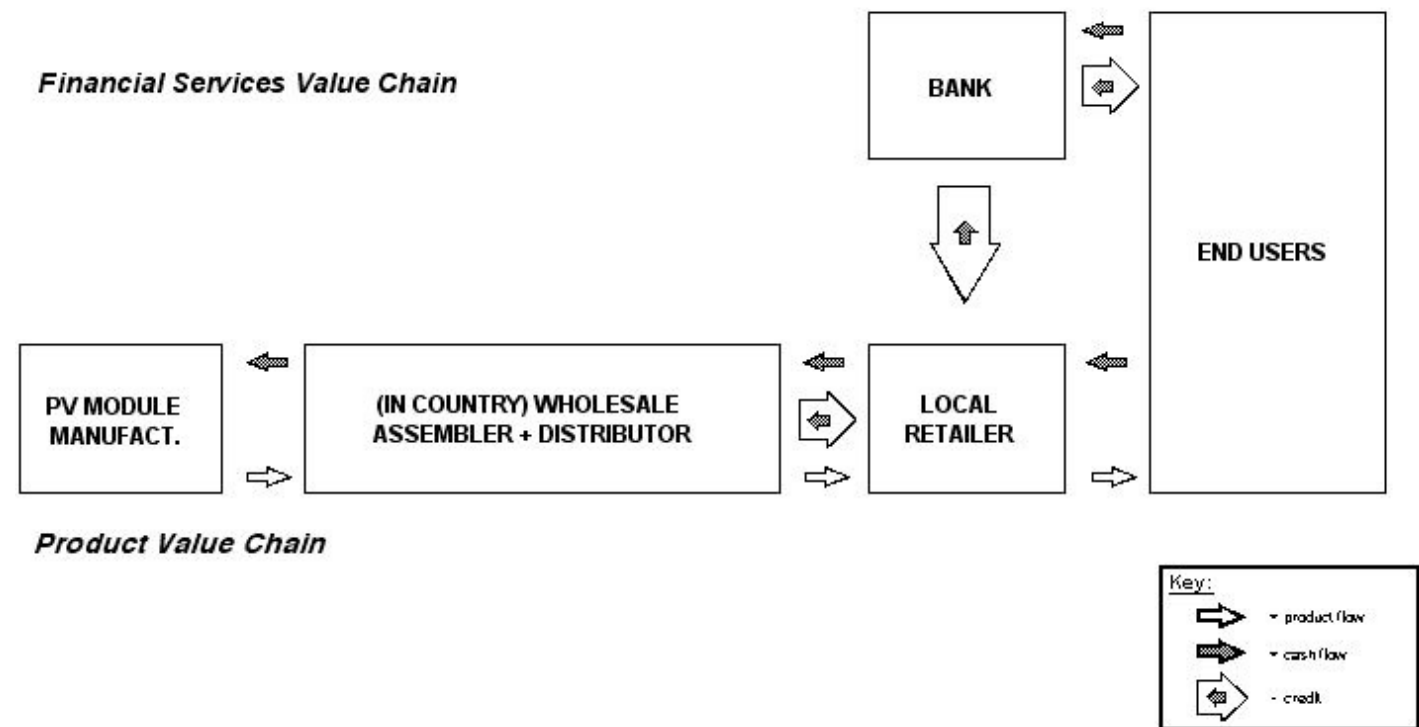
ing its ability to offer a secure line of credit to its dealers to encourage these financed purchases.

- The National Renewable Energy Lab in Golden, Colorado, has decided to serve as a trainer of solar entrepreneurs internationally, and will provide technical assistance to aid in the creation of locally based solar industries in developing countries. NREL has a widely distributed group of partners around the world.
- 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. The collaborative also hopes to develop a complementary nonprofit corporation to provide guidance on project preparation, training, marketing, and government policy.
- The International Finance Corporation (IFC) and the Global Environment Facility (GEF) are moving through the approval process for the \$60 million “PV Market Transformation Initiative” (PVMTI). The PVMTI is designed to significantly accelerate the commercialization, market penetration, and financial viability of PV technology in the developing world.
- With RBF support, Environmental Advantage and the National Renewable Energy Lab have undertaken the financial and legal research called for by Pocantico participants. EA is actively seeking investors and lenders to buy receivables from Sudimara Solar, Soluz, and New World Power, all of which have expressed a need for working capital to expand their businesses. 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.

With all of these activities and others worldwide now reaching a critical mass and momentum, it appears that the solar home system industry is at an important transition point in its evolution. 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 economies of scale inevitably develop, it is likely that the use of solar home systems will become significantly more widespread. As market innovation accelerates, the Southern experience with solar energy could also have implications for cost-effective applications of solar technology in the North.

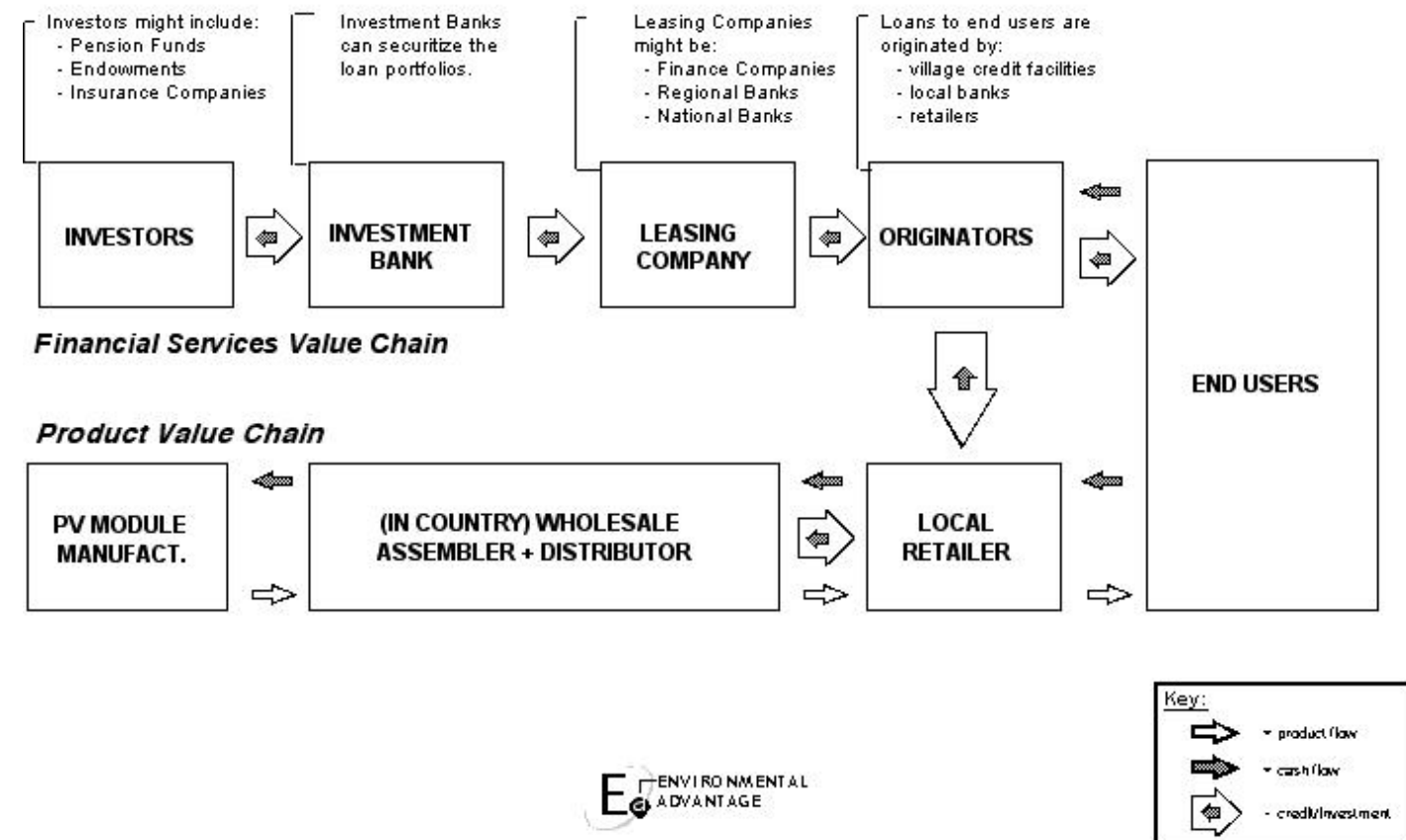
**FIGURE 1:
SOLAR INDUSTRY VALUE
CHAINS (EXISTING)**

Context: This diagram represents the sequence of operations through which the solar home system (SHS), or financing for the SHS, is ultimately delivered to the end user.



**FIGURE 2:
SOLAR INDUSTRY VALUE
CHAINS (PROPOSED)**

Context: This diagram represents the ideal sequence of operations for the solar industry. Note difference in the financial value chain from the previous diagram.



**FIGURE 3:
SOLAR INDUSTRY VALUE
CHAINS (POTENTIAL
BUSINESS CONCERNS)**

Context: This diagram represents the potential business concerns held by each actor on the proposed value chains.

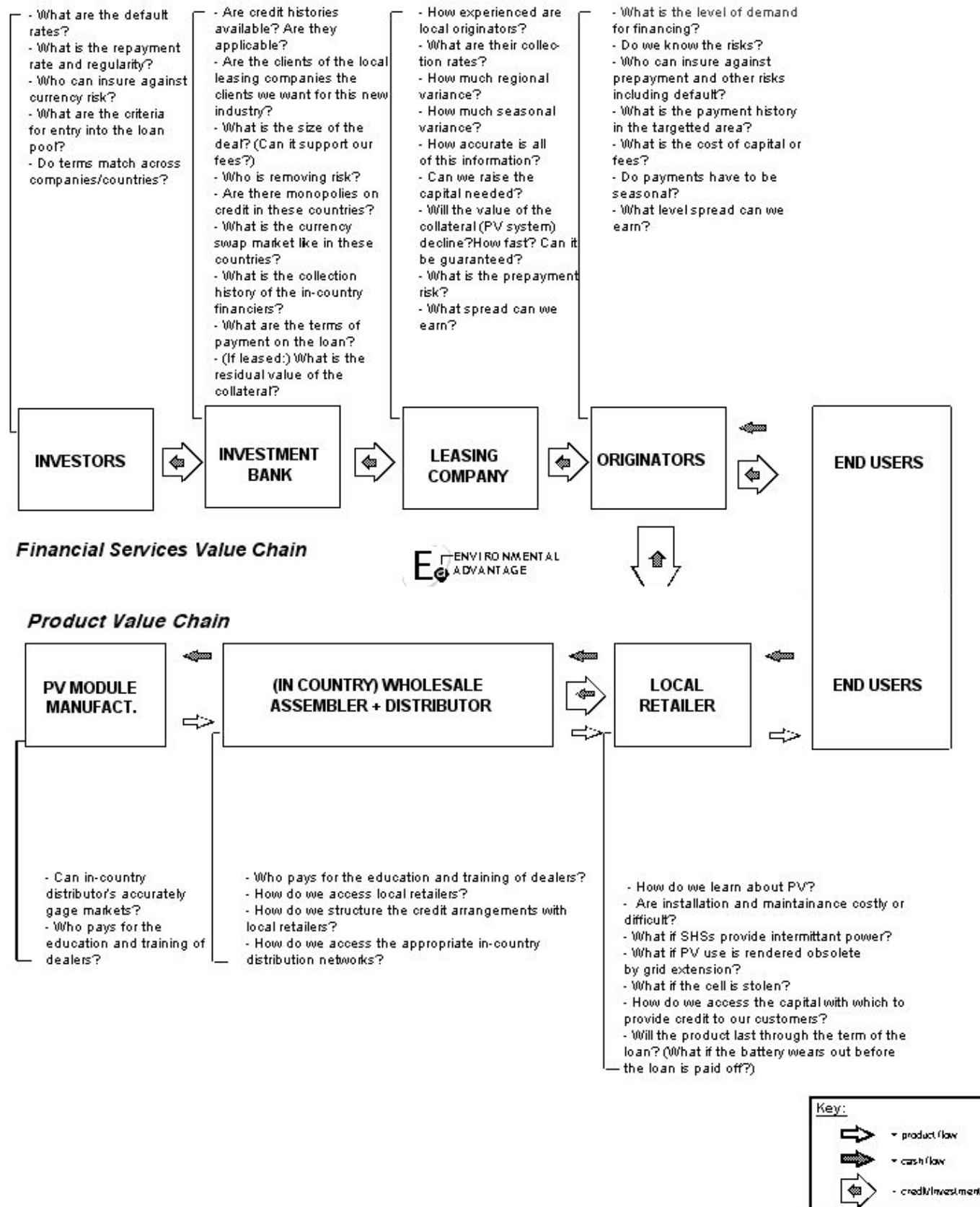


FIGURE 4: FINANCIAL NEEDS OF VARIOUS ACTORS IN THE PROPOSED SOLAR VALUE CHAIN AND SOLUTIONS

	Institutional Investor	Investment Bank Bundler	Assembler/ Finance Company	Retailer/Originator	End User
FINANCIAL NEEDS	Investment grade products with very low transaction costs which match term, returns, and risk requirements.	Adequate deal flow and fees to justify investment in product development, customers to purchase products.	Working capital to onlend for SHS loans, inventory finance, equity, "learning" costs.	Working capital equity, funds to onlend for SHS purchases, inventory finance, training costs for installers.	Credit for SHS purchase.
SOLUTIONS	Private placements of loan portfolios, securitization, over-collateralization, currency swaps, credit enhancement, pooling insurance.	Grants to buy down product development investment, investment banks contribute "pro-bono" to start the market.	Dedicated credit lines for SHS lending, equity or equity-like capital for expansion into solar lending, subsidization of some start up costs.	Small equity and equity-grant investments (SME funds), assembler guaranteed inventory finance, concessional funds for some training and development.	Micro-credit programs, dealer credit (farm equipment), village level banks finance cooperatives.

FIGURE 5: PROBLEMS TO BE AVOIDED

- Incentives, such as subsidies, while conceived with the best of intentions can harm nonsubsidized players in their attempt to grow their businesses.
- Excessive focus on the short-term goals of projects can divert attention from the longer-term task of creating the necessary market infrastructure.
- Overselling photo voltaic can create unrealistic expectations, leading to misuse of, and damage to, SHSs. If people think they are getting a power source which is similar to a grid connection, both the systems and PVs “word of mouth” will suffer.
- The payment process does not always provide an incentive to the dealers to provide service and to customers to rely on trained service providers and to learn about appropriate maintenance that they can provide.
- Project developers and entrepreneurs cannot afford to ignore the major educational effort with the financial services sector that they will need to engage in to grow their business. In fact, entrepreneurs should consider having someone on their team with experience and/or connections in the financial services industry.
- Don’t just sell to whomever can buy. Being strategic about the geographic concentration of systems allows the distributor to provide high-quality service at a low cost.
- Systems should be sized appropriately to customer needs. Problems have occurred with systems bigger than needed to power lights but not big enough to power an AC television for several hours a day.
- Solar companies might have to be involved in selling DC appliances or find ways of educating the consumers of SHSs about them and directing them to suppliers.
- It will be important to find ways to insure aspects of these transactions whether it is to reduce convertibility, currency, country, or possibly even project risk.
- Discarded or inappropriately recycled batteries are a serious environmental problem which the industry cannot afford to ignore if it is to grow by an order of magnitude. To maintain their environmentally preferable status, photo voltaic companies will need to offer recycling programs or work with reputable local battery recyclers.

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THE ROCKEFELLER BROTHERS FUND AND ITS POCANTICO PROGRAMS

The Rockefeller Brothers Fund, a private foundation, was established in 1940 by the five sons and daughter of John D. Rockefeller, Jr., in order to coordinate their philanthropic interests and to help realize the shared ideals of the Rockefeller family. The Fund's major objective is to improve the well-being of all people through support of efforts in the United States and abroad that contribute ideas, develop leaders, and encourage institutions in the transition to global interdependence. Since 1984, the principal part of the Fund's grantmaking program has been organized around the theme of One World, with two major components: sustainable resource use and world security. The Fund's other program interests are: promoting and sustaining a vital nonprofit sector, both nationally and internationally; improving the quality of life in New York City; strengthening the numbers and quality of teachers in public education in the United States; and improving the quality and accessibility of basic education for children and adults in South Africa.

The Pocantico Conference Center of the Rockefeller Brothers Fund is located in the Pocantico Historic Area, the heart of the Rockefeller Family estate in Westchester County, New York. The Historic Area, which is owned by the National Trust for Historic Preservation and leased by the Fund, includes John D. Rockefeller's home, Kykuit, the surrounding gardens and sculpture collections, and the Coach Barn meeting facility. At Pocantico, the Fund convenes a wide range of meetings and conferences related to its philanthropic programs. In connection with its conference program, the Fund publishes a series of occasional reports, called Pocantico Papers, designed to widen the impact of selected RBF-sponsored meetings at the Conference Center. The Pocantico Programs also include a public visitation program and year-round stewardship of the site.