IFC International Finance Corporation
World Bank Group

GEF

Selling Solar

LESSONS FROM MORE THAN A DECADE OF IFC'S EXPERIENCE

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International Finance Corporation
2121 Pennsylvania Avenue, NW
Washington, DC 20433 USA
Telephone: 202-473-3800
Internet: www.ifc.org/EnviroPublications
Email: enviro@ifc.org

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ACRONYMS AND ABBREVIATIONS USED IN THIS REPORT

CEPALCO	Cagayan Electric Power and Light Company
DE	distributed generation
DGIS	Directorate General for International Cooperation
EBFP	Environmental Business Finance Program
EE	energy efficiency
EEAF	Environmental Enterprises Assistance Fund
EETS	Environ Energy-Tech Service, Ltd.
EIA	Energy Information Administration
EMT	External Management Team
EPA	U.S. Environmental Protection Agency
FI	financial intermediary
GEF	Global Environment Facility
GTC	GT Consulting, Inc.
IEA	International Energy Agency
IFC	International Finance Corporation
IMF	International Monetary Fund
IRC	Investment Review Committee
KREA	Kenya Renewable Energy Association
KW	kilowatt
KWh	kilowatt/hour
MDG	Millennium Development Goals
MW	megawatt
MWh	megawatt/hour
MBIL	Moser Baer India Ltd.
NGO	nongovernmental organization
OECD	Organization for Economic Co-operation and Development
ONE	Office National de l'Electricite
PADGO	Portfolio Approach to Distributed Generation Opportunity
PV	photovoltaic
PVMTI	Photovoltaic Market Transformation Initiative
RE	renewable energy
REEF	Renewable Energy and Energy Efficiency Fund
SDC	Solar Development Capital
SDF	Solar Development Foundation
SDG	Solar Development Group
SEF	Sustainable Energy Facility
SHS	solar home system
SME	small and medium enterprise
SPM	Sunlight Power Maroc S.A.
SRI	socially responsible investment
TERI	Tata Energy Research Institute
TRED	Triodos Renewable Energy for Development
SECO	Swiss State Secretariat for Economic Affairs
VBARD	Vietnam Bank for Agriculture and Rural Development
VWU	Vietnam Women's Union
WBG	World Bank Group
WHO	World Health Organization
Wp	peak watt

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A JOINT MESSAGE

The Global Environment Facility (GEF) is the largest funder of renewable energy in the developing world, supporting solar, wind, and other clean forms of energy. In 14 years, GEF's clean energy portfolio has grown to more than $1.9 billion in grants for projects in more than 60 developing countries, with a total value of nearly $12 billion. These projects hold the promise of reduced greenhouse gas emissions, while also alleviating poverty through the provision of modern energy services using locally available resources.

GEF's approach to renewable energy seeks to create conditions for growing commercially sustainable markets, catalyzing private investment and supporting government commitments to programs and policies, and widespread consumer acceptance. In promoting these aims, the private sector focus of the International Finance Corporation (IFC) is particularly important and valuable. IFC brings an institutional commitment and proven track record in promoting sustainable private sector investment in developing countries. As GEF seeks to define more effective means of engaging the private sector as a partner in promoting solutions to global environmental problems —a current priority on our agenda—IFC's experience and capacity will be increasingly important.

As this study illustrates, despite the environmental appeal of solar PV and other renewable energy technologies, finding practical business solutions to their introduction has not been easy. GEF has a responsibility not only to report these results, but also to avoid repeating mistakes and incorporate the lessons of experience going forward. I am, therefore, very pleased by the effort IFC has made to review the outcome of its projects and make them available for others working in this field of increasing worldwide interest. The discussion of how these lessons have influenced more recently established projects and mainstream IFC investments is an encouraging example of GEF's influence on the larger investment community. I congratulate IFC for this study and trust it will be widely disseminated.

Monique Barbut
Chief Executive Officer and Chairperson
Global Environment Facility

Lack of access to electricity remains one of the key challenges in the developing world. Renewable energy solutions including solar PV can make a significant contribution to addressing the issue of rural electrification. However, finding a way to employ these solutions on a commercial and sustainable basis in emerging markets has yet to be discovered.

For almost 20 years, IFC has explored options for the commercialization of solar PV in the developing world. In the early to mid-1990s, IFC initiated several solar PV activities in partnership with other investors. Although these efforts could not overcome all the complexities of the solar PV market, and have not always lived up to their original expectations, they have provided valuable lessons of experience that are documented in this study.

This report is in two parts. Part 1 describes the history of IFC's approach to solar PV and explains why IFC today has developed a different approach to addressing rural electrification. It will be of interest to those now in the field as context and background.

Part 2 provides case studies on IFC's solar PV financing initiatives, as well as examples of some of the projects that these initiatives supported. These, we hope, will be useful to those in the business of exploiting the approaches to the nascent PV market in emerging markets.

In light of these lessons of experience, IFC is moving toward a broad approach to market-based solutions to rural electrification that supports a variety of technologies, including the commercialization of low-power lighting devices, and distributed power generation.

IFC's efforts in this field would not have been possible without donor support. The role of the Global Environment Facility (GEF), the primary source of funding for renewable energy projects in developing countries, was, and remains, invaluable in providing the resources required to cover the higher risks and noncommercial costs of new business models and financing programs.

Developing and sharing lessons of experience are a pivotal part of IFC's strategy, and I hope this study will be a useful tool to those who are currently operating in, or planning on entering, the solar PV market in emerging markets. I also hope that this publication will contribute to the growing body of knowledge regarding sustainable energy solutions for rural electrification.

Rachel Kyte
Director
Environment & Social Development Department

EXECUTIVE SUMMARY

Rural electrification has been a long-time focus for the World Bank Group (WBG) overall, and IFC, the World Bank's private sector investment arm. The contribution of electrification to quality of life, through improved livelihoods and health, and increased education and productivity, is well documented. With approximately one-third of the world's population living without access to electricity—mostly in rural areas of developing countries—rural electrification is a key means of achieving the Millennium Development Goals (MDGs)[1] and reducing poverty.

Concern about the global environment in recent years has led to an increased focus on renewable energy (RE) technologies. The Global Environment Facility (GEF) was initiated as a pilot project in 1991 and then formally established in its current form in 1994 with a mandate to address climate change and develop a strategy to support RE investments. The World Bank Group became interested in exploring the solar photovoltaic (PV) market as a means to providing clean energy service in rural areas that had no access to the grid. IFC recognized an opportunity to use GEF funds to test various options for the commercialization of solar PV in emerging markets.

This publication documents IFC's solar PV experience. In total, IFC managed five GEF-funded solar PV initiatives, of which four are discussed in this publication: the IFC/GEF Small and Medium Scale Enterprise Program (SME Program), the Photovoltaic Market Transformation Initiative (PVMTI), the Solar Development Group (SDG), and the grid-tied solar power plant of the Cagayan Electric Power and Light Company (CEPALCO).[2] While IFC programs have been responsible for the installation of over 84,000 solar home systems (SHS), these programs have been less successful from a financial standpoint, IFC having been unable to significantly transform markets and create sustainable businesses as originally anticipated.

In some of the initiatives that were implemented, we have found the main challenge to lie, not in the technology of solar PV, but in accurately judging market reality and trends. IFC's solar PV portfolio has been significantly impacted by well-documented market trends. These included a failed prediction that the price of solar PV panels would come down, the decrease in supply of smaller modules, and a number of economic shocks. Hindsight shows that the initial beliefs of IFC and many market players about the solar PV market were overly optimistic. Through the implementation of its solar PV initiatives, IFC has learned a great deal, not only about the solar PV market in general, but also about the type of financing required to support solar PV market growth and what it takes to develop a successful solar PV company. Perhaps one of the most important lessons that IFC has learned is that supporting the growth of the solar PV market is far more complex than first envisioned, particularly due to the level of market segmentation that exists.

IFC remains committed to addressing the issue of rural electrification in developing countries and is cautiously optimistic that a self-sustaining solar PV market will develop there. However, in light of the lessons, we are moving away from focusing narrowly on solar PV as a way of addressing rural electrification. Instead, we are moving toward a broader approach, such as supporting a variety of technologies, the commercialization of low-power lighting devices, and distributed power generation.

[1] A set of eight international development goals for 2015, adopted by the international community in the UN Millennium Declaration in September 2000, and endorsed by the International Monetary Fund (IMF), the World Bank, and Organization for Economic Co-operation and Development (OECD).

[2] This review does not discuss the experience of the Renewable Energy and Energy Efficiency Fund (REEF), due to an agreement among participating investors restricting disclosure.

KEY LESSONS FROM IFC'S EXPERIENCES IN SOLAR PV

- **The issue of affordability cannot be addressed without segmenting the market.**

The rural unelectrified market in developing countries is large. To reach it, proper segmentation along income lines, needs, and lifestyle are necessary. It was initially felt that if solar PV module prices could be brought down to a certain level, or if business models could be structured to maintain low monthly payments, solar PV would become financially affordable to the consumer and competitive with alternative energy sources. Experience has shown that the definition of affordability varies among market segments (relative income levels, market applications, etc.), and it remains a challenge for PV companies to identify the niche market segments where solar PV is the least-cost energy alternative for the consumer.

- **While solar PV is a viable technical solution, it is not the only solution. Without some level of subsidization similar to that provided for grid-connected electricity, it often remains too expensive for the average rural consumer.**

Experience has also demonstrated that people are looking for a constant supply of electricity provided by grid connection. It is important to note that, while solar PV is cheaper for governments than costly grid expansion in dispersed rural populations, grid connection has emerged as a key political tool in many developing countries, and the grid has almost always been heavily subsidized. In addition, solar PV simply cannot provide equivalent services to the grid, and it is also not the only technology available for addressing rural electrification demand. The high initial cost of acquiring a solar PV system makes solar PV considerably less affordable to the rural poor than alternatives, such as car batteries and kerosene.

- **Private equity is not the most appropriate financial mechanism for financing solar PV activities in developing countries.**

An important lesson for IFC was that, while private equity and venture capital firms are heavily involved in the manufacturing of solar PV for developed country markets, the risks and economics of solar PV in the developing world mean that the returns that such off-grid investors typically look for are nonexistent. Profitable opportunities for solar PV utilization in the developing world lie further up the value chain, primarily in the manufacture of solar PV modules for export to subsidized, developed world markets.

- **Good government relations and support are a strong success factor.**

While there are examples of companies able to establish successful ventures without express government support, those companies fortunate enough to operate with a government concession for exclusive territorial rights to distribute solar PV systems (or with some form of subsidy or favorable pricing agreement) tended to be more successful than companies operating without explicit government support.

PART I

Introduction: The Development Case for Rural Electrification

More than 1.6 billion people, roughly one third of the world's population, live without access to electricity. The vast majority of those without electricity live in rural areas. The World Bank estimates that 67 percent of the rural population in developing countries is without electricity. As a result, low-income households around the world spend billions of dollars every year on expensive and environmentally damaging energy sources such as charcoal, firewood, and disposable batteries, with an estimated $38 billion a year spent on kerosene alone. This is especially true in Africa, where roughly two thirds of households—more than 580 million people—depend on wood fuel for their daily cooking and heating needs. People in emerging markets who rely on these fuels use much of their labor to gather wood fuel and are exposed daily to indoor air pollution. The World Health Organization (WHO) estimates that the pollution caused by using indoor biomass cook stoves is responsible for 1.6 million deaths per year—mostly of young children and mothers.

Access to modern, reliable energy is important for rural development and improved livelihoods. Energy is a major tool for poverty alleviation, income generation, health, and other developmental agendas. The provision of clean electricity to low-income households allows for increased opportunities for studying in the evenings, as well as increased productivity of agricultural and micro-enterprise activities. Numerous studies have confirmed that the social benefits from electrification—the ability to power lights, radios, small appliances, and televisions—make a significant contribution to enhancing quality of life. This enhanced quality of life has, in turn, proved to be a key driver of increases in the demand for energy.

SOLAR PV: AN ATTRACTIVE TECHNOLOGY FOR RURAL ELECTRIFICATION

Inefficient energy infrastructure, rapidly growing demand, and a general lack of generating capacity mean that many developing countries are unable to meet their basic energy demands. The International Energy Agency (IEA) estimates under its reference scenario that developing countries require a $300 billion annual investment for the electricity sector alone.[3] In rural areas, where as many as four out of five people lack electricity, conventional grid-connected electricity schemes are often not feasible. Grid expansion can be extremely costly and has been demonstrated numerous times to be far less cost effective than supplying SHS.[4] Because of the high cost of extending electrical grid coverage in these areas, non-grid-tied renewable energy technologies, such as solar PV, may be a least-cost solution.

The availability of clean electricity not only helps households avoid the health risks associated with conventional forms of energy, such as kerosene, charcoal, and disposable batteries, but it also helps the global environment through the avoidance of greenhouse gas emissions and conventional air pollution associated with fossil-fuel-based forms of electricity. Renewable energy technologies also help governments gain energy independence and eliminate the need for costly grid expansion to remote villages.

Solar PV and SHS are attractive renewable energy technologies for many applications in off-grid areas. Most developing countries lie in areas with high solar insolation levels—a "must" for solar PV—and, with the added benefit of SHS being modular, SHS can be installed to provide energy for one house, groups of houses, or an entire village. Other renew-

[3] International Energy Agency (IEA), *World Energy Outlook 2004*, OECD and IEA, Paris.

[4] Foley, 1995, p. 41.

[5] Erickson, 1995, p. 1130.

[6] Cabraal et al., 1996.

[7] For more information on the WBG renewable energy strategy, visit www.worldbank.org/re.

[8] IFC's initiative with CEPALCO in the Philippines was the only grid-tied investment made.

able energy resources (e.g., hydro or biomass) are typically better suited for less dispersed populations, as they generally become economical only if they are able to provide energy to a more sizable population.[5]

Photovoltaic technologies already provide electricity in developing countries to an estimated 500,000 to 1 million rural households lacking access to electricity grids. SHS is one of the most common forms of solar PV application in rural areas. An SHS usually provides electricity for two or three fluorescent lights; a radio, cassette player, or television; and other small appliances. Electricity is drawn from rechargeable batteries charged through an electronic charge controller by solar PV modules mounted on a pole beside the house or on the rooftop. The total capacity of the unit is usually in the range of 30-100 peak watts (Wp), but can be less or greater.[6]

The direct economic benefits of SHS include increased convenience and safety, improved indoor air quality, a higher quality of light than kerosene for reading, and the displacement of CO_2 emissions. Improved lighting provides additional educational benefits, particularly for children, and can allow income-generating activities to occur beyond normal work hours. Solar PV systems can power lights and vaccine refrigerators in medical clinics, run low-lift water pumps, and allow for the operation of other vital systems.

THE WORLD BANK GROUP'S INVOLVEMENT IN SOLAR PV

When the Global Environment Facility (GEF) was established in 1994, it made available a new source of funds to support projects that generated global environmental benefits. One of GEF's operational programs supports renewable energy activities that are unable to secure commercial financing elsewhere. The WBG was at the time particularly interested in utilizing GEF funds to develop the renewable and energy efficiency potential in emerging markets and to gain experience in the solar PV market.[7]

IFC was particularly interested in exploring opportunities for the commercialization of solar PV. With its mandate to further economic development through the private sector, IFC had been active in the solar PV market since 1989, when it made a $3 million investment (debt and equity) in Shenzhen YK Solar PV Energy Co., Ltd., a solar PV manufacturer in China. Although the investment, made using regular IFC funds, did not meet its original expectations, it established an important precedent for investing in solar PV businesses in frontier markets.

IFC has since used its skill and experience in structuring projects that target the private sector to develop and implement a number of GEF-funded solar PV projects, many of which operated across country lines. Today IFC, together with the World Bank, is the largest financier of off-grid solar PV in the developing world, having supported the installation of over 1.3 million solar PV systems.[8] (See Table 1 below for details on the World Bank Group's solar PV–related projects.)

TABLE 1: WBG SOLAR PV INITITIATIVES

COUNTRY	NUMBER OF PROJECTS	NUMBER OF SYSTEMS INSTALLED*	SOLAR PV CAPACITY (kWp)	COST** ($ MILLIONS)
Argentina	1	30,000	2,843	36.0
Bangladesh	1	198,000	9,900	91.4
Bolivia	1	60,000	2,600	38.6
Burkina Faso	1	8,000	300	3.0
Cambodia	1	10,000	400	4.0
Cape Verde	1	4,500	129	2.5
China	1	400,000	10,000	144.9
Ecuador	1	2,200	110	1.5
Ethiopia	1	6,300	407	5.4
India	1	45,000	2,500	24.0
Indonesia	1	8,500	425	3.8
Laos	1	4,000	160	1.3
Madagascar	1	15,000	625	7.5
Mali	1	10,000	420	5.0
Mexico	2	37,000	704	12.9
Mongolia	1	50,000	520	5.2
Mozambique	2	9,800	1,096	13.5
Nicaragua	1	6,000	215	3.0
Pacific Islands	1	21,000	630	16.5
Papua New Guinea	1	2,500	100	2.2
Philippines	2	139,000	10,000	113.0
Senegal	1	10,000	420	5.0
Sri Lanka	2	104,400	4,176	36.1
Swaziland	1	2,000	100	1.3
Tanzania	1	40,000	2,500	30.0
Uganda	1	90,000	6,300	67.7
Multiple countries†	14	84,000+		25.3
Total	**44**	**1,300,000+**	**~58MW**	**~700.0**

Source: Anil Cabraal, 21st EU Solar PVSEC, 2006 (with update, January 2007).

* Figures include both the number of systems installed and the target installation for projects currently under implementation.

** Cost includes only total investment of solar PV components/applications.

† Includes projects of the SME Program in Bangladesh, Dominican Republic, Honduras, Tunisia, and Vietnam, and PVMTI in India, Kenya, and Morocco.

CHAPTER 1

IFC's Approach in the Early 1990s

THE EMERGENCE OF SOLAR PV

In the early 1990s, when IFC was in the process of structuring its first solar PV market initiative, there was a great deal of anticipation about the future of solar PV in emerging markets. Overall industry growth had accelerated steadily since the early 1980s.[9] In emerging markets, it was felt that there was an opportunity for small-scale solar PV applications, such as SHS, to replace diesel generation and to provide supplementary power to grid-connected systems.[10]

The first renewable energy initiatives that were implemented in emerging markets were largely donor-led and focused on demonstrating the functionality of the technology. Little to no attention was paid to commercializing the market to support wider dissemination of the technology. Given that the majority of early initiatives were grant-based programs, many of them ended when funding was exhausted, as the programs had not been designed with financial sustainability or replication as key considerations.

By the mid-1990s, large capital flows were streaming into solar PV businesses. Large players, such as BP, Shell, and Total Energie, were entering this market, manufacturing solar PV panels, and selling solar PV systems to rural electricity consumers in developing countries. Anyone with the means and interest in electricity in emerging markets experimented with solar PV in what appeared to be a major emerging business opportunity.

SIZABLE MARKET AND DEMAND

The potential market was considered very attractive. An estimated 1.6 billion people were without electricity (roughly 400 million households), all of which could be electrified with SHS. The thought was that if solar PV was made available to a community, demand would be similar to that experienced with the arrival of grid-connected electricity. While the initial start-up cost of acquiring solar PV was considerably more expensive than the alternatives, such as batteries or diesel generators, it was assumed that a significant segment of the unelectrified population would opt for the superior quality of solar PV, could financially afford it, and would purchase systems if credit were available. The opportunity to bring about a substantial increase in the market size was present; in fact, some were predicting a similar

growth pattern to that experienced with personal computers and mobile phones.

PRICES WOULD FALL AND SOLAR PV COULD BECOME MORE FINANCIALLY AFFORDABLE

It was widely perceived that the main barrier to scaling up the industry was rooted not in the technology, but in the financial affordability of solar PV. Solar PV had proved to be unaffordable for three key reasons: (1) the overall price of solar PV modules was not considered competitive against alternative electricity sources, such as diesel generators; (2) there was no financing available to help solar PV consumers with the large initial cost of acquiring and installing a solar PV system; and (3) subsidies for other forms of energy, such as grid-tied electricity, were distorting the market. The appropriateness of solar PV technology itself was not called into question, as it was largely believed to be the best technological solution to rural electrification, given its scalability and fit for dispersed populations.

At the time IFC was structuring the solar PV initiatives discussed in this report, it was widely thought that the prices of solar PV modules would continue to decline. The price of solar PV modules had decreased by a factor of over 50 since the early 1970s, and it was expected that further price reductions would continue to occur as a result of technical progress in materials, cell design, and manufacturing methods, as well as economies of scale in manufacturing.[11] It was expected that solar PV module prices would decline sufficiently to allow solar PV to become a cost-effective replacement for diesel fuel or kerosene. With cost expected to decrease, the lack of consumer access to financing was seen as the major constraint. IFC considered that it could structure solar PV initiatives to address this constraint.

SIGNIFICANT SOLAR PV MARKET TRENDS

During the period in which IFC's solar PV projects were implemented, there were a number of well-documented market trends that emerged in the global solar PV market that had a significant impact on solar PV markets in the developing world. These were the discontinuation of the expected downward trend in solar PV module prices, the increased demand for large solar PV systems in the industrialized world, and the global economic shocks that occurred in the late 1990s and early 2000s (the Asian and Russian financial crises of 1997 and 1998, respectively, the Argentine economic crisis of 1999, and the 9/11 attacks). While these market trends were not on their own responsible for the limited success of IFC's portfolio, they did serve to further exacerbate existing obstacles.

Prices did not decrease as expected and, in recent years, the exact opposite has occurred. According to the United States Department of Energy's Energy Information Administration (EIA), the average price for silicon contracts increased by approximately 25 percent between 2004 and 2006.[12] As silicon is a key component in the construction of solar PV panels, this has had a serious impact on the overall price of solar PV systems. The main reasons for this increase were the continued tight supply of high-grade silicon, as well as the increased demand for solar PV, fueled by subsidized programs in the industrialized world.

It is currently estimated that as much as 50 percent of the cost of solar PV electricity is paid for through transitional subsidies. Most of this is for grid-connected systems, which currently represent well over three quarters[13] of the total solar PV market. In Germany, for example, the electric utilities are now paying customers a significant premium for any surplus solar PV power they sell back to the grid. This huge premium has resulted in a sizable increase in the global demand for solar PV systems.

The increase in demand for solar PV in the industrialized world has affected solar PV markets in the developing world, not only through increased prices, but also by shifting production away from the smaller modules. Load requirements in industrialized countries are significantly higher than those in developing countries, and manufacturers have chosen to move away from the manufacture of smaller modules in favor of the increased profitability and steady cash flow associated with catering to the industrialized country market. The lack of supply of smaller modules has led to increased working capital requirements for smaller integrators,[14] as well as increased pressure on prices for smaller modules. In the period between mid-2005 and the end of 2006, the price of 40-watt panels has increased by 50 percent (36 percent for 20-watt panels).[15]

[9] Jackson, 1999, p. 376.

[10] Ahmed, 1994, p.7.

[11] This review does not discuss the experience of the Renewable Energy and Energy Efficiency Fund (REEF), due to an agreement among participating investors restricting disclosure.

[12] http://www.solarbuzz.com.

[13] Some estimates place grid-connected systems at over 90 percent of the total solar PV market.

[14] Hande, 2006.

[15] Hande, 2007.

CHAPTER 2

IFC's Experience in the Solar PV Market

IFC has learned many lessons from its experience in the solar PV market. These lessons are summarized in the following chapter. By far the most important lesson that IFC has drawn from its experience is that there is not simply one target market for solar PV in developing countries, namely the entire unelectrified market, but many different target market segments. To be successful, solar PV ventures should be structured with a narrow, well-defined target market. The investment offering can then adequately address a relatively homogenous set of needs. This was a relatively difficult lesson for IFC as, from the outset, the goal of many of our solar PV initiatives was simply to provide services to the unelectrified. As a result, the experiences outlined below led to varying degrees of success, both in their effectiveness and in their implementation.

IFC approved its first GEF-financed investment to a

TABLE 2. IFC/GEF SOLAR PV INITIATIVES

PROGRAM	DATE OPERATIONS BEGAN	GOAL	TOTAL INVESTMENT AMOUNT	GEF SHARE OF TOTAL FUNDING	CURRENT STATUS
SME Program	1995	Increase access to finance, build capacity, and increase growth of markets for SMEs active in the areas of climate change mitigation and biodiversity conservation.	$20 million* ($2.7 million used for five solar PV-related businesses)	100%	The SME program was absorbed into the Environmental Business Finance program in 2004. Some of the solar PV investments have been closed; others are ongoing and operating successfully.
PVMTI	1998	Accelerate the sustainable commercialization and financial viability of energy services, based on solar PV electricity.	$30 million	100%	Ongoing
SDG	2000	Deliver SHS to rural households in developing countries.	$41 million (SDF $12 million, SDC $28.7 million)†	25%	Dissolved in 2004
CEPALCO	2002	Demonstrate solar PV effectiveness in supplying energy during peak usage periods, thus avoiding new plant construction.	$5.775 million	70% (CEPALCO provided $1.775 million in financing)	Operating successfully

*The SME Program received a total of $20 million in funding from the GEF in two stages; a portion of this funding was earmarked to finance solar PV-related projects.

†For details on additional shareholders, see the SDG case study on page 49.

solar PV company in 1998 through the IFC/GEF Small and Medium Scale Enterprise (SME) Program. That same year, IFC's first solar PV-focused financing facility, the IFC/GEF Photovoltaic Market Transformation Initiative (PVMTI), also became operational. Over the next five years, IFC supported three additional solar PV-related initiatives, all financed by GEF, including the Solar Development Group (SDG), which included the Solar Development Foundation (SDF), Solar Development Capital (SDC), and the CEPALCO Solar Photovoltaic Demonstration Project.[16] Table 2 outlines IFC's GEF-funded solar PV initiatives.

The programs and projects implemented by IFC have resulted in significant overall social and environmental benefits. Examined for nonfinancial returns, such as the number of households electrified, the displacement of indoor air pollution, gender empowerment, education, health, and increased income-generation opportunities for the end user, the IFC solar PV portfolio has performed well, with over 84,000 SHS installed. However, from a financial standpoint, performance has proved below expectations, as it has generally not met the initial projections of investee companies.

THE IFC/GEF SMALL AND MEDIUM SCALE ENTERPRISE PROGRAM

The IFC/GEF SME Program was established in 1995 as a $20 million initiative, financed entirely by GEF. It sought to increase access to finance, build capacity, and increase markets for SMEs active in the areas of climate change mitigation (energy efficiency and renewable energy) and biodiversity conservation through the provision of concessional loan financing. The SME Program was the first GEF-funded, nongrant, SME financing program targeting the private sector. While the SME Program did not specifically target solar PV companies, it became operational at a time when there was considerable interest in the solar PV market. (See the IFC/GEF SME Program case studies, page 30.)

Over its lifetime, the SME Program approved investments in five solar PV-related businesses (see Table 3 for details). The SME Program's experience in the solar PV sector was mixed, with one successful project (Grameen Shakti in Bangladesh) and other projects with more limited success. In 2004, the operations of the SME Program were absorbed by the Environmental Business Finance Program (EBFP), a $20 million IFC/GEF initiative that was designed as a successor to, and based on, the experiences of the SME Program.

TABLE 3. IFC/GEF SME PROGRAMS'S SOLAR PV PROJECTS PORTFOLIO

COMPANY	COUNTRY	COMMITMENT (IN MILLIONS)
Grameen Shakti	Bangladesh	$ 0.750
Environmental Enterprise Assistance Fund (EEAF) Soluz Dominicana*	Dominican Republic	0.075
Soluz Honduras**	Honduras	0.500
E + Co Rex Investment†	Tanzania	0.150
Cogener	Tunisia	0.500
Selco Vietnam	Vietnam	0.750

* The SME Program lent to EEAF, which on-lent to Soluz Dominicana S.A., an SHS distributor.

** Soluz Honduras S.A. de C.V. received a $400,000 loan, as well as a $100,000 equity investment.

† The SME Program lent to E+Co fund, which on-lent to Rex Investment Ltd., a leading Tanzanian solar PV distributor.

Perhaps one of the most important lessons IFC learned from the SME Program's experience with the solar PV market was that it was possible to offset some of the risks associated with solar PV by investing in a number of different markets and sectors.

Contrasting the experience of Grameen Shakti, which operated in densely populated Bangladesh, with those of Selco Vietnam and Soluz Honduras showed that economies of scale are harder to come by in sparsely populated and remote rural areas. Economies of scale are vital to the success of solar PV companies, since they reduce the financial cost of monthly rental fee or payment collection, as well as an ongoing system service and maintenance. Without a sizable service population, a private solar PV company simply cannot financially sustain the cost of a service technician or collection agent, and ultimately this leads to collection issues and difficulties in maintaining systems (as was the case with both Selco Vietnam and Soluz Honduras).

The SME Program experience highlights the importance of local ownership and government support. Grameen Shakti's ties to Grameen Bank and, through it, the local community proved to be invaluable and a major driver of Grameen Shakti's success. Soluz Honduras found that the lack of a defined exclusive government concession to defend geographic service territories was problematic when it was faced with unexpected grid expansions that eliminated large numbers of established customers. (See case studies on Grameen Shakti, Soluz Honduras, and Selco Vietnam in Part 2.)

PHOTOVOLTAIC MARKET TRANSFORMATION INITIATIVE

The IFC/GEF PVMTI is a $30 million GEF-funded initiative designed to accelerate the sustainable com-

[16] This review does not discuss the experience of the Renewable Energy and Energy Efficiency Fund (REEF), due to an agreement among participating investors restricting disclosure.

mercialization and financial viability of energy services based on solar PV technology in India, Kenya, and Morocco. Launched in 1998, PVMTI is expected to continue to the end of its extended mandate in December 2009 and, by the beginning of 2007, had committed over $18 million to 12 projects. (See PVMTI case study, page 40.)

PVMTI initially found it difficult to structure deals as the extensive documentation required, small investment size, and long negotiation periods proved too burdensome for many small and thinly capitalized solar PV companies. It quickly became apparent that companies would not be able to absorb and repay committed funds by the original end date of December 2007. The extensive documentation process and small investment size also resulted in high operational costs for PVMTI in relation to its portfolio. In 2004, PVMTI underwent a significant restructuring that extended its operational mandate by two years and has resulted in an increase in the proportion of disbursements to commitments to roughly 80 percent.

As PVMTI is still an operational project, it is difficult to evaluate its overall performance (see Table 4 for a summary of the PVMTI portfolio). To date, PVMTI financing has resulted in the installation of over 60,000 SHS units in previously unelectrified households. The Mid-Term Program Review, which was completed in July 2006, noted that PVMTI will be responsible for the displacement of an estimated 109,466 tonnes of CO_2 emissions over the lifetime of the installed SHSs.

The PVMTI experience highlights the need for flexibility in program design. The initial $500,000 minimum investment proved to be too large for most SMEs to absorb, and the extensive business plans and other documentation proved too daunting for the small businesses active in the solar PV sector, particularly those in the lower density rural areas where solar PV was most needed. PVMTI was, indeed, flexible, and IFC was able to restructure the program to better suit the needs of the market.

PVMTI's experience in Kenya highlighted the need for technical assistance funding. While the Kenyan solar PV market was well-established, with many players and a true entrepreneurial culture, there was no real structure to the market and no standards. It quickly became apparent that there was a need for funding to help strengthen the overall market through the creation of performance standards and by securing government support. (See case studies on SREI, Muramati Tea Growers SACCO and Sunlight Power Maroc S.A. in Part 2.)

TABLE 4. PVMTI'S ACTIVE SOLAR PV PROJECT PORTFOLIO

COMPANY	COUNTRY	COMMITMENT (IN MILLIONS)
Selco India	India	$ 1.10
Eskom-Shell Solar Home Systems	India	3.90
Shri Shakti	India	2.23
SREI Infrastructure Finance, Ltd.	India	3.50
Barclays Bank, Kenya	Kenya	2.00
Equity Building Society (EBS)	Kenya	2.10
Muramati District Tea Growers SACCO	Kenya	0.60
Salafin S.A.	Morocco	1.00
Sunlight Power Maroc S.A.	Morocco	1.075

SOLAR DEVELOPMENT GROUP

The Solar Development Group (SDG) was a $41 million initiative which became operational in 2000. The goal was to deliver SHS to rural households in developing countries. SDG was comprised of two separate entities: (1) Solar Development Capital (SDC), a $28.7 million for-profit private equity fund that provided growth capital for private solar PV and solar PV-related businesses; and (2) Solar Development Foundation (SDF), a $12 million nonprofit entity that provided business development assistance and seed financing to support the establishment of new solar PV businesses. (See SDG case study, page 49.)

SDC experienced problems very early in implementation. There simply were no viable opportunities in the solar PV market that would provide the returns that private equity investors were seeking. Despite revisions of return expectations, SDC managed to approve only six investments, totaling $3.9 million (of the approved projects, only $650,000 was disbursed to three investments), before being liquidated in 2004. In contrast, SDF, with its focus on the provision of early-stage working capital loans, guarantees, and technical assistance grants, was largely able to meet its targets, making commitments totaling over $3.5 million to 54 companies in 23 countries. With SDC's liquidation, however, SDF transferred its operations to the Triodos Renewable Energy for Development (TRED) Fund and SDG ceased to exist in April 2004.

IFC learned a great deal from the SDG experience relating to the type of financing programs required for solar PV. A key lesson was that a diverse shareholder group can be problematic. With over 15 different investors from a wide range of institutions (nongovernmental, bilateral, and multilateral financ-

ing organizations, socially responsible investment funds, and private companies), as well as private individuals, it was very difficult to satisfy the shareholders' different objectives and expectations. When it became obvious that SDC required restructuring, reaching consensus on a new structure proved impossible and SDC was eventually disbanded.

The SDG experience also highlighted the necessity of focusing mainly on market development and capacity building. Overall, SDG had only focused on developing individual businesses, rather than on the market as a whole.

The SDG experience, more than any other IFC solar PV initiative, demonstrates IFC's optimistic outlook on the market. During the initial planning stages for SDG, over 100 investment opportunities were identified for SDC. Ultimately, none of the opportunities identified in the feasibility study received SDC support, as the market was not prepared for equity-type investments, companies were not in a position to absorb so much capital, and the return expectations by most of the candidate businesses were not met.

CAGAYAN ELECTRIC POWER AND LIGHT COMPANY

CEPALCO is a private electricity distribution company on the island of Mindanao in the Philippines. In December 2002, CEPALCO received $4 million in GEF funding (loan convertible to grant) from IFC to build a 1 MW distributed generation power plant, which was integrated into the 80 MW distribution network of CEPALCO and operated in conjunction with an existing 7 MW run-of-the-river hydroelectric plant. The purpose of the project was to demonstrate the effectiveness of solar PV in addressing distribution system capacity issues, thereby delaying the need to construct a new hydroelectric plant. The solar PV plant operated through a conjunctive use application, whereby hydropower and solar PV resources were used jointly, for the first time, to increase the capacity of the hydropower unit and convert the solar PV plant's power output to firm dispatchable power, rather than an intermittent resource.[17] (See CEPALCO case study, page 54.)

Fully operational since 2004, the CEPALCO plant has operated successfully and without incident since its inauguration, making a strong technical case for the reliability of utility-scale solar PV power plants and resulting in a significant reduction in greenhouse gas emissions. It is important to note that the GEF grant, which was provided through IFC, effectively subsidized 70 percent of the construction and start-up costs of the CEPALCO solar PV plant. Thus, the intended potential for replication is currently somewhat limited, since global solar PV prices remain too high.[18]

The CEPALCO experience highlights the importance of a strong local presence and knowledge of the local market and its regulations. Although the CEPALCO plant was a small plant, the Philippine Government did not make a distinction between it and the more conventional electrical plants. CEPALCO was still required to comply with the permit process required for much larger fossil-based plants. As a result, over 50 permits and licenses would have been required, many of which were inappropriate for a small, clean RE plant. Without the staff knowledgeable of local government processes, this would have been a very daunting process, potentially crippling the project's implementation.

The CEPALCO project also highlights the necessity of capital cost reductions for larger-scale grid applications. Without the GEF grant, the CEPALCO plant would not have been financially viable, as the price of solar PV modules was simply too high to be competitive with the capital cost of a 1 MW diesel generator. Perhaps most important, the CEPALCO project demonstrated the potential for conjunctive use applications of solar PV.

[17] World Bank Group, *Renewable Energy for Development—The Role of the World Bank Group*, 2004.

[18] Other large-scale solar PV power plants are now being constructed in Europe and North America, due to generous subsidy programs, financial incentives (e.g., tax credits), and the existence of renewable energy portfolio standards, some of which require a certain percentage of solar capacity. Plans for a 40MW solar PV plant were recently announced in Europe (see box relating to Moser Baer, page 22).

CHAPTER 3

IFC's Lessons of Experience

Through the implementation of the projects discussed in this report, IFC has learned a great deal about the solar PV market in developing countries, the type of financing required to support solar PV market growth in those countries, and what it takes to develop a successful solar PV company. Perhaps one of the most significant lessons that IFC has learned is that the solar PV market is far more complex than first envisioned.

This complexity is rooted in the fact that, despite the apparent social and environmental benefits, solar PV remains unaffordable to the majority of the unelectrified population in most developing countries. The mere fact that it is more economically affordable for a government to provide electricity through solar PV than through grid expansion does not, in itself, make solar PV financially affordable to the end user. It is important to explore the different segments of a potential market, develop products that are suitable for different consumers, and respond to a range of needs and income levels, as well as identify opportunities where solar PV is the least-cost alternative.

LESSONS ABOUT THE SOLAR PV MARKET IN GENERAL

While solar PV technology is a well-established technology, and technical advances have been significant during the last several decades, the emergence of a consumer market for solar PV is relatively recent in most developing countries. When IFC first became involved in the solar PV market, there was a great deal of excitement regarding the potential for growth in the market. As IFC quickly came to realize, however, these projections were overly optimistic and not supported by changes in market fundamentals. Affordability remains a key issue today; government support is still needed, but often lacking; and, overall, unsubsidized solar PV programs are difficult to implement, particularly in light of the degree of subsidization and political support for alternatives, such as grid extensions.

Expectations Were Overly Optimistic

It has now become apparent that early solar PV programs, designed by IFC and others, suffered from overly optimistic outlooks on the solar PV market's growth opportunities. With 400 million unelectrified households, the potential market seemed vast, but it rapidly became apparent that the actual potential demand did not equal the entire unelectrified population. While extensive market studies were carried out prior to the implementation of any of IFC's solar PV programs, these studies focused more on identifying businesses than on evaluating end-user demand. Furthermore, upon implementation, it became apparent that many of the opportunities that had been identified by the market studies during the planning stage were not appropriate. In the case of SDC, for example, not one of the over 100 opportunities identified in the feasibility study received SDC support. The initial market assessment had overestimated the maturity of the market; it simply was not yet ripe for the type of equity investment SDC was seeking to provide.

Solar PV Is Not the Only Answer to Rural Electrification

Most of IFC's financing programs had a dedicated focus on solar PV, an optimistic and too restrictive "tunnel-vision" reflection of the general belief that

solar PV was the best solution in areas not connected to the electrical grid. Small-scale solar PV systems do not offer the constant supply of electricity that most people want, and without focused financing programs, it continues to be unaffordable to the vast majority of the unelectrified population. In the absence of a grid connection market, consumers have continued to find other, more affordable ways (diesel generators, disposable batteries, kerosene lamps) to meet their electricity needs.

The Hard-to-Define and Very Segmented Solar PV Market

The market for solar PV in developing countries was initially defined to be the total number of unelectrified households, some 1.6 billion people. In reality, the market for solar PV is much smaller and significantly more complex to define; smaller largely due to the issues of financial affordability and perceived value, and complex in the need to recognize the different market segments, which are rooted in income level, lifestyle, and numerous regional and geographic differences.

Financial Affordability and Perceived Value

The biggest barrier to widespread adoption of solar PV technologies is affordability. At the time each of the IFC initiatives was structured, it was widely believed that the price for solar PV modules would continue to decrease significantly as mass production scaled up, thus making solar PV electricity more competitive. However, as indicated previously, the anticipated decrease in solar PV prices did not materialize; the price actually increased in 2004/2005.

The issue of affordability has been a key driver of the business models employed by solar PV companies. In order to keep the upfront cost of SHS affordable, companies have generally followed one of two approaches: they have provided SHS on a fee-for-service, or rental model, charging a monthly fee for the service provided, or they have arranged for financing to allow the consumer to pay the balance of the SHS in monthly installments (lease/hire purchase model). Many businesses also engage in cash sales. Through Soluz Honduras, experience has shown that the fee-for-service, or rental, model has ultimately proved unsustainable, since unexpected grid expansion tends to jeopardize the customer base before the high upfront costs of acquiring and installing the solar PV systems can be recovered by the solar utility.

The continued high price of solar PV modules is further offset by the issue of perceived value. Experience by IFC and others has shown that affordability is not exclusively linked to price or the availability of financing. Affordability is also linked to the perceived value and opportunity cost of solar PV purchase. In many rural settings, the purchase of a solar PV system represents a very significant expense; in Vietnam, for example, the systems provided by

LESSON LEARNED: GOVERNMENT SUPPORT CAN MAKE A DIFFERENCE

SOLAR PV PLANT CONSTRUCTION IN THE CZECH REPUBLIC

The IFC/GEF CEEF program* has issued a $1.08 million project guarantee for a 1.2MW solar power plant, the largest solar PV power plant installed to date in Central and Eastern Europe. The solar PV power plant became operational on January 29, 2007. This installation, in Busanovice, southern Bohemia (Czech Republic), will decrease the country's CO_2 emissions by 743 tonnes annually, and will produce 620MWh/year.

Electricity from solar PV, as well as other renewable sources, has the support of Czech national renewable energy legislation, which guarantees feed-in electricity tariffs for 15 years from project commissioning and off-take obligation for the grid operator. For solar PV power, the feed-in tariff is 13.62 Czech crowns/kWh ($0.62/kWh).

The plant has already been connected to the distribution network and started commercial operation on February 1, 2007. The 2,660 silicon-based solar PV modules, which are spread across 6,170 m^2, can ensure electricity supply for 172 households. The maximum planned capacity of the power plant is 693 kW. A solar PV panel with an area of 1 m^2 produces as much electricity in a year as 250 kg of coal and saves a total of 750 tonnes annually of CO_2 that would otherwise be discharged into the atmosphere by the operation of a coal-fired power station. By the end of 2007, the plant capacity will be ramped up to 1.2 MW.

* IFC/GEF-CEEF, the Commercializing Energy Efficiency Finance Facility, operates in Eastern Europe with both GEF and IFC financing. The facility provides a partial guarantee for loans made by local financial intermediaries for EE/RE projects, as well as technical assistance.

Selco Vietnam were sold for roughly a year's income. As a result, the decision to buy even a small solar PV system often meant sacrificing a larger item. There is a trade-off, however: with their limited electricity supply capacity, solar PV systems often do not come out on top, when compared to possible alternative purchases.

Economies of Scale

Solar PV technology is well suited to rural, highly dispersed, sparsely populated areas, but it is precisely in these areas that solar PV programs are most difficult to implement. A certain scale is required in order to become profitable, but if the company sees a need to reach too far out of the central community to increase the scale, it can become too expensive to service the consumers, and the economies of scale are then lost. Solar PV companies are more likely to experience success when able to operate in markets with critical masses of potential consumers that were geographically concentrated. It is only when operating in a relatively dense market that companies are able to take advantage of economies of scale. Part of Grameen Shakti's success, for example, is attributed to its servicing densely populated areas; economies of scale were not an issue. While there are examples of solar PV businesses that have operated successfully in more sparsely populated areas, it is certainly a more difficult venture.

Government Support and Enabling Environment

A supportive legal environment is essential and should include as many of the following elements as possible: no import duties or tariffs on SHS components; incentives for solar PV energy or absence of competing subsidized electricity; publicly disclosed long-term government electrification plans; and a legal basis for enforcing loan collection. For example, the SME Program's investment in Soluz Honduras had significant issues surrounding unexpected grid expansion, forcing Soluz Honduras to remove newly installed systems at a considerable loss. In contrast, PVMTI's investment with Sunlight Power Maroc benefited from an agreement with the

national utility to provide SHS under a subsidized fee-for-service scheme within an exclusive geographic concession.

Subsidies

Unsubsidized solar PV programs have proved particularly difficult to implement. Rural electrification is heavily subsidized throughout the developing world, as are solar PV and other RE technologies in developed countries, such as Germany, Japan, and the United States. All programs examined in this report received some form of subsidization, be it in the form of financing, using GEF funds provided through IFC at terms unavailable in the market, or through local government, as in the case of Sunlight Power Maroc, which has benefited from an extensive government program, subsidizing fee-for-service solar PV systems. The CEPALCO project received a grant equivalent to 70 percent of the overall construction cost of the plant. While the plant makes a strong technological case for the reliability of utility-scale solar PV power plants, from a financial standpoint the plant would not have been feasible without some form of subsidy. It is widely acknowledged that given most current market conditions, some form of subsidy is necessary to maintain solar PV businesses in the developing world.[19] IFC has found that there is a particular need for continued technical assistance funding as part of its financing programs. The question that remains to be answered, however, is whether technical assistance grants will provide enough of a subsidy, or if more substantial subsidies are needed and, if so, in what form?

LESSONS ABOUT IFC'S FINANCING PROGRAMS

With GEF funding, IFC has been able to implement a number of different solar PV financing programs. Despite the enthusiasm, with which the inception of the different financing programs was based, IFC learned very early in the implementation of its solar PV programs that the market reality was not what had been envisioned. There was need for greater flexibility and patience. Despite the risk-sharing tools offered by IFC, in large part through GEF support, financial institutions (FIS) continued to perceive solar PV to be risky, due to their inexperience with the technology, the nature of SMEs, and the economics of the solar PV market. In the end, it was found that many of IFC's financing programs required tailoring to the specific needs of individual countries and, therefore, the experience offered limited replicability at a general level. Most profitable opportunities in the solar PV market also lay further upstream in the value chain.

Need for Flexibility in Program Design

The solar PV market is very much a developing market and, as such, it requires substantial flexibility in project design, as shown by the following examples. IFC's experience in solar PV has demonstrated the need to adapt initial project designs to a number of areas: from the length of repayment schedules to interest rates to the business plan and, particularly, with respect to the financial instrument used.

RESTRUCTURING. In the face of continued difficulties in placing funds, particularly in Kenya, PVMTI's approach to the market was restructured. The restructuring, allowing for more technical assistance funding and longer repayment periods to be provided to Kenyan clients, had a significant effect on PVMTI's ability to place funds. The different experiences of SDF and SDC also highlight the importance of being open to revising the original program design. SDF, with its more flexible funding options (providing working capital loans with minimal security, guarantees, and grants), was able to successfully meet its financing targets, while SDC, with its focus on larger projects, greater return expectations, and exclusive focus on equity investments, had a great deal of difficulty placing its available funds. Had SDC been designed differently from the outset, or if it had been able to reach consensus amongst its shareholders concerning its attempted restructuring, it is possible that the overall experience of SDG would have been much more positive.

VOLATILE MARKET CONDITIONS. Lower income rural populations are particularly susceptible to the macroeconomic situation of their country (economic shocks, currency changes, changes in the price of crops), as well as natural disasters. They are also subject to cash flow issues, as monthly incomes fluctuate according to seasonal harvests and sporadic income-generation activity. These issues had a strong effect on the ability to make payments both at the consumer and project level, and IFC programs had to introduce some flexibility into the repayment plans to accommodate these issues. Grameen Shakti saw a full 90 percent of its operating area flooded in 1998, when the worst flood in over a century hit Bangladesh. People were focused on the essentials (food and shelter) and, as a result, sales were non-

[19] Solar PV businesses are able to operate sustainably without subsidies when they are the lowest cost source of power for a market segment.

existent and the default rate on collections was extremely high. The SME Program loan to Grameen Shakti had been structured with a two-year grace period, with payments to be made on an annual basis and, as a result, Grameen Shakti did not have issues in servicing the SME Program loan, even though collections from Grameen Shakti's clients had to be delayed as a result of the flood. Selco Honduras also suffered a major setback following the devastation brought by Hurricane Mitch in 1998.

SIMPLIFIED TRANSACTION PROCESS. In many instances, IFC's lengthy and cumbersome deal approval process proved too stringent for small solar PV companies. The SME Program, which had been specifically designed for small and medium companies, adopted a less burdensome deal approval process that was more in line with the characteristics of solar PV companies. Lacking an extensive focus on SMEs, both SDC and PVMTI had cumbersome documentation processes, resulting in deals being canceled due to the fact that the time from approval to disbursement was too long, as well as high operational costs in relation to portfolio size.

GRAMEEN BANK

Grameen Bank was established by Professor Muhammad Yunus in 1971 as a research project. By December 31, 1995, the bank had equity of $100 million. Not regulated by the Bangladesh Superintendent of Banking or any similar regulatory body, Grameen Bank is notionally owned by its 2 million members, each of whom owns one share. The majority of the bank's clients are poor and landless and live in rural areas, with 94 percent being women. The members elect 9 of the 13 members of the Board of Directors.

In 2006, Muhammad Yunus and Grameen Bank were awarded the Nobel Peace Prize for their work on economic and social development among the poor.

Need for Flexibility in Investment Offerings

In addition to flexibility in program design, flexibility in investment offerings is necessary. Investment offering needs vary significantly, based on market segment, specific country, or regional needs. Many of IFC's programs offered one particular type of financing—SDC provided private equity, and the SME Program provided concessional loans through intermediaries—and, as a result, it was found difficult to place their funds. SDC was eventually disbanded due to its inability to disburse funds, as the market was generally not ready for private equity investments. The SME Program, with its concessional loan offerings, proved more flexible, and placed the majority of its solar PV-related funds directly, without the help of intermediaries.

Private Equity Is Not the Answer

IFC attempted to attract private equity to the solar PV market through SDC. It found, however, that private equity funds, as a financial instrument, are not well-adapted to the needs of the solar PV market in the developing world[20] and the demanding requirements of a private equity fund. The private equity model is premised on the concept of high risk/high return. The solar PV market in the developing world has certainly proved itself to be high risk; however, financial returns have generally been disappointing. In addition to poor returns, SDC found it difficult to make equity investments, due to the small deal sizes, limited management skills, lack of financial accounting standards, inadequate exit strategies, and the time-consuming and costly administrative monitoring required for equity investments.

Yet, solar PV companies are in need of capital. Launching a successful SHS distribution company requires a significant upfront investment in order to purchase equipment, establish distribution channels, and raise consumer awareness. IFC experience has shown that it generally takes several years to recoup this investment. Renewable energy and energy efficiency projects often attract similar types of investors; however, it is important to keep in mind that the payback periods for renewable energy projects, in particular solar PV projects, are much longer than those for energy efficiency projects. To compare, energy efficiency projects often have payback periods of less than two years, while renewable energy projects are almost always over three years. In the case of solar PV projects, payback periods can be in excess of 10 years. Patient capital and long-term loan commitments with modest financial return expectations are what is needed. For small rural businesses, simple loan instruments with modest security provisions are most appropriate.

Financial Institutions Still Find Solar PV to Be Too Risky

IFC underestimated the conservativeness of local financial institutions as far as providing financing to smaller solar PV companies. IFC believes that in order to leverage local financial resources, it should not only raise awareness and provide technical assistance, but also engage the local financial institutions more directly by devising risk-sharing products that can be deployed to finance renewable energy pro-

[20] This experience is somewhat unique to the developing world. Many private equity and venture capital companies are involved in solar PV manufacturing projects looking to sell solar PV in developed countries, where bigger systems are being sold, prices are higher, distribution problems less daunting, and needed economies of scale are easier to come by.

jects. Unfortunately, solar PV proved to be too risky for most FIs. Solar PV is deemed risky for two reasons: (1) most solar PV companies are SMEs, and FIs have generally been wary of financing SMEs, and (2) the economics of the solar PV market means that there are high risks and uncertain returns. Grameen Bank's support of Grameen Shakti (see Grameen Shakti case study, page 32) was a notable exception to the reluctance of FIs to support solar PV projects and provides a successful example of how financial intermediaries can support the solar PV market. However, this is more representative of the uniqueness of Grameen Bank (see box, page 20) than it is indicative of the possible interest of most local FIs to engage in solar PV.

The SME Program, in particular, sought to work through financial intermediaries. However, while the program was able to work through intermediaries for a number of the projects implemented through it, when it came to solar PV investments, this proved to be a significant challenge. In Vietnam, for example, the SME Program had initially hoped to provide financing to the Vietnam Women's Union (VWU), which had taken on the sales and collections role for Selco Vietnam. However, the VWU viewed the risks of providing end-user financing as too high, and was unwilling to take on the responsibility for the financing. In the end, the SME Program provided the loan directly to Selco Vietnam. In fact, E+Co and Environmental Enterprises Assistance Fund (EEAF), both nonprofit nongovernmental organizations (NGOs) and financing institutions with environmental missions, were the only intermediaries supported by the SME Program that agreed to commit concessional loan financing to solar PV projects.

Need for a Broader Technological Focus

In the IFC experience, investment facilities that were exclusively focused on solar PV (SDC and PVMTI) had more difficulty placing funds than the programs that had the flexibility to also invest in other sectors and technologies (SME Program). Furthermore, those types of programs were able to offset some of the risks associated with solar PV.

Need for a Broader Operational Focus

It is important to note that SDF, with its exclusive focus on solar PV, was largely successful. However, this success can be linked to its pre-agreed scope of operation; unlike other projects, SDF was a nonprofit entity that provided a range of business development assistance and seed financing to establish new solar PV ventures and support existing early-stage businesses. The type of flexible support SDF provided was greatly needed and in high demand in the solar PV market and, as a result, SDF was largely able to meet its goals. By contrast, both SDC and PVMTI were faced with having to undergo major restructuring, since their narrow initial investment terms were out of touch with the market reality. SDC was eventually disbanded when management was unable to identify a large enough number of investments to provide the type of returns investors sought. PVMTI was restructured to allow for longer repayment periods and increased funding for technical assistance. PVMTI also relied only on GEF funding, while SDC had private capital, which was more demanding.

Limited Replicability

The experience of PVMTI, in particular, demonstrates how the same model can lead to different results in different countries because of specific country conditions. PVMTI operates in India, Kenya, and Morocco, three countries selected for their supportive policy environments and the presence of a

LESSON LEARNED: THE NEED FOR A MIX OF TECHNOLOGIES

THE PORTFOLIO APPROACH TO DISTRIBUTED GENERATION OPPORTUNITY (PADGO) PROJECT

The ultimate goal of the PADGO project is to reduce CO_2 emissions by displacing central fossil-fuel-based generation in favor of a portfolio of renewable and clean fossil-based distributed energy (DE) generation technologies with waste heat recovery (also known as combined heat and power). In order to achieve this goal, the project has been divided into two phases.

Phase 1 of the project will focus on Sri Lanka, and will have three specific goals. First, it will develop a performance framework that would enable risk sharing between IFC and the local banks on their existing portfolio of mini-hydro investments. Second, PADGO will focus on introducing new technologies to the DE mix by promoting complementary DE technologies (for example, reciprocating engines, biomass, PV, wind). IFC will work with established private sector players to do one or more pilot projects with a technology that has not been extensively implemented in Sri Lanka. Third, it will identify the key problems that the electricity grid may face with large-scale DE generation, and will develop key guidelines on how DE generation can be assimilated into an integrated resource planning effort at Ceylon Electricity Board.

During Phase 2, IFC will incorporate into the risk-sharing framework the lessons learned from the introduction of the new technology-based pilot project initiated in Phase 1. The framework will thus be made more robust and applicable to a larger set of technologies. The financing process will move closer to an asset-backed securities approach, as larger volumes of transactions are targeted. Significant progress is also expected during Phase 2 on the integration of DE technologies into a mini-grid structure that allows for dispatch capability and value for capacity.

vibrant emerging solar PV market. PVMTI experienced considerably more success in India, where the market for solar PV was widely established and enjoyed considerable government support, and there were a large number of established solar PV companies and relatively widespread knowledge about solar PV technology. In Kenya, PVMTI found that there was considerably more need for technical assistance funding. A large number of solar PV systems had been sold in Kenya on a pure cash basis by very small local companies, but there were no performance standards, and the quality of many systems had been called into question, undermining the initial progress that had been made in the market. In Morocco, a stepped-up fee-for-service program, subsidized by the government, reduced the need for consumer financing, while increased availability of black market solar PV modules put increased pressure on module prices.

There Are Profitable Opportunities in the Solar PV Market, But They Lie Further Upstream in the Value Chain

An important finding that emerged from IFC's solar PV experience is that there are more viable opportunities further upstream (module manufacturing) in the value chain than downstream (SHS distributors). IFC's investments lay primarily further downstream in the value chain. One reason for this is that manufacturing companies are often able to obtain local commercial financing more readily, because it is backed with assets, unlike the cash-flow-backed financing provided to SHS distributors, and IFC aims to provide financing only when it is not available through local sources. A second reason is that the vast majority of manufacturing activity in the solar PV industry is focused on export to subsidized western markets (primarily Europe), and it was not appropriate for IFC to use GEF funds when it could not ensure that they would be used to support renewable energy in the developing country.

Need for Technical Assistance Funds

Technical assistance grants are still needed in order to help move the solar PV market forward. In order for commercial solar PV enterprises to be successful, technicians need to be trained, industry standards need to be developed, and local governments need to be lobbied for support. PVMTI found that TA was particularly needed in Kenya. In the 2004 restructuring, the initiative approved additional TA grant funding to support the training of solar PV technicians, create quality awareness in the market, support the Kenya Renewable Energy Association (KREA), and establish a quality assurance program for SHS in the Kenyan market.

Shareholder Diversity

The more diverse a shareholder group is, the more difficult it is to manage expectations. The immaturity of the solar PV market means that financing programs have to be flexible in order to respond to the changing market realities. With a diverse shareholder group, this flexibility often does not exist. Both PVMTI and SDC found very early on in the implementation stage that original targets should be restructured and reevaluated. PVMTI, with its simple shareholder base, was able to complete these changes; however, SDC, with its very diverse shareholder base, found it impossible to reach consensus on changes, which forced its dissolution, rather than allowing for more flexible restructuring. The shareholder diversity that had been much applauded during the initial structuring of SDC proved, in the end, to be one of SDC's greatest constraints.

LESSON LEARNED: MOVING UP THE VALUE CHAIN

MOSER BAER IN INDIA

Moser Baer India Ltd. (MBIL) is the third-largest manufacturer of recordable optical storage media products (CDs and DVDs) in the world. MBIL is also an existing IFC client. Currently, MBIL is undertaking a two-year diversification program that involves setting up an export-oriented solar PV cell and module manufacturing facility with an installed annual production capacity of 80MW in Greater Noida, India.

IFC has recently approved a $22.5 million long-term loan to the company to support this $92 million project. This project, which has the potential to avoid 80,000 tonnes of CO_2 emissions annually, will also lead to the creation of about 600 additional jobs.

LESSONS ABOUT WHAT MAKES A SUCCESSFUL SOLAR PV COMPANY

While there are some notable successes among some of the solar PV companies IFC provided financing for, the majority of them did not live up to their original expectations. Although IFC has not been able to identify a fully viable sustainable business model for solar PV distribution companies in developing countries to replicate, its decade-long experience working in the solar PV market has highlighted a number of key areas that companies should focus on and resources that need to be in

place in order to help ensure the successful operation of such businesses.

Product Offering and Market Segmentation

In order to ensure that they are providing the right products, solar PV companies should acknowledge the different market segments that exist. Low-income consumers are often looking for a solar PV system that will support a single light source, while higher income consumers might well be grid-connected and be looking to purchase larger solar PV systems that recharge back-up batteries to help ensure an uninterrupted power supply in the event of power outages. The needs of each of these different customers vary greatly, and solar PV companies should adjust both their product offering and their marketing strategies in order to satisfy different consumer market segments.

In addition to income level, consumption priorities and lifestyle have proven to be key segmentation issues. These issues also vary from country to country. In Vietnam, for example, having a television was seen as more important than having a light; therefore, people were more interested in larger solar PV systems. Additionally, there was no debt or consumer credit culture in Vietnam; i.e., there was little market for smaller systems, and consumers tended to be from higher income groups, who could afford to purchase systems outright (so-called "early adopters").

Provision of Consumer Financing

Consumer financing has often been seen as the key element to developing the solar PV market. Without financing, the large initial price tag of acquiring a solar PV system is simply unaffordable to the vast majority of the population without electricity. IFC's experience has shown that investors and banks do not like to finance solar PV purchases, as they perceive them to be too risky. Also identified was that solar PV companies are generally more skilled at the manufacturing and commercial distribution of solar PV, and are not concerned with the risks associated with provision of consumer financing. Successful solar PV companies are those that have a way of engaging skilled providers of consumer financing, thus allowing them to remain focused on their core solar PV business. Grameen Shakti, an SHS provider in Bangladesh that received financing from the SME Program, was well positioned to provide consumer financing because of its parent company, the well-established and respected Grameen Bank. This relationship was a major contributing factor to the success of Grameen Shakti.

LESSON LEARNED: AFFORDABLE PRODUCT OFFERING TAILORED TO TARGET MARKET SEGMENT

LIGHTING THE BOTTOM OF THE PYRAMID

The Lighting the Bottom of the Pyramid program will leverage IFC's global network, industry expertise, and regional experience, as well as donor funds to catalyze local and international lighting-related companies to offer the unelectrified population in Kenya and Ghana greater access to modern and affordable off-grid lighting products and displace fuel-based lighting products (kerosene lamps, candles).

Current consumption of fuel-based lighting represents a large global market, mostly served by oil and gas companies, but largely untapped by lighting companies. Independent estimates indicate that worldwide spending on fuel-based lighting in developing countries is $38 billion per year. In Kenya and Ghana alone, IFC estimates the total spending on fuel-based, off-grid lighting to be $1.4 billion per year. Hence, IFC believes there is an opportunity to attract lighting companies to enter and compete in the fuel-based, off-grid lighting market with modern and affordable off-grid lighting products, harnessing the private sector profit-seeking motivation to increase access to modern lighting services and reduce poverty.

In order to seize this opportunity, IFC will facilitate the entry of local and foreign lighting companies to this market by helping firms (i) understand the market, including consumer behavior and preferences concerning lighting, acceptable pricing points, and distribution channels, and (ii) understand and mitigate the perceived risks of entering into a new market in a region that, for most private companies, is very challenging. The entry of several modern lighting companies in this market and their competition for market share will bring unelectrified citizens in Kenya and Ghana a variety of modern off-grid lighting products that will be better and more affordable than fuel-based lighting. Their lower power requirements will also enable more cost-effective use of solar PV as a power source (e.g., solar PV lanterns).

As of January 2007, 135 private companies and 63 stakeholders from 35 countries had expressed interest in participating in this initiative. The project target end-results for Kenya and Ghana are (1) to provide greater access to off-grid lighting products that are more modern and affordable than fuel-based lighting; (2) to reach 316,000 (low-end scenario) to 1,500,000 (high-end scenario) end users with modern, off-grid lighting products by 2015; and (3) to reduce CO_2 emissions from fuel-based lighting from 782,000 tonnes (low-end scenario) to 3,909,000 tonnes (high-end scenario) by 2015.

For more information, please visit www.ifc.org/led.

Management and Staffing

A consistent theme that emerged from IFC's solar PV experience is that the entrepreneur is absolutely critical to the success of the project. Given that solar PV players tend to be small and operate in complex markets, it is documented that hands-on managers who possess strong management skills are crucial.

Managers should be flexible in order to respond quickly to changing market realities. Establishing a local presence through appropriately trained local staff is mandatory for any company looking to be a player in the solar PV market. As the solar PV market in each country differs, the social and cultural knowledge of local staff is essential to the development of a solid understanding of consumer needs.

As mentioned above, Grameen Shakti benefited significantly from its relationships with Grameen Bank, as the bank's presence in approximately 36,000 villages provided significant local knowledge that it was able to share with Grameen Shakti. Furthermore, Grameen Bank's general manager dedicated 20 percent of his time to the direction of Grameen Shakti.

The experience of CEPALCO in the Philippines highlights the need for a strong and experienced management team and staff who understand the local environment. Although it was only a small, 1 MW RE project, local staff had to obtain over 50 permit approvals before construction on the CEPALCO solar PV plant could begin, a feat that would likely have been impossible without adequately knowledgeable local staff. Furthermore, the permitting process delayed construction and, as a result, strong management was required for the project to be completed on schedule.

Local Partnerships and Government Relations

The importance of strong government relations, particularly in terms of understanding planned grid expansions, cannot be overstated. The Soluz Honduras experience showed the significance for strong government relations to be backed by legally binding concession agreements. Soluz was operating in Honduras without any formal government concessions and, as a result, found itself unprepared for competition from unexpected grid expansions. Grid expansions are a political tool in many developing countries, and are often unpredictable in terms of funding and timing. Operating without some sort of binding legal agreement from the government puts companies at increased risk of customer loss.

In addition to supportive government relations and, in some instances, due to inadequate government relations, the development of local partnerships is pivotal to the success of a solar PV company. When Grameen Shakti first began operations in Bangladesh, for example, local government support was lacking, and the company sought to partner with local educational institutions to ensure that it remained on the cutting edge of technology. When Selco entered the Vietnamese market, it formed a partnership with the Vietnam Women's Union (VWU) to support the financing of sales of SHS in rural communities. The VWU had representatives in every village in the country, and while the partnership was eventually dissolved, it was of great benefit to Selco Vietnam, as they began to gain a foothold in the country.

Sales versus Rental

There are two primary models currently being employed in the solar PV market: sales (on a hire-purchase basis) and fee-for-service rentals. According to IFC's experience, the sales model is much more sustainable, especially given current market conditions. Soluz Honduras began operations as a fee-for-service company, supplying SHS to consumers on a rental basis. It became apparent after several years of implementation, however, that the rental model was not financially sustainable. While a rental model made it easier for the end user to ac-

quire the systems, the equipment cost accumulated with the company and, as a result, it was not financially sustainable for an SME start-up. The initial large outlays for capital equipment could not be offset by small monthly rental fees. Soluz Honduras eventually adopted a sales model.

Marketing

Even when a company has matched the right products to the right market segment, a strong marketing effort is crucial. There is still substantial misinformation and lack of understanding as to what services a solar PV system can reliably provide and at what cost. Furthermore, the presence of poor quality systems in some markets has resulted in solar PV being perceived as unreliable and even undesirable. Solid marketing strategies that include demonstration projects should be in place in order to educate the general population. Grameen Shakti initially provided SHS free of charge to key people in a village, promoting a type of demand associated with "keeping up with the neighbors". Selco Vietnam engaged the VWU to help sell their systems, as the VWU had presence and influence in just about every village in the country. These unique marketing strategies contributed significantly to overall sales.

Entrepreneurial Spirit

In some countries, notably India and Bangladesh, there was a considerable entrepreneurial spirit to be found among end users. This entrepreneurial spirit appeared to have some influence on the success of the solar PV company itself. In Bangladesh, one end user used solar PV panels to charge cellular phones, which he then rented out to people in his village. His business was so successful that he was able to purchase a larger solar PV system while also providing a better education opportunity for his children. Where this type of entrepreneurial spirit existed, there was greater demand for solar PV systems, and consumers had a greater ability to make their payments. It also demonstrated how the provision of solar PV can lead to increased income-generating activities.

CHAPTER 4

IFC's Approach Today

Having extensively evaluated not just its own experience, but also the experience of several key players in the solar PV business, IFC remains cautiously optimistic that it is not a question of "if", but of "when" the goal of a self-sustaining solar PV market in developing countries will be met. Simultaneously, IFC recognizes the current limitation of solar PV technologies to address the issue of rural electrification. To that extent, it is currently exploring new ways to address rural electrification through using a variety of renewable energy technologies as it moves away from a specific solar PV focus to a more technology-neutral approach.

Although generally less heralded now compared to the mid-1990s, solar PV as a technology continues to hold promise, having proved to be the most appropriate way of meeting the power needs (lighting, television, radio) of dispersed and remote rural households. With the rising price of crude oil and natural gas, the global commitment to the Millennium Development Goals and Kyoto Protocol, renewable energy technologies, including solar PV, will become more economically viable. The private sector can play an important role in making renewable energy and solar PV services available, as demonstrated by IFC through its recent investment in Moser Baer in India (see box on page 22).

The most important factor that will determine the future role of solar PV in rural electrification initiatives continues to lie in the ability of companies to identify the niche market segments for which this technology is the least-cost alternative. The continued decline in solar PV prices will help create more of these opportunities. Increased manufacturing capacity, new materials that bypass the global bottlenecks caused by the limited supply of silicon, and newer and higher efficiency solar PV materials and end-user devices (i.e., lighting via LEDs) are all contributing factors that should reverse the recent upward trend in solar PV price.

Continued Support to the Market

While solar PV is no longer a specific focus, IFC remains committed to it as a renewable energy technology for addressing the issue of rural electrification in developing countries. IFC has moved away from solar PV-focused initiatives, such as SDG and PVMTI, in favor of more technologically neutral programs. The corporation is increasingly providing its own funding on commercial terms, without reliance on donor subsidies, to support

[21] This includes hydropower projects greater than 10MW per facility.

WORLD BANK GROUP COMMITMENT TO RENEWABLE ENERGY

The WBG has remained true to the commitment it made at the June 2004 International Conference for Renewable Energies in Bonn, Germany, to increase its renewable energy and energy efficiency portfolio by 20 percent during a five-year period (2005–2009). During both 2005 and 2006, the WBG surpassed its Bonn target, having financed $668 million worth of EE/RE projects in 2006 and $461 million worth in 2005. These commitments represent a 45 percent increase for new RE and EE, more than double the Bonn 20 percent target. Overall, financial support to EE/RE[21] was $860 million in fiscal year 2006. Total WBG sustainable energy financing in 2006 supported 61 projects in 34 different countries.

Among the various WBG institutions and units, IFC was the largest contributor to RE and EE, with $393 million in commitments, and contributions of $326 million of its own funds for new RE and EE projects and $67 million for hydropower projects greater than 10MW. These increases suggest that the concerted efforts of the WBG to scale up support for new RE and EE are having a positive impact.

larger utility-scale projects, through its Infrastructure Department, as well as solar PV module manufacturing companies, through its Global Manufacturing Department. (See Lesson Learned box on Moser Baer, page 22) Smaller solar PV initiatives, such as the SHS distributors profiled in this study, may find IFC support through the following market acceleration schemes:

WORKING THROUGH FIS: THE ENVIRONMENTAL BUSINESS FINANCE PROGRAM (EBFP). The EBFP, a $20-million GEF-funded facility, builds upon the experiences of the SME Program, and is specifically interested in engaging financial intermediaries in the financing of SMEs involved in activities that benefit the global environment. Designed to provide FIs with risk-sharing mechanisms that encourage intermediaries to provide financing to SMEs undertaking environmental projects, the EBFP also provides technical assistance grants to develop and strengthen an FI's appraisal, risk management, and monitoring and evaluation processes, as well as promote market development. Sustainable energy is a key focus of this program.

DIRECT INVESTMENT TO SUPPORT A MIX OF TECHNOLOGIES: THE SUSTAINABLE ENERGY FACILITY (SEF). The SEF is a $14 million IFC/GEF fund that finances sustainable energy and energy efficiency projects in Brazil, Central America, China, and Southeast Asia. Designed based on the experience of previous IFC programs, including SDG, the SEF structure has a more streamlined approval process. A clear focus was placed on debt instruments over equity, with convertibility features to take advantage of any potential upside. Unlike some earlier initiatives, the SEF has moved away from a single focus on solar PV to a broader renewable energy focus.

FOCUS ON AFFORDABLE OFF-GRID LIGHTING PRODUCTS: LIGHTING THE BOTTOM OF THE PYRAMID. This initiative seeks to catalyze local and international lighting-related companies, offering the unelectrified population in Kenya and Ghana greater access to modern and affordable off-grid lighting products, and displacing fuel-based lighting products (such as kerosene lamps or candles). The initiative aims to facilitate the market entry of the lighting companies by helping firms, firstly, to understand the market, including consumer behavior and preferences concerning lighting, acceptable pricing points, and distribution channels and, secondly, to understand and mitigate the perceived risks of entering into a new market in a region that, for most private companies, has been very challenging. (See Lesson Learned box on the Lighting the Bottom of the Pyramid initiative, page 23.)

FOCUS ON DISTRIBUTED GENERATION PROJECTS: THE PORTFOLIO APPROACH TO DISTRIBUTED GENERATION OPPORTUNITY (PADGO). This project aims to reduce CO_2 emissions by displacing central fossil-fuel-based generation in favor of a portfolio of renewable and clean fossil-based distributed energy generation technologies with waste heat recovery (also known as combined heat and power). A key focus of the project is on developing a performance framework to enable risk sharing between IFC and local banks, and on piloting private company projects using new technologies. (See Lesson Learned box on PADGO, page 21.)

TABLE 5: WORLD BANK GROUP COMMITMENTS FOR RENEWABLE ENERGY AND ENERGY EFFICIENCY IN FISCAL YEAR 2006 (MILLIONS OF DOLLARS)

SOURCE OF FUNDS	NEW–RE	HYDRO >10MW	EE	TOTAL
World Bank (IBRD/IDA)	135.7	118.6	115.3	369.5
World Bank (GEF and Carbon Finance)	54.7	6.0	1.2	62.0
IFC (own funds)	17.4	67.0	309.0	393.4
IFC (GEF, Carbon Finance and other trust funds*)	13.0	0.0	20.1	33.1
MIGA	0.0	0.0	1.8	1.8
Total	**220.8**	**191.6**	**447.4**	**859.8**

*The IFC's "other trust funds" category includes the Environmental Opportunities Facility.

Through the above market acceleration initiatives, the corporation aims to provide technical assistance and financing to support renewable energy technologies and practices that are commercially viable in certain applications, but whose market penetration is hindered by the persistence of market barriers. These barriers may include high upfront costs; a lack of financing, successful business models, adequate product quality standards, and consumer awareness; limited managerial and technical skills among project developers, etc. By addressing these barriers through carefully designed market interventions, which may include transaction support, enterprise and public education, and development of quality standards, these initiatives seek to accelerate

the penetration of sustainable energy technologies so that, at the end of project implementation, the market is further ahead than it would have been otherwise.

Going forward, IFC expects to see an increasing number of opportunities for mainstream renewable energy and energy efficiency investments, as renewable energy technologies become more competitive and regulatory frameworks are improved to encourage greater utilization. Beyond these efforts to finance mainstream sustainable energy projects, IFC has utilized and will continue to utilize limited—and carefully targeted—concessional funding to support worthwhile projects that are likely to accelerate the application of RE and EE technologies in developing countries. Since GEF was established in 1991, a significant quantity of funds has been provided by GEF under its operational programs to mitigate the effects of global climate change. IFC has received approval for more than $200 million in GEF funds to support climate change mitigation initiatives, including renewable energy. GEF funding continues to play a vital role in IFC's continued support of solar PV and other renewable technologies.[22] IFC always attempts to minimize the use of concessional funding and targets the subsidies in a hierarchy of preferred market interventions that favor projects that are closest to commercial viability and preferably involve a mainstream IFC investment.

By building partnerships with key players in the renewable energy field and increasing confidence in solar PV technology among suppliers, governments, utilities, and end users in developing countries, IFC, as part of the World Bank Group, seeks to promote solar PV and sustainable energy technologies. In general, it seeks to identify avenues to maximize financial leverage and experience and acts on particular opportunities to aggregate markets.

[22] While GEF support is generally not needed for small hydro initiatives, it is still an important component of solar PV, geothermal, and wind initiatives.

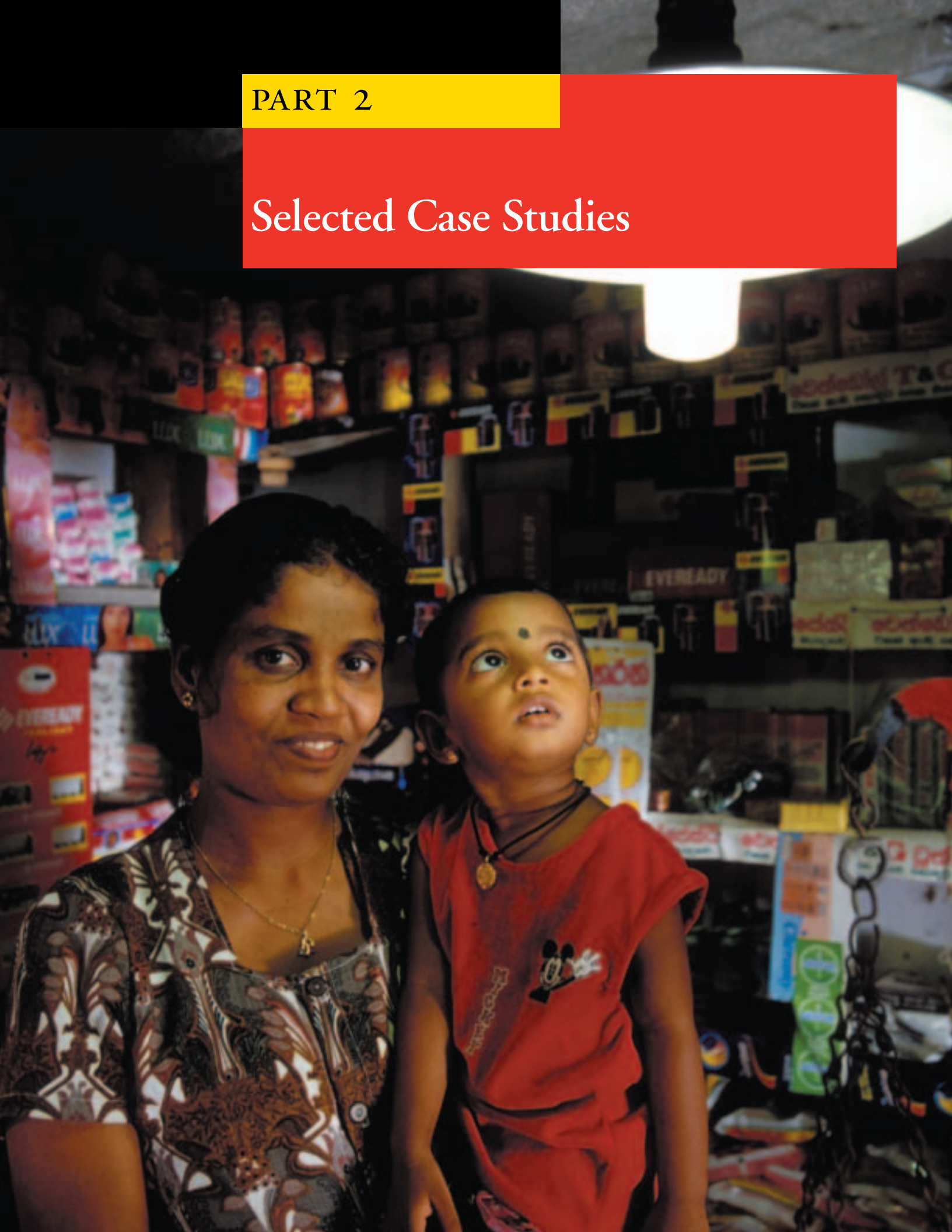
MAINSTREAMING SOLAR PV INTO IFC INVESTMENTS

The projects described in this report were primarily financed with concessional resources from GEF and other donor support mechanisms, because they did not meet minimum eligibility requirements for IFC investments (although IFC also did invest on its own account in the externally managed funds created under SDG). One measure of success in donor-supported programs is the process of "mainstreaming"; i.e., the ability to make similar investments on commercial terms without donor subsidies, an evolution that is occurring in the context of IFC's EE financing programs. As described in this report, the Corporation has approved an investment in a solar PV manufacturing facility in India (see Lesson Learned box on Moser Baer, page 22) and has indirectly supported a bank loan for a grid-tied solar PV power plant in the Czech Republic through a clean energy finance program (see Lesson Learned box on solar plant construction in the Czech Republic, page 17). For IFC to make additional fully commercial investments in solar PV production or enterprises, several conditions will have to be met:

- The investment should meet minimum size requirements to justify IFC's transaction costs. While some latitude has been allowed for RE projects, deals of less than $10 million are unlikely to be attractive.
- The expected rate of return should be commensurate with the level of perceived risk, which may be an issue for the production and sale of solar PV cells and modules currently being sold, primarily to satisfy short-term regulatory policies in a few industrialized countries, principally Germany, Spain, and the United States.
- Other positive attributes that may increase IFC interest in a project include opportunities to engage and influence government policy (e.g., through a solar PV purchase program), the leveraging of commercial finance from local FIs, local employment and associated supply chain benefits of the investment, and expected opportunities for further business growth.
- The proposed financing should also meet standard IFC conditions, including maintenance of appropriate minimum debt service coverage ratios, projected business performance metrics, sponsor support, and security arrangements. Most importantly, the financing should be based upon a sound and financially viable business plan that addresses a quantifiable market opportunity and is guided by an experienced management team.

PART 2

Selected Case Studies



CASE STUDIES I

The IFC/GEF Small and Medium Scale Enterprise Program

The IFC/GEF Small and Medium Scale Enterprise Program (SME Program)[23] was established in 1995. Financed with $20 million in GEF funds and managed by IFC, the program's goal was to improve access to finance, capacity building, and markets for SMEs active in the areas of climate change mitigation (energy efficiency and renewable energy) and biodiversity conservation. The program was the first GEF-funded, non-grant, SME financing program targeting the private sector and the first GEF program designed to receive capital reflows.

BACKGROUND

The objective of the SME Program was to encourage the private sector to generate global environmental benefits. It provided loans of $500,000 to $1 million to various intermediaries (financial, not-for-profit, NGO), and private companies for on-lending to SMEs whose activities would conserve the global environment. The goal was to help these SMEs expand so they would generate more environmental benefits. At the same time, the program sought to demonstrate that environmental benefits could be achieved through the private sector on a commercial basis, without the need for grants or subsidies.

The intermediaries were selected by IFC on the basis of their experience working with SMEs as well as their financial viability, understanding of environmental sectors, and technical capabilities in both environmental and financial areas. The intermediaries identified, assessed, financed, and monitored environmental SME projects, assuming the risk inherent in these projects by providing loans to, or making equity investments with, the SMEs. Initially, the intermediaries typically received a long-term (up to 10 years), low-interest-rate loan (typically 2.5 percent per year) from the SME Program, combining their own funds with other sources of funding to complement the financing requirements for the eligible SME projects.

Over its lifetime, the SME Program established a solid reputation and momentum, attracting the continued interest of intermediaries and other institutions. The initial $4.3 million pilot phase was replenished with $16.5 million in 1997 to expand operations and reach additional SMEs. Over its lifetime,[24] the SME Program approved $16.9 million to 25 nontraditional financial intermediaries, NGOs, or companies in 21 countries, which have provided financing to some 140 SMEs.

While the SME Program was not designed to specifically target the solar PV sector, it became operational at a time when IFC had become interested in making solar PV-related investments. Ultimately, the SME Program financed six projects that involved solar PV businesses: Grameen Shakti, Soluz Honduras, and Selco Vietnam (all SHS distributors); E&Co and EEAF (both nonprofit financing organizations with an environmental mission)[25]; and Cogener (a Swiss engineering company that installed solar-powered advertising panels at a Tunisian airport). This study has focused on the three SHS distributors:

- **Grameen Shakti.** A subsidiary of Grameen Bank, Grameen Shakti works to develop and deliver renewable energy systems to rural households and businesses in Bangladesh. The primary focus is on solar PV SHS.

- **Soluz Honduras S.A. de C.V.** A subsidiary of Soluz, Inc., USA, Soluz Honduras sells and rents small solar PV systems to rural customers in Honduras.

■ **Selco Vietnam, Ltd.** A subsidiary of U.S.-based Solar Electric Light Company, Selco Vietnam sells solar systems to unelectrified households in Vietnam.

Together, these three projects have installed over 24,000 SHS, for a total electrical capacity of over 1.3MW at peak performance.

WHAT WORKED AND WHAT DID NOT

A "Hands-on" Approach

A key factor for the success of the SME Program was the small size of the program, which enabled the management to be very "hands on" and knowledgeable of the projects it financed. Unlike other IFC projects with external management, the program was managed by an internal staff team. This "hands-on" management approach enabled the program to respond rapidly to restructuring.

Diversity of Portfolio Offsets Risks of Solar PV

In contrast to other facilities with which IFC was involved in the solar PV sector, the SME Program was able to invest in SMEs working in sectors other than solar PV. Given this flexibility, the program was able to develop a diverse portfolio that was not dependent on one particular market, allowing it to offset the risks of the solar PV market through SMEs working in less risky markets. Many of the solar PV ventures operational around the same period as those financed by the SME Program had considerable difficulties. The solar PV market simply did not develop as had been expected.

The Need for Local Ownership and Government Support Proved Vital

One of the key lessons of the overall SME Program experience was the importance of local country ownership and government involvement. Evidence suggests that this was similarly the case among solar PV-focused projects, Grameen Shakti being the only project that was locally owned and operated, while both Soluz Honduras and Selco Vietnam were subsidiaries of U.S.-based companies. Both Soluz and Selco were overly enthusiastic about the size of their potential markets, and both suffered from a lack of government support. While Grameen Shakti did not have considerable support from the Bangladeshi government, it had the support of a widely recognized, respected, and reasonably well-capitalized organization with a similar client base that helped them to develop networks to overcome that obstacle.

Economies of Scale Are Hard to Come By in Sparsely Populated Areas

The SME Program experience in solar PV highlights the importance of economies of scale to the solar PV market. Grameen Shakti, operating in densely populated Bangladesh, was a successful venture; Soluz, operating in Honduras where the rural population was more dispersed, was less so. While each entity operated under a different business plan, both were confronted with having to reach a certain scale in order to be profitable. However, that scale was far easier to attain in a densely populated area than within a dispersed population. While Grameen Shakti easily gained access to economies of scale serving many people in one community, Soluz Honduras, operating in areas with more dispersed populations, found itself in a no-win situation. To increase its scale, it needed to expand its area of operations, but when it did extend, its service costs increased.

CONCLUSION

Although the SME Program initially planned to finance projects through FIs, it ultimately financed most of its solar PV-related SME projects directly.[26] The program had found that FIs had little interest in financing solar PV projects (the two solar PV-related projects that were financed involved FIs with an environmental mission). Many FIs remained leery of financing SMEs, and when SMEs were coupled with a nascent technology like solar PV, FIs (particularly commercial banks) became even more reluctant.

Grameen Shakti, the SME Program's most successful solar PV project, far exceeded expectations in terms of the number of solar PV systems installed. Grameen Shakti continues to perform well, with a total of 77,000 SHS installed, benefiting more than 700,000 people in Bangladesh.[27] The performance of other PV projects of the SME Program projects has failed to live up to original expectations.

The SME Program proved overall to be quite successful, despite the mixed experience in the solar PV sector. Such experience gained has now been incorporated into the design of the EBFP. As previously mentioned, the EBFP is an IFC/GEF partnership which targets SMEs working on projects that are beneficial to the global environment. This program has RE, including solar, as one of its target technologies and activities.

[23] In the case of the SME Program, SMEs were defined as enterprises with assets valued at less than $5 million.

[24] In 2004 the SME Program was absorbed by the GEF-funded Environmental Business Finance Program.

[25] Both E&Co and EEAF on-lent to solar PV-related projects.

[26] The E&Co loan to Rex Investment in Tanzania and the EEAF loan to Soluz Dominicana represent the only solar PV projects to receive SME Program funds through FIs.

[27] http://www.grameen-info.org/grameen/gshakti/index.html, February 2, 2007.

GRAMEEN SHAKTI

Grameen Shakti (meaning "village power" in Bengali), established in July 1996 by Grameen Bank, aims to support this bank's poverty reduction mission by developing and delivering RE systems to rural households and businesses in Bangladesh. While the focus was on solar PV SHS, Grameen Shakti also supported wind and biomass projects, though on a much lesser scale.

BACKGROUND

Grameen Shakti has a secondary mandate, that of helping connect rural areas to the world through (solar-powered) information technology. Although registered as an NGO, it is run, for the most part, as a for-profit enterprise. The company's solar PV program represents its largest business line, purchasing solar PV panels and other systems components (i.e., batteries) from a range of foreign and local suppliers; and assembling, selling, installing, and, where necessary, financing them.

The Bangladeshi market for SHS is considered to be relatively large. Approximately 70 percent of households do not have accessibility to electricity, and frequent floods and cyclones, low levels of urbanization, and a very slow political and economic reform process have made establishing a traditional energy network (or grid) very challenging. Furthermore, the density of the Bangladeshi population means that, even in rural areas, there are significant concentrations of potential consumers.

In March 1998, Grameen Shakti was approved for financing from the SME Program. The $750,000 that the firm received permitted it to purchase SHS inventory. The program loan called for the sale of 3,200 systems within two years and provided a two-year grace period on repayment. This freed capital for Grameen Shakti to provide financing to customers, enabling them to overcome two considerable barriers to SHS sales in Bangladesh, namely, high upfront costs and lack of consumer credit.

An additional barrier to SHS sales in Bangladesh was lack of a strong field-based sales and service structure. The company, nevertheless, was fortunate in its ability to tap into the existing Grameen Bank branch network. The latter, as indicated earlier, has a presence in approximately 36,000 villages in Bangladesh, and Grameen Shakti operates through offices housed within the bank's branch locations.[28] Grameen Shakti offices are established in locations with high electricity demand and no access to the grid. Each office is staffed by two people, a manager and a technician, and is overseen by division managers who report to the general manager of Grameen Shakti.

In addition to being able to tap into Grameen Bank's branch network to reach customers and quickly establish a local presence, Grameen Shakti also benefits in other ways from the bank. Most notably is the use of the Grameen name, a name widely recognized and respected. Grameen Shakti also makes use of the expertise of the general manager of Grameen Bank, who spends 20 percent of his time directing Shakti.

OBSTACLES

Overall, Shakti has experienced many issues in the Bangladeshi market that are similar to those of other SHS companies in other world markets. There has been considerable skepticism concerning the viability and cost of SHS systems, coupled with the limited purchasing power of target end users, relative to the large capital cost of imported SHS equipment. Large volumes were needed to get unit costs down to a financially sustainable level, but to effectively do this, a large sales force was needed, and the cost of making individual sales with associated support was high.

While Bangladesh is ideally suited to solar power because of its higher than average solar radiation (ranging from 4.0 to 6.5kWh per square meter), solar energy industry activity was minimal at the time of Grameen Shakti's founding. The local market had not yet been established, and the Bangladeshi Government offered no support. Heavy import taxes on internationally sourced solar panels and a lack of local suppliers drove up prices. Furthermore, a general lack of awareness surrounding the technology was a consequence for low demand.

To overcome these obstacles, Grameen Shakti placed considerable focus on providing increased value to its clients, while making a dedicated effort to reduce costs and thus lower prices. An extensive warranty package (which could be extended for a small fee) included free maintenance for the first three years, training seminars for clients, routine system maintenance, and monthly inspections. This warranty has enabled the establishment to manage its maintenance costs and has contributed to a high level of customer satisfaction. Additionally, the company offers clients a 20-year money-back guarantee in the event that a client is, for any reason, unsatisfied with his/her system or the national grid, which is extended to service the client.

Lacking government support, Grameen Shakti had to rely on partnerships with other organizations in order to stay ahead. Partnerships with educational institutions and suppliers played an important role in pursuit of new technologies and identification of trends. In partnering with educational institutions, the company hoped to maximize its resources and provide clients with the most up-to-date and efficient technology. The provision of the most market-applicable technologies allowed the management to keep a step ahead of the competition. Partnerships with suppliers also proved useful

GRAMEEN SHAKTI AWARDS

Like its parent, Grameen Bank, Grameen Shakti has been widely recognized for its efforts in the international community and has been awarded a number of honors, including:

- Energy Globe 2002—Best 50
- European Solar Prize 2003—awarded by Eurosolar for spreading RE through micro-credit
- Best Organization Award 2005—awarded by Infrastructure Development Company, Ltd., of Bangladesh

[28] Today there are over 160 offices.

from both a cost and environmental management perspective. Grameen Shakti, for instance, maintains an agreement with one of its battery suppliers to take back, recycle, and adequately dispose of used batteries.

Grameen Shakti has made strong efforts to raise awareness about solar energy systems. A key marketing strategy involved targeting the wealthier members of a particular village; this approach was successful in promoting a type of demand associated with "keeping up with the neighbors." Grameen Shakti also actively promoted the use of SHS in income-generating activities.

A mere 2.5 percent of sales were full cash remittances; most sales depended on a 36-month payment plan. The seasonal cash flow of the economy proved to be a significant influence on customers' ability to make payments, and the collection program was adjusted accordingly. Most of the systems procured were for household application and quality of life improvement (e.g., lighting and entertainment); however, some were used for income-generating applications (see box on this page for an example).

The worst flood in over a century hit Bangladesh in 1998, devastating two-thirds of the country. A full 90 percent of the Grameen Shakti operating area was flooded, and as a consequence, no sales were recorded and defaults on collections soared, as people's focus shifted to the bare essentials of food, clothing, and shelter. The structure of the SME Program loan, with its two-year grace period and the arrangement of payments to be made on an annual basis, enabled IFC's client to remain current on its loan, despite the delay in collections.

The importance of Grameen Bank cannot be overstated. The bank's knowledge of the market, and its existing distribution infrastructure and client base, are key contributors to Grameen Shakti's success. As was evidenced in the other solar PV investments under IFC's SME Program, a lack of local knowledge and presence is a major barrier to the success of a solar PV enterprise. Furthermore, Grameen Bank was a valuable source of funding for the firm during its early stages.

AN EXAMPLE OF AN INCOME-GENERATING ACTIVITY

A shop owner in the Tangail district of Bangladesh purchased a 40Wp system from Grameen Shakti. Demand for cell phone services had emerged in his village and he saw an opportunity to provide solar-charged phone services.

Business growth was significant: operations were extended by four hours a day, and the owner was able to add cell phone rentals to his product offerings. In only four months, income from the phone operations reached Tk2,000 ($30) per month—easily covering his payment installments of Tk470 ($6) a month to Grameen Shakti.

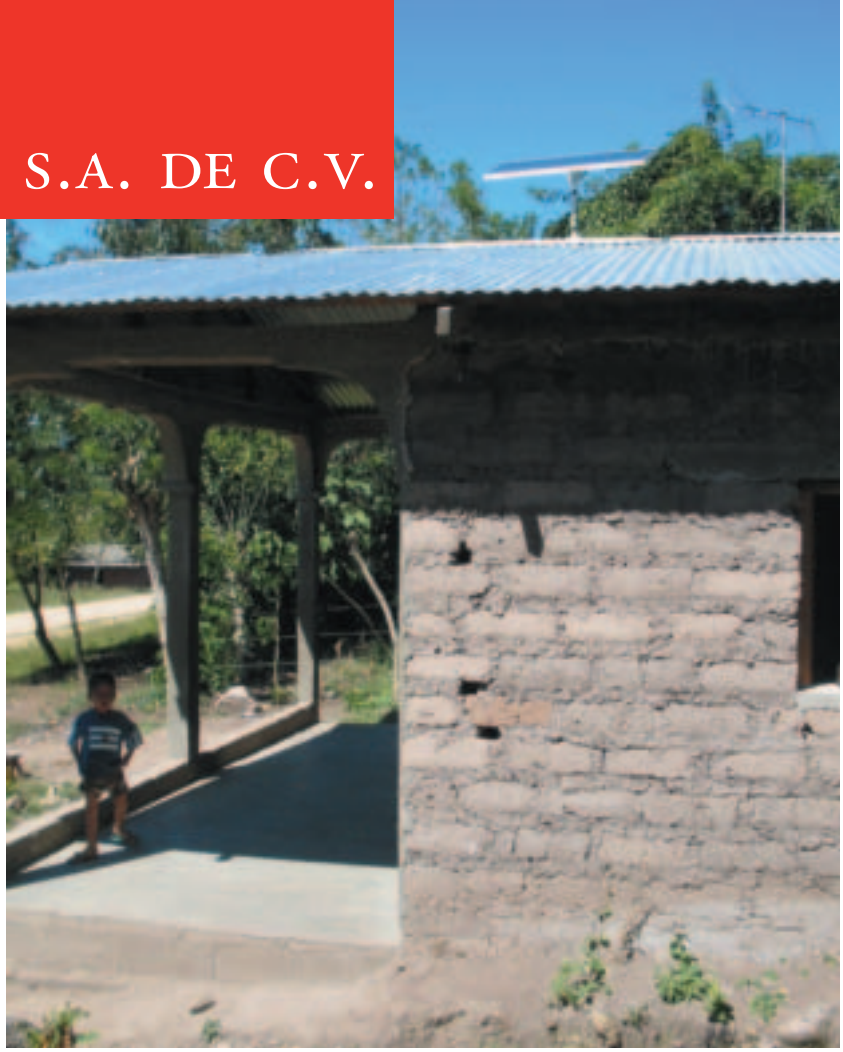
TABLE 6. GRAMEEN SHAKTI AT A GLANCE, 2007

Number of villages covered	25,000
Total beneficiaries	More than 700,000 people
Unit office	227
Total employees	1,135
Total installation of SHS	77,000
Installed power capacity	3.85 MW
Daily power generation capacity	16 MW-hr
Installation rate	Over 2000 SHS/ month
Installation of micro utility system	1,000 system
Installation of biogas plant	500 (through October 2006)

MOVING FORWARD

To date, Grameen Shakti has installed over 77,000 solar PV systems, with a total installed capacity of 3.85MW (a power generation capacity of 16MW per hour). This has considerably improved lives and has provided cleaner energy to 700,000 Bangladeshis. As rural communities have become electrified, the company has been able to work toward achieving its secondary objective, that of connecting the rural areas of Bangladesh with the rest of the world through the service of information and communication technology, as well as offering computer education and Internet access, provided by engineers at solar-powered offices. Computer education includes applications, such as Microsoft Office and graphic design, as well as hardware installation and computer language. This successful company has diversified its operations to include the construction of 500 biogas plants to provide improved energy solutions to cooking. (See Table 6 on this page for a summary of Grameen Shakti's achievements.)

SOLUZ HONDURAS, S.A. DE C.V.



Headquartered in San Pedro Sula, Honduras, Soluz Honduras S.A. de C.V. is a subsidiary of Soluz, Inc., USA. Soluz Honduras began operations in 1998, selling and renting small solar PV systems on a retail basis to rural customers, who had no access to electricity. Soluz Honduras was one of the first solar PV companies to employ a rental model, which decreased the initial costs of acquiring a solar PV system without having to depend on consumer subsidies, donor programs, or capital buy-downs.

BACKGROUND

Soluz, Inc. was established in 1993 to further commercialize solar PV applications for rural areas, building upon the solar PV sales enterprise established by Richard Hansen in the Dominican Republic in 1986. Today Soluz, Inc. has two subsidiaries, Soluz Honduras and Soluz Dominicana S.A. in the Dominican Republic.[29] The solar PV rental offer was added to the existing cash and micro-credit sales offers, first in the Dominican Republic in 1994, and later in Honduras, where Soluz Honduras had been selling solar PV on a wholesale basis since 1994. Rolling out the solar PV rental offer was a major focus aimed at penetrating rural markets. Customers were charged the equivalent of a $20 installation fee, as well as an average monthly fee of $15 for rental and maintenance of the system (purchase of the battery was an additional cost incurred by the client). Along with rural households, Soluz Honduras sought to target small businesses, churches, schools, and health clinics, providing solar PV systems at monthly fees similar to the cost of alternative energy sources (i.e., kerosene, dry cells, and automotive batteries). Despite an entirely rural client base and the devastating effects of Hurricane Mitch,[30] Soluz Honduras managed to attract 500 solar PV rental clients in its first year of operations. By 2000, revenue totaled $144,556, with $100,499 (70 percent) accounting for solar PV rental and $44,057 (30 percent) for solar PV sales.

In late 2000, the SME Program approved a $400,000 loan and a $100,000 equity investment in Soluz Honduras. The funds were to be used to expand the Soluz customer base. With a further $1 million from a co-investment transaction with the SME Program and two other investors ($250,00 each from Corporacion Financiera Ambiental, Costa Rica, and Triodos Bank's Solar Investment Fund[31]), Soluz hoped to expand its solar PV rental customer base to a break-even point of 2,500, a critical step on the way to a target of 5,000 customers.

By July 2002, the number of solar PV rental customers was stagnant at 1,500 and in danger of declining. Unexpected grid expansion and the inability to continue to pay for installed systems meant that Soluz Honduras was forced to disconnect existing customers faster than it was adding new ones. In contrast to the year 2000, revenue in 2002 totaled $406,772, with $227,762 (56 percent) accounting for solar PV rental and $179,010 (44 percent) accounting for solar PV sales. In an effort to increase revenue and increase margins, Soluz increased its focus on sales (primarily by developing its dealer network).

It became evident that the unsubsidized solar PV rental offer was not financially viable. While the upfront costs of installing a system decreased, the monthly charges remained too high for over 50 per-

[29] Soluz Dominicana also received support from the SME Program through the EEAF.

[30] Soluz Honduras was founded just prior to Hurricane Mitch, which devastated much of Honduras and Nicaragua in 1998. The heavy rainfall associated with the hurricane caused catastrophic flooding that was blamed for over 11,000 deaths.

[31] The Netherlands' first green investment fund screens its investments using social and environmental criteria.

cent of rural households. Furthermore, the solar PV rental offer did not succeed in creating an operating margin for Soluz Honduras, due to the high collection and maintenance costs associated with such a highly dispersed customer base. The local company then adopted a more streamlined sales model, selling wholesale through dealers and, thus, increasing sales and assuring their margins. The company began to sell off solar PV rental assets to meet lender obligations and focus staff time on increasing sales revenue through an expanding dealer network. It also continued to sell solar PV systems, on a cash and micro-credit basis, to rural customers and institutions out of its three office locations.

The Soluz business model (which included both rental and sales offers) resulted in more complicated operations than would typically be found in a solar PV business of equal size. The rental offer, in particular, required that Soluz Honduras devote considerable attention (at considerable cost) to collections and service in remote off-grid areas, where even well-established micro-finance institutions were unwilling to provide their financial products. The company attempted to essentially build a micro-rental financial product offering in a very challenging environment, without the benefit of the developmental subsidies routinely provided to micro-finance institutions when establishing operations in similar environments. All this led to high overhead and transaction costs that needed to be offset solely by customer payments. An unsubsidized commercial approach to establishing a pioneering solar PV rental operation was simply too challenging.

In July 2003, Soluz found itself in severe financial distress, with an $850,000 debt burden. When it was clear that a change was needed for the company to survive, investors offered waivers of certain fees and payments, seeking only profitability. This suggested a change in the business model of the company. Thus, an increased focus on sales, including the aggressive sale of used solar PV rental systems, was established to help meet lender payment obligations and to build a viable operation. Management proposed that, in the short term, Soluz Honduras could reduce its solar PV rental fixed-asset inventory significantly, while at the same time increasing and streamlining its sales efforts.

OBSTACLES

Like most other solar PV businesses around the globe, the key problem faced by Soluz Honduras was that of affordability. The Soluz business model was designed specifically with this element in mind. In addition to cash and micro-credit sales, the company placed emphasis on fee-for-service or rental

systems. By renting systems, customers avoided the high upfront costs of purchase, and the company maintained solar PV system ownership to facilitate repossession. The company, itself, however, had to raise significant capital to invest in solar PV units and to develop efficient micro-rental collection and service operations in remote areas, a process that the company struggled with for several years. While monthly fees collected from the limited number of clients during startup simply did not offset the firm's operating costs, rollout peaked at 1,500 rental units, as "customer churn" reached high levels (3-5 percent). The company's financial structure was too highly leveraged with debt for such a risky new venture. Total financing was $1.5 million, with $850,000 in loans. Debt repayment obligations provided little in the way of flexibility if the rollout of revenue and expense did not stay to plan.

Although Soluz Honduras succeeded in significantly lowering the upfront costs for customers, many found the monthly costs of renting a solar PV system from the company to be higher than those associated with kerosene and batteries. Furthermore, when rural families lack the funds to purchase kerosene and batteries, it is not as crucial as being obligated to pay for a rental contract for a solar PV system. Many households did rent a solar PV system, but later found that they were unable to continue payments. Soluz Honduras attempted to price rental fees to the equivalence of combined current energy costs (e.g., kerosene, dry cells, car batteries), but it estimated that, at this rate, it would require 2,500 clients to break even. The firm instead disconnected a significant number of customers who were unable to make their payments, resulting not only in a loss of income, but also in costs related to the physical act of disconnecting and remarketing the solar PV system.

The unpredictable timing of government rural electrification project timing, even when there were communication efforts with the local authorities, coupled with unexpected grid expansions, especially due to election promises, meant that Soluz often found out about grid expansions just months before the grid reached a community. This required Soluz to remove hundreds of installed solar PV systems before the initial investment could be recovered. From this, an interesting paradox emerged, further compounding the issue of unexpected grid expansion: residents wealthy enough to afford solar PV systems generally lived close to urban centers. Thus, they were more likely to receive grid service in the near future, while the available off-grid customer base continually became more dispersed and thereby more difficult to serve.

Despite its difficulties, Soluz Honduras was seen as a pioneer in the area of solar PV rental in the nation. The company was well-respected and had little competition in the direct servicing of rural customers. When it came to larger sales, however, competition was strong, particularly in the areas of government bids and institutional sales.

MOVING FORWARD

Operations were further restructured in May 2005, in an effort to overcome the large debt burden. A memorandum of understanding was signed between Soluz Honduras and the SME Program, whereby a significant portion of the debt would be forgiven, and a one-year repayment plan was designed for the remaining financing. Staffing and all expenses were streamlined. At this point, Soluz began to focus exclusively on sales, using the cash proceeds from the sale of solar PV rental assets to pay back its creditors (installed rental systems continued to be serviced until they were sold on short-term credit to existing or new customers).

While the financial performance of Soluz Honduras was disappointing as a result of this overly ambitious attempt to pioneer an unsubsidized solar PV rental offer, the environmental and social benefits of the project should not be overlooked. To date, the company has installed well over 5,000 systems, and while the business model has proved difficult, the project did provide clean energy, leading to positive social and environmental impacts. The aggressive penetration of a solar PV rental system created widespread awareness of solar PV in rural areas, thus increasing demand. Employment opportunities and income were provided for the micro-enterprises that were contracted to collect monthly fees.

The move away from a rental offer to a cash and short-term credit sales focus has resulted in increased cash flows to Soluz Honduras, thus reducing its debt burden. With the reduced debt, the Honduran firm expects to now have a viable business model. Up to now, high debt on the books during the past three years of financial restructuring has made it difficult to purchase on credit. With a debt-free balance sheet, however, a viable and sustainable future, in which the company will operate with less required capital, will begin to emerge.

SELCO VIETNAM, LTD.

Selco Vietnam, Ltd., based in Ho Chi Minh City, is a subsidiary of the U.S.-based Solar Electric Light Company. Launched in 1998, Selco Vietnam sold solar systems to unelectrified households in Vietnam and was the first 100-percent foreign-owned company licensed to operate in the country.

BACKGROUND

Solar Electric Light Company is a U.S.-based company with offices in India, Sri Lanka, and Vietnam. It grew out of the activities of the NGO Solar Electric Light Fund, which was founded in 1990 to assist in the financing and installation of solar energy system projects throughout a number of developing countries. The for-profit Solar Electric Light Company was launched in the late 1990s to scale up the provision of solar electricity to households in developing countries through a commercial market-based approach. It operated through its subsidiary companies in India, Sri Lanka, and Vietnam (see box below).

Vietnam has a significant power shortage, with little capacity to meet urban demand and no infrastructure to distribute electricity beyond urban areas. The general lack of access to electricity, coupled with the fact that even rural Vietnamese had higher disposable incomes than those in neighboring countries, made Vietnam appear to be an attractive market for SHS providers.

Selco Vietnam's primary focus in the country was on the sale of SHS to households. However, it also provided specialized applications, such as solar street lights, water pumps, and hot water heaters. An important part of Selco Vietnam's business model was its relationship with the VWU, through which it had access to villages, and its partnership with the Vietnam Bank for Agriculture and Rural Development (VBARD), which provides consumer financing.

Selco Vietnam received a $750,000 loan from IFC's SME Program in 1998. The loan was to enable the company to provide collateral to third-party financial intermediaries (specifically VBARD) for working capital financing up to $200,000, and to secure loans for the company's customers to finance purchases of SHS. In addition, the loan agreement called for the sale of 12,000 SHS in two years.

OBSTACLES

The principal barrier faced by Selco Vietnam was that of affordability. Vietnam had no debt culture and, thus, no consumer financing availability, retail banking, or home mortgage market. A general overall distrust of the banking sector signified that most would rather do without than incur debt. In fact, until 2002, banks were controlled by local political institutions, and loans were approved not on creditworthiness but, rather, on the recommendations of the local people's committee, which was at odds with the Selco Vietnam business model, since it relied on the availability of consumer finance.

Complicating the matter were the issues around the mass publicity of grid expansion and the fluctuating incomes common among the rural population, making consumers considerably price conscious. Unlike other countries, the Vietnamese did not establish income-generating businesses based on solar power (i.e., solar-charged cellular phone rental), a fact that also contributed to the price consciousness of consumers.

Vietnam presented a further complication: a television was considered more important than lighting among the targeted consumer group. As a result, larger solar PV systems, capable of powering a television, were in demand. In fact, most customers sought the largest and more expensive SHS the company had on offer, which resulted in reducing the affordability of SHS even further.

Most potential customers lived within 1 km of a battery-charging station. The average amount spent on batteries per month in Vietnam was the equivalent of between 66¢ and $2, considerably less than

AWARD FOR CORPORATE EXCELLENCE

Established by the U.S. Secretary of State, the Award for Corporate Excellence recognizes businesses that exemplify good corporate citizenship abroad.

In 2001 the Solar Electric Light Company received the award for its work in reducing poverty and spurring economic development in rural Vietnam by supplying household electricity to families that lack access to the power grid.

what was required for a solar PV system. The number of those without access to electricity (60 percent) was initially taken as a measure of the prospective market, but upon later review, it was determined that only about three percent of the unelectrified population could actually afford a solar PV system.

There were also issues surrounding the policy environment. There was a heavy local political influence, yet it was not always supportive of Selco's activities. Seen as a U.S. company, Selco Vietnam did not always get the same level of support that a Vietnamese company might have received. While import duties for solar modules and batteries were waived for Selco Vietnam, the inconsistent subsidy policy for electricity proved problematic.

In an attempt to address the issue of consumer credit, IFC originally hoped to make the GEF loan to the women's union, so that it could on-lend to consumers. However, the VWU was concerned with the liability issue, and ultimately the funds were loaned directly to Selco Vietnam, with the VWU agreeing to administer them.

Selco Vietnam's expertise lies in the areas of solar sales and service, not in that of consumer finance. The initial intent had been to work through VBARD (which would provide consumer financing with funds guaranteed by the SME Program) and the VWU (which would handle the collections). Unfortunately, when VBARD failed to make financing available to potential Selco Vietnam customers, Selco Vietnam was forced to start providing consumer financing itself. Subsequently, when the VWU failed to provide proper collections service (its priorities having shifted as a result of a pending election), the solar PV company was forced to take on the added responsibility of a collections agent. But this proved to be a particularly challenging endeavor, as the company was unskilled in the areas of consumer finance and collections, and was operating in a market with no debt history or consumer banking.

MOVING FORWARD

In the end, Selco Vietnam was forced to accept that demand for lighting was considerably less than expected in the country. During its first two years, the entity had planned on sales of 12,000 units, but it struggled to reach 1,600. Sales targets were eventually revised downward by 50 percent.

In an effort to lower the cost of the solar PV equipment, the company has now formed partnerships with other Solar Electric Light Company subsidiaries around the world in order to purchase larger quantities from suppliers with volume discounts. Additionally, it has learned from the experiences of other subsidiaries by sharing information.

Selco Vietnam has struggled financially since it began operations. The management has undertaken some significant changes to improve financial performance, reducing operational and administrative expenses, and increasing its presence in the market. Since the end of 2006, the company has been operating in survival mode, with only five employees focused exclusively on cash sales. No credit is available, and the firm is not expected to make its SME Program loan repayment deadline.

CASE STUDIES 2

Photovoltaic Market Transformation Initiative

The IFC/GEF Photovoltaic Market Transformation Initiative (PVMTI) is a $30-million initiative designed to accelerate the sustainable commercialization and financial viability of energy services, based on solar electricity (solar PV) technology in India, Kenya, and Morocco. Funded by GEF and managed by IFC, PVMTI was based on the premise that private sector project design and financing on a commercial basis would stimulate more sustainable ventures than government or donor-financed solar PV procurements alone. Launched in 1998, PVMTI is still operational today, and has committed over $18 million to 12 projects.

BACKGROUND

The PVMTI concept originated at a meeting held in Princeton, New Jersey, in the early 1990s. The meeting was attended by a large number of academics, NGOs, the WBG, and others interested in the acceleration of the global market for solar PV and other RE technologies in developing countries. The original project concept, dubbed the "Green Carrot," was based on the same market transformation concepts used by the United States Environmental Protection Agency's (EPA) "Golden Carrot" program (see box, page 41). When offering the "prize" was deemed unfeasible, the program was rebranded as PVMTI, and management of the program was passed from the World Bank to IFC.

Although PVMTI was restructured under IFC, the lessons learned from "market pull" initiatives (undertaken in North America and Europe, which employed financial incentives to engage the private sector to encourage market adoption of new energy and RE technologies such as the "Golden Carrot" program) continued to play a key role in the program design. While the initiative was originally conceived to be a $60 million program that would involve global competitive procurement among private sector companies, it was soon decided that it would be more prudent to pilot the concept as a smaller $30-million initiative, targeting a small number of countries.

COUNTRY SELECTION PROCESS

The initial selection process began with the identification of 35 potential countries. Of these 35 countries, 30 were supplied with a summary of the PVMTI program concept and a request for an expression of interest. Of those that responded, Algeria, Argentina, Indonesia, Sri Lanka, Zambia, and Zimbabwe were removed from consideration due to planned World Bank and/or GEF projects, or unfavorable economic conditions. The remaining countries, Brazil, China, India, Kenya, Morocco, Pakistan, and Thailand, were visited for further consultation during the first half of 1996.

Three countries were ultimately selected for implementation: India, Kenya, and Morocco. Each of the three was considered to have an emerging solar PV market and a supportive policy environment in which the solar PV sector could grow.[32] In India, home to the largest solar PV market in the developing world, PVMTI was expected to stimulate investments in new commercial (not government-driven) sectors. In Kenya, which had a dynamic solar PV market with over 150,000 SHS sold without any formal credit facilities, PVMTI was expected to provide working capital and end-user financing in a market dominated by small-scale enterprises. In Morocco,

PVMTI was expected to contribute to the demonstration of the potential of private franchise models and guarantee facilities to finance alternatives to nonviable grid extension, based on a commitment to solar PV by the national electric utility, Office National de l'Electricite (ONE).

During the preliminary stage, some 25 potential projects totaling nearly $175 million in financing were identified. Many of these projects were to support companies that sold and/or leased, distributed, installed, and serviced solar PV equipment. Other projects were focused on supporting the expansion of existing sales and distribution networks and entry into new markets, and a small number of projects were identified working with FIs to establish financing mechanisms to support end user purchases.

MANAGEMENT

During the country assessment period, it became apparent that a much higher level of engagement would be needed over a longer period of time than originally planned. Sector and country expertise, similar to that of an investment fund, was important if PVMTI were to succeed. Rather than establish in-house expertise, IFC management chose to select an external manager. IFC decided to retain Impax Capital Corporation (now Impax Asset Management, Ltd.)[33] and IT Power, Ltd.,[34] both firms experienced in managing small, innovative renewable energy portfolios, to serve as an external management team (EMT). The EMT also included local partner organizations in each of the countries—IT Power India (a subsidiary of IT Power UK), Pipal Ltd. (a Kenyan project management company in the solar field), and RESING (a Moroccan project management company)—which provided critical support and local knowledge at all stages of the process.

The role of the EMT was to solicit, screen, and structure solar PV business proposals and conduct the appropriate commercial, technical, and financial due diligence. Once the EMT felt it had a solid project, it would present the project to the IFC Investment Review Committee (IRC) for final approval. After approval from the IRC, the EMT would be responsible for ensuring that all disbursement conditions were met, as well as for reviewing progress on a regular basis subsequent to disbursement. The EMT is compensated in two forms: a set project management fee paid quarterly over the life of the program, and a series of performance bonuses, some of which are tied to performance and some of which are tied to timing in the program. The set project management fees make up the majority of the EMT compensation.

STRUCTURE

PVMTI was financed with $30 million from GEF, allocated as follows: $15 million for project financing in India, $5 million each for Kenya and Morocco, and the remaining $5 million to be used for technical assistance and project execution. The technical assistance component of the program amounted to $3 million, or 10 percent of total funds. These funds were to be provided for noncommercial purposes, such as technical assistance, training, the development of standards, and additional uses as required by individual projects. It was expected that $13.5 million would be recovered from investments and portfolio earnings, and would be returned to GEF at the end of PVMTI's operational period.

The financing terms offered by PVMTI's were designed to be sufficiently flexible to respond to the needs of each project, and included debt, guarantees, and grant funding. Most investments were expected to request debt at or below market terms. Additional financing tools, including partial guarantees and equity, were also available, if the benefits of such tools were deemed sufficient to justify the increased complexity.

THE GOLDEN CARROT PROGRAM

The Golden Carrot program is a federal program of the United States Environmental Protection Agency designed to support the commercialization of new energy-efficient appliances in the residential sector.

The "Golden Carrot" program offered a financial incentive to manufacturers to support advances in energy efficiency. In the program, 24 utilities pooled $30 million in the Super Efficient Refrigerator Program. That program then held a contest, and the manufacturer that built the most efficient CFC-free refrigerator at the lowest cost was awarded guaranteed rebates from the pool to offset the incremental product costs. At the same time, consumers got more affordable and environmentally friendly refrigerators.

[32] Each country had, at the time, a large number of households in off-grid areas, an adequate financial services sector, and an existing solar PV sales market (either subsidized or unsubsidized).

[33] Impax Asset Management, Ltd., is a specialist fund management company focused on the environmental sector. With £420m ($838 million) in funds under management in a combination of listed and private equity, Impax had the necessary skills to assess potential investments and to implement the same.

[34] IT Power, Ltd., is an energy consulting firm with a specialization in RE engineering and related economic, financial, commercial, and environmental considerations. IT Power has completed over 1,000 projects for both government and private sector clients in over 100 countries.

RESTRUCTURING

In 2004, PVMTI underwent a significant restructuring. The slow execution of deals in the early years of the PVMTI program, due to the extensive documentation, minimum investment size, and long negotiation periods, resulted in a lower-than-expected disbursement rate. With funds not being disbursed, the expected reflows (interest and principal payments) did not accumulate as expected, and PVMTI ran into issues with insufficient cash flow to cover its ongoing administrative and operating costs. The restructuring sought to extend the program implementation period by two years (from 10 years to 12), in an effort to bring disbursements of committed funds to approximately 70 percent, and to reclassify $1 million of PVMTI's investment funds to finance the cash shortfall on the administrative side of the project.

As part of the 2004 restructuring, PVMTI also received approval for a grant of approximately $350,000 for a stand-alone technical assistance capacity-building program in Kenya. This project consists of the development of training curriculum and the provision of training to solar PV technicians, creation of quality awareness in the market, establishment of a quality assurance program for SHS in the Kenyan market, and provision of support to the Kenyan Renewable Energy Association (KREA). The total cost for these activities is estimated at $476,900, which includes about $115,000 of in-kind contributions and co-financing for the project. The GEF funds used for this are all grant funds.

In October 2006, PVMTI sought, and was granted, approval from GEF to increase the funds available for technical assistance, from a maximum of 10 percent of the overall program funds to a maximum of 20 percent. This request was made in response to the findings of the Mid-Term Review that suggested IFC should explore the possibility of deploying uncommitted investment resources to grant-oriented technical assistance activities, such as training, solar PV information dissemination, and capacity building for the industry sector that will help advance the overall objective of PVMTI. This was suggested, in part, because PVMTI was one of the earliest market transformation initiatives that IFC had managed, and lessons from subsequent projects seemed applicable to PVMTI at the mid-term point. Since PVMTI's inception, IFC has managed a number of other programs that have resulted in greater market impact than PVMTI is likely to have at the end of its life. This is mainly the result of a larger emphasis on technical assistance and capacity building (as a portion of overall investments). The change in October 2006 sought to correct this imbalance, while there was still ample time within the PVMTI program to implement new technical assistance and capacity building.

PERFORMANCE

To date, the IRC has approved a total of 16 sub-projects (six in India, six in Kenya, and four in Morocco).[35] The active PVMTI portfolio is comprised of nine projects with commitments of over $17.5 million (see Table 7 at left).

Experience to date with the different projects has been mixed, with some proving very successful and some unable to make any progress due to a variety of outside reasons. This report has focused on Muramati District Tea Growers Savings & Credit Cooperative Ltd. (Muramati), SREI Infrastructure Finance, Ltd. (SREI), and Sunlight Power Maroc S.A. (SPM). These projects were selected to be representative of the overall PVMTI portfolio, as they represent projects in each of the countries in which PVMTI was active, projects involving both financial intermediaries and direct investments with PV companies, and projects that achieved varying degrees of success.

[35] It is important to note that projects approved through the IRC are documented by the IFC legal team. In some cases, projects were approved by the IRC, but legal documentation was not finalized due to a variety of reasons.

TABLE 7: PVMTI'S ACTIVE SOLAR PV PROJECT PORTFOLIO

PROJECT	COMMITMENT (IN MILLIONS)	UNITS INSTALLED (APPROXIMATELY)
Selco India	1.10	15,000
Eskom-Shell Solar Home Systems	3.90	26,000
Shri Shakti	2.23	2,000
SREI Infrastructure Finance, Ltd.	3.50	15,000
Total India	10.73	58,000
Barclays Bank, Kenya	2.00	0
Equity Building Society (EBS)	2.10	0
Muramati Tea Growers SACCO	0.60	170
Total Kenya	4.70	170
Salafin S.A.	1.00	0
Sunlight Power Maroc S.A.	1.075	1,700
Total Morocco	2.075	1,700
Total PVMTI	**17.505**	**59,870**

WHAT WORKED AND WHAT DID NOT

The PVMTI experience was similar to that of other solar PV projects undertaken by IFC and others, in that it highlighted that solar PV projects are most challenging to implement, precisely in those markets where the demand for it, and the economic justification for it, might be greatest. Often, rural, poor, and sparsely dispersed communities, who are far from the grid and thus need solar PV, are unlikely to generate the resources necessary for purchasing or maintaining these units without extensive subsidies. The PVMTI experience also demonstrates that there is an ongoing need for capacity building and technical assistance, that investment terms and management of solar PV focused projects should be tailored to the specific needs of solar PV, and that product quality is a serious issue.

Capacity Building and Technical Assistance May Be More Important than Business Finance

At the time PVMTI was introduced, and for several years thereafter, the Kenyan market was not prepared for the financial product and services that PVMTI offered. The minimum deal sizes were too large for existing solar PV firms, and larger entities, such as FIs, were not interested in pursing the rural solar PV market. Quality solar PV products and a reliable solar PV service network were also lacking in this market. In recognition of this, PVMTI directed its efforts at providing technical assistance to raise public awareness of the merits of solar PV, upgrade the skills of local technicians, and foster an enabling environment for the establishment of high-quality solar PV products and service providers.

Enabling Environment Is Critical

Success in the solar PV business, and the appropriate business model to adopt, will depend to a large degree on the enabling environment in which the firm operates. India has the largest RE financing effort offered by any developing country. Governmental efforts to promote RE, including solar PV, compete with PVMTI, but also help open up the market and establish solar PV as a viable technology. Additionally, the fact that the population of India is large and densely populated means that service technicians can economically serve a small geographical area (relatively inexpensive to reach potential clients) with a critical mass of SHS units. Furthermore, favorable tax, regulatory, and grid-extension policies may help the development of the solar PV market in a given country.

Product Quality Standards Are also Critical

Many of PVMTI's investments found the lack of product quality standards to be detrimental to their operations. Muramati saw systems fail and installations delayed as a result of faulty batteries. SPM saw increased pressures on prices as a result of cheaper contraband product on the Moroccan market. In hindsight, PVMTI should have been more proactive in improving product quality and establishing quality-control mechanisms. A portion of the grant component would have been well spent investing in product innovation and quality control.

IFC's Typical Project Financing Requirements Are Ill-Suited to Small Business Transactions

IFC's legal documentation and loan security docu-

ments are suited to large project finance transactions. They can be extremely burdensome and time consuming for SMEs that are more accustomed to much simpler due diligence processes. As a consequence, investment transactions take months or years to complete and, in some cases, market conditions will change significantly between the investment approval and financial closure time frame. A further consequence is that the administrative costs are high in relation to investment size.

Many solar PV businesses in the target countries found the $500,000 minimum investment to be too large. This was particularly true in Kenya, where investments were limited to FIs and banks. Going through the banks, however, proved to be cumbersome and time consuming, since the banks did not see financing SHS as a main line of business, and it was difficult to get many of them to move expeditiously on the projects.

Furthermore, the small businesses and entrepreneurs targeted by PVMTI found the extensive business plans and other documentation required to be somewhat daunting. While they had energy and ideas, many were not skilled in the writing of business plans. This resulted in long negotiation periods for customized contracts. In some instances it took a year from the date of review to the date of disbursal.

Dedication to Solar PV and Provision of Value-Added Services Are Critical to Success

All of the firms that achieved modest success in terms of utilizing PVMTI resources and drawing down their commitments were already in the solar PV business, or seeking to enter the business, when they received funding from IFC. PVMTI found that firms that provided further value added, in particular servicing and maintenance, were more successful. Those who moved farther up the value chain, and were involved in the assembly of solar components and the installation of systems, seemed to do significantly better than firms that were merely engaged in consumer or producer financing.

Firms that received PVMTI financing that did not have a particular focus on solar PV were significantly less successful. Muramati, for example, was dedicated to providing financing to people working in the Kenyan tea sector, not to promoting solar PV. As a result, the financing of SHS fell outside the core business line, and proper resources were not dedicated.

Decision Making Needs to Be Done by Those Closest to the Project

The pace of decision making was hindered by the administrative structure adopted in this project. All decisions regarding investment commitment, loan closure, disbursements, and acceptability of loan collateral were made by IFC staff (Legal Department and Environment and Social Development Department) upon the recommendation of the EMT. This structure has resulted in significant delays in the administration process, as those closest to the projects (the EMT) were not making the decisions.

CONCLUSION

PVMTI has experienced considerably more success in India than in Kenya or Morocco. This success can be attributed, in large part, to the high population density in off-grid areas, the existence of established solar PV companies, and the relatively widespread knowledge about solar PV technology. In Kenya PVMTI had initially set out to provide working capital and end-user financing. However, the focus has since shifted to providing more technical assistance funding, particularly in the areas of training and quality assurance. In Morocco PVMTI has continued to rely on support from the national utility, ONE.

Given that PVMTI is still an operational project, it is difficult to come to any conclusions as to its overall performance. While the program started slowly, disbursements have increased significantly since the 2004 restructuring. With over $12 million in disbursements, PVMTI is currently on track to meet the revised disbursement goals.

PVMTI was able to provide financing for a number of businesses that otherwise would not have been available. As a result of this financing, over 60,000 previously unelectrified households now have electricity. The Mid-Term Review, which was completed in July 2006, noted that PVMTI will be responsible for the displacement of an estimated 109,466 tonnes of CO_2 emissions over the lifetime of the SHS installed.

MURAMATI DISTRICT TEA GROWERS SAVINGS AND CREDIT COOPERATIVE, LTD.

The Muramati District Tea Growers Savings and Credit Cooperative, Ltd. (Muramati), based in Kenya, was approved for financing from PVMTI in June 2000. The funding received was to support the introduction of a loan scheme to finance Muramati members in the purchase of SHS.

BACKGROUND

Founded in 1993, Muramati has grown to be one of the largest savings and credit cooperatives serving the tea sector, with a current membership of over 32,000. Muramati's primary purpose is to provide basic savings and lending services to those involved in the tea sector in Kenya.

The concept for which the PVMTI funds were dedicated was relatively simple. Muramati would work in partnership with a local SHS supplier, which would supply and maintain the systems, while Muramati would market the systems and provide potential customers with the financing to purchase the systems. The customer would be required to pay a deposit on the system and maintain monthly payments.

OBSTACLES

Progress on the project was initially quite slow, as both Muramati and the SHS supplier seemed to be waiting for the other party to drive progress. Under the initial agreement, the SHS supplier had agreed to establish infrastructure in Muramati's regions to service the SHS installed through the project, however, given the low volume of SHS orders, they were unwilling to make this investment and provided service from their headquarters in Nairobi, four hours away. This resulted in delays in installing new SHS, as the supplier would only install in batches, as well as in delays in responding to maintenance calls. A further issue resulted when the supplier received a faulty batch of batteries, causing a number of system failures. Finally, there was a problem with the pricing systems. Muramati was assuming most of the financial risk in the arrangement, yet with tea prices having been stagnant over the past several years, tea growers were particularly aware of what constituted value for money, and the supplier's systems were seen as being particularly expensive.

An additional reason for the slow initial progress of the project was rooted in that Muramati only had to pay interest on drawn funds and, therefore, was in no great rush to proceed with the disbursements from IFC. Given this slow initial progress, PVMTI has had to restructure the terms of the Muramati loan, delaying the second and third disbursements, as well as the overall repayment schedule.

The credit terms initially offered by Muramati proved to be problematic. The short-term loan of up to 18 months proved to be far too short to ensure affordable repayment installments. Similarly, the 50 percent down-payment requirement proved too much for many potential borrowers, and the interest rates set at 15 percent per annum were considered too high.

No market survey, unfortunately, had been undertaken during the preliminary stages of the pro-

ject to determine the level of demand for SHS among Muramati members. Over the course of the program's implementation, it became evident that many Muramati members were taking out loans to purchase SHS on the open market, where they were available for a competitive price. While there was indeed a demand for SHS, this did highlight the fact that the driving factor in purchasing decisions was price, not quality, thus leaving the systems offered by Muramati at a distinct disadvantage.

At the time of financial closure, there were concerns about weak finances and internal controls. As a result, a rather cumbersome system of accounts was established to manage the flow of funds.[36] Today, Muramati continues to expand its membership and is in good financial health, despite the difficult conditions in the tea sector in recent years.

MOVING FORWARD

Muramati eventually did engage a new supplier to provide systems at considerably lower prices than the original SHS supplier for the project. The issue of maintenance was addressed through the use of grant funds from PVMTI, used to train local freelance technicians to perform ongoing maintenance of SHS. Credit terms offered by the cooperation were changed; the maturity of loans was increased to three years with a down payment no longer required; and interest rates were reduced to 12 percent per annum. These revised terms were, at the time, considered to be much more attractive to potential borrowers.

However, despite the above initiatives, the supplier partnership has failed to properly materialize, and Muramati no longer engages in such partnerships. Until 2006, Muramati continued to provide financing to its members to purchase SHS, although members were free to select the system and installer of their choice. During the last four years, Muramati has attempted to undertake marketing campaigns for SHS awareness to its entire membership. The results of this strategy have been limited. In late 2006, Muramati asked to halt its PVMTI program, and it has fully repaid its outstanding loan and unused grant funds. The company felt that the program was too cumbersome to manage and that it was ultimately outside its core business.

[36] IFC required that the disbursed funds to the Muramati project be held in a joint account (IFC and Muramati) at Barclays Bank in Kenya. Muramati was to draw down funds from this account only on approval from IFC. This process meant that Muramati had two steps to receive funds: 1) request a disbursement from IFC to the IFC/Muramati account, and 2) request approval of withdrawals from the jointly held account. This process could take four weeks or more.

SREI INFRASTRUCTURE FINANCE, LTD.

SREI Infrastructure Finance, Ltd. (formerly SREI International Finance, Ltd.), is among the largest nonbanking FIs in India. SREI is engaged in the financing of construction and mining equipment, infrastructure projects, and renewable energy systems. In February 2001, SREI received financing from PVMTI to address two key issues facing the Indian solar PV industry, namely, the lack of after-sales services and maintenance activities, and the lack of rural credit mechanisms.

BACKGROUND

Although India has one of the world's largest solar energy programs, it still suffers from the same issues that face solar PV markets around the world: affordability and reliability of technology. The SREI project sought to address these issues by developing a financial model to provide unelectrified households with easy access to credit facilities in order to be able to access lighting options, and developing a network of solar service centers in the rural areas by building on the existing infrastructure of systems integrators.

The project involved a partnership between SREI (providing management and a financing mechanism for rural credit), Tata BP Solar India (India's largest solar PV cell and module manufacturer, which provided the SHS), The Ramakrishna Mission (an NGO with solar electrification experience and contacts with rural communities), and the Tata Energy Research Institute (TERI) (which brought project management and quality assurance experience).

OBSTACLES

During the first few years of the project, implementation was impeded by significant disputes between the partners. The disputes centered around the initial anticipation that SREI would use loan funds to establish The Ramakrishna Mission infrastructure in rural areas in order to install and maintain SHS. This endeavor never materialized, and eventually the partnership was dissolved.

SREI hoped to simplify operations and reduce costs by establishing a one-stop location where consumer credit, SHS and spare parts sales, and after-sales service and maintenance were fully integrated. The concept, unfortunately, did not materialize, due to the reluctance of SREI to establish rural infrastructure.

Initial attempts to establish a rural credit mechanism were unsuccessful. SREI was reluctant to take on rural consumer credit risk, despite its partial guarantee. During the early years of operation, sales were almost 100 percent cash and carry, and the issue was addressed by SREI providing supplier credit, establishing partnerships with rural banks for credit and, eventually, by the provision of consumer loans.

MOVING FORWARD

Today, SREI continues to source solar modules from Tata BP in India, and is working with a new rural electrification service provider, Environ Energy-Tech Service, Ltd. (EETS). This new partnership has been in place for over two years and is considered to be progressing well.

PVMTI financing made it possible to provide EETS with working capital loans, enabling EETS to introduce several small innovations to enhance customer satisfaction, such as theft insurance, damaged parts replacement, regular visits by field technicians, and five years of free service.

The SREI experience presents an interesting case study. SREI focused on some of the more challenging areas of India, initially experiencing a great deal of difficulty. Currently, however, SREI performs well—the project has expanded beyond PVMTI to other projects—and it has installed over 15,000 SHS. Its experience highlights the need for patience, particularly in a challenging solar PV market.

SUNLIGHT POWER MAROC S.A.

Sunlight Power Maroc S.A. (SPM), in Morocco, received PVMTI funding in December 2004. The funding was requested to finance infrastructure expansion and working capital requirements for a fee-for-service project, as well as to create a new credit business for solar PV sales.

BACKGROUND

SPM was originally founded in 1998 to provide installation and maintenance of SHS in Morocco (primarily in the northern regions of Taza, Swfrou, Taounate, and El Khemisset). The original business model was based on a nonsubsidized fee-for-service rental scheme for SHS ranging from 20 to 80 Wp. SPM would maintain ownership of the systems, and the households would pay a deposit followed by monthly fees, depending on the size of the system.

In early 2004, SPM signed an agreement with Office National de l'Electricité (ONE), to provide SHS under a subsidized fee-for-service scheme. The ONE scheme was established to provide solar PV electricity to the 15 percent of rural households (approximately 300,000) that are not targeted for grid connection. The scheme, established in 2002, has awarded six contracts for a total of 112,000 SHS.

Under the terms of the agreement, SPM was given exclusivity in the regions in which it was to install the ONE systems, and it was provided with a seven-and-a-half-year time frame to complete the installation. ONE pays SPM an upfront subsidy, and SPM undertakes the maintenance and repair of the system over a 10-year period, in return for a monthly fee paid by the end user.

When SPM applied for financing from PVMTI, the company had insufficient capital to meet leverage requirements. To overcome this obstacle, IFC considered historical equity contributions as cofinance to meet minimum leverage requirements, and PVMTI was able to recognize historical shareholder contributions that had funded the business prior to PVMTI involvement. As a result, no new cofinancing was required for the project. As an exceptional case in the PVMTI portfolio, special approval had to be granted.

OBSTACLES

A number of market issues impacted negatively on SPM's initial success. Firstly, significant grid expansion has taken place in recent years, shrinking the potential market for recipients under the ONE scheme. Secondly, ONE has significantly increased its subsidized fee-for-service scheme (which SPM benefits from), making credit schemes less desirable for the public and impacting sales. Thirdly, there is increased availability of cheap contraband solar PV modules in Morocco, putting pressure on prices and making potential sales margins significantly narrower.

SPM had a similar experience to other PVMTI projects relating to meeting the disbursement requirements. The cumbersome documentation process resulted in a two-and-a-half-year delay from IRC approval to financial closure.

MOVING FORWARD

Despite the above obstacles, SPM has made significant progress under PVMTI, and continues to increase installations under the ONE scheme. SPM has attributed its ability to expand and establish three new service centers to PVMTI funding. It currently has installed approximately 6,000 SHS.

SPM has not yet managed to establish a credit business, as it has focused efforts on establishing the ONE business. Furthermore, SPM argues that consumers cannot yet afford the monthly credit payments and, therefore, it has not put forth the necessary effort to establish a credit business. Currently, no further efforts are being made to establish a credit scheme, as the company maintains its focus on installations under the ONE scheme.

CASE STUDIES 3

Solar Development Group

The Solar Development Group (SDG), a $41-million initiative, was created with the goal of increasing the delivery of SHS to rural households in developing countries. Comprised of two separate entities, Solar Development Capital (SDC) and the Solar Development Foundation (SDF), SDG provided financing to private sector companies involved in rural solar PV activities in developing countries, as well as grants for business development services.

BACKGROUND

Motivated by the enthusiasm about the potential for rural solar PV electrification exhibited by those involved in the solar PV industry during the mid-1990s, the charitable foundation community in the United States saw an opportunity to engage with the WBG. In early 1996, a letter was sent from the Rockefeller Foundation (on behalf of a number of members of the charitable foundation community) to Jim Wolfensohn, then president of the WBG, proposing the creation of a solar energy investment subsidiary.

The proposal called for the injection of "massive" amounts of money to launch the emerging market solar PV industry, through the development of an investment vehicle that would dramatically expand financing for commercial companies, so that they could develop and provide rural energy services. The vision was grand, and at the earliest stage of concept development, investing up to $1 billion to catalyze the solar PV market was discussed.

By the end of 1996, a significantly scaled-down concept paper for a $50-million "Solar Development Corporation" was being circulated. IFC was brought in to work on the WBG-led initiative, given its experience in private sector project finance. An external consultant, contracted in July of 1997 to develop a feasibility study and business plan, found that the solar PV market showed tremendous potential, and identified over 100 investment opportunities. In March 1999, Triodos Solar PV Partners[37] was appointed as advisor, and the fundraising and business planning process began.

Originally envisioned as a single entity with both financing and technical assistance components, the SDG, as the final initiative was named, consisted of two separate but closely related and supportive entities, SDF and SDC. SDF was initially proposed as a $19.5 million NGO, offering business development and seed financing in the range of $10,000– $100,000 to assist solar PV companies in preparing for private investment. SDC was envisioned as a $32 million for-profit private equity fund, providing growth capital in the range of $100,000–$2,000,000 for private solar PV and solar PV-related businesses in developing countries (see Table 8 for an overview of SDG, page 50).

SDG, through its two separate entities, in effect responded to two perceived problems in the market. SDC was designed in response to a view that there was a cost-effective business over the horizon, provided economies of scale could be achieved through higher volumes and greater commercial returns could be realized through lower unit costs. In turn, SDF was designed to respond to the solar PV market (with high costs and underfunded entrepreneurs) requiring more of a nonprofit model, which became known as a patient capital approach. It soon became evident that it was impossible to address both issues under one framework.

The goal was to raise a total of $50 million from a

[37] A nonprofit organization, Triodos Solar PV Partners was formed by three organizations: Triodos International Fund Management (part of the Triodos Bank Group), Environmental Enterprises Assistance Fund (EEAF), and solar PV sector experts GT Consulting, Inc. (GTC), a joint venture of Soluz, Inc. and Enersol Associates, Inc.

TABLE 8: SOLAR DEVELOPMENT GROUP AT A GLANCE

	SDF	SDC
Objective	Help PV companies prepare for private investment	Provision of capital to PV-related SMEs, ESCOs, banks, microfinance institutions and leasing companies
Company Type	Not-for-Profit	For-profit private equity fund with venture capital elements
Number of Investments Made	Target: 75 enterprises in first five years Achieved: Commitments totaling over $3.5 million in 63 projects (54 companies) $2.2 million disbursed by early 2004	Target: 27 investments in 15 companies totaling $18 million, including eight loans to FIs totaling $10 million Achieved: Six investments ($3.9 million) approved; three investments disbursed, totaling $650,000
Total Capitalization	Target: $19.5 million Achieved: $12 million	Target: $32 million Achieved: $28.7 million
Geographical Scope	Target: Global Achieved: 23 countries	Target: Global Achieved: Three countries
Type of Investment Vehicles	Loans (up to four years at 0 –10 percent interest in local or U.S. currency) Guarantees (to facilitate local bank lending) Technical Assistance Grants	Minority position capital investments Provision of additional debt/quasi debt
Date Began Operations	March 2000	April 2001
Date Closed and Managing Agency Appointed	March 2004 Operations transferred to the Triodos Renewable Energy for Development (TRED) Fund	April 2004 Assets sold to TRED Fund, thereby liquidating the fund

consortium of investors and donors for SDG. Ultimately, $41 million was raised from private sector solar PV businesses, individual private investors, NGOs, multilateral organizations, bilateral organizations, and various socially responsible investment (SRI) funds. SDF was supported, in large part, by multilateral and bilateral organizations,[38] as well as the charitable and NGO community.[39] (See Table 9 for detail on SDF shareholders, page 51.) SDC also received multilateral and bilateral support,[40] as well as support from AstroPower (now GE Solar), a private individual, NGOs,[41] and a number of SRI Funds.[42] (See Table 10 for detail on SDC shareholders, page 51.)

Each entity (SDC and SDF) was established with its own mandate and separate board of directors. The separation of the two entities was necessary, as previously mentioned, not only to address the two key perceived issues in the market, but also since SDG had raised funds from foundations based in the United States. These foundations enjoy a tax-exempt status, provided they do not engage in profit-making activities, such as venture capital. As such, the charitable foundations made up much of the shareholder base for SDF, the NGO charged with the market development activities and riskier seed capital initiatives, while the SRI funds were focused on by SDC, the for-profit venture capital fund.

IMPLEMENTATION

SDF began operations in early 2000 with $12 million in commitments, and soon approved its first transactions. SDC concluded its fundraising phase in April 2001 at $29 million, and approved its first investment five months later.

It soon was clear that the investment opportunities identified in the feasibility study had been grossly overstated; in fact, not one of the over 100 opportunities identified in the feasibility study ultimately received support from SDC. There was a ma-

[38] Directorate General for International Cooperation (DGIS) of the Netherlands Ministry of Foreign Affairs, IFC, Swiss State Secretariat for Economic Affairs (SECO), and WBG.

[39] Cordaid, Joyce Mertz-Gilmore Foundation, Rockefeller Foundation, Rockefeller Brothers Fund, and Stichting Triodos-Doen Foundation.

[40] GEF, IFC, SECO.

[41] Cordaid and Environmental Enterprise Assistance Fund (EEAF).

[42] Calvert World Values International Equity Fund, Rabobank Foundation, and Triodos Bank Group.

jor disconnect between where those involved in the initial structuring of SDG felt the market was and where it actually was. The market was simply not ripe for equity investments, the market assessment having overestimated the maturity of the solar PV market and the number of business opportunities. Furthermore, market conditions were changing: the Latin American and East Asian financial crises and the 9/11 attacks had an impact on emerging market economies. Neither had the solar PV market moved as expected; in fact, the cost of solar PV had actually increased rather than decreased, while the increased demand in the developed world was shifting the attention of manufacturers away from the developing world. In 2002, less than a year after SDC had begun operations, Triodos International Fund Management indicated that the existing investment guidelines were unrealistic, given the nature of the market, and that new investment guidelines were needed. These issues, consequently, resulted in lower return expectations.

Discussions on restructuring share ownership within SDC began to take place. While restructuring was necessary, the conflicting interests of the different shareholders were making it difficult to reach consensus. Those shareholders, who looked at their involvement more from a profitability standpoint, felt that the investment fund had no future and should be closed. In contrast, those, such as IFC's Environment and Social Development Department, which had a mandate to provide innovative project financing, felt that SDC should be restructured.

A revised implementation plan to expand the number of financing instruments offered by SDC and to lower the return requirements was presented to and approved by a majority of the SDC board. The plan required larger shareholders buying out the smaller shareholders. Despite the restructuring effort, however, there were not enough viable investment opportunities, and in June 2004, only three years after it began operations, SDC was disbanded as a legal entity. Assets were sold to the Triodos Renewable Energy for Development (TRED) Fund. At the time of sale, 13 percent ($3.6 million) of the $29 million in funds committed to SDC had been called. Of this amount, $650,000 was disbursed to investments; the remainder went to operational and deal-related expenses.

Amid discussions relating to the restructuring of SDC, the SDF Board of Directors solicited proposals to manage the NGO in the event SDC were to fail. In early 2004, SDF transferred operations to the TRED Fund.

TABLE 9. SDF SHAREHOLDERS

SHAREHOLDER	PERCENT
World Bank	45.2
International Finance Corporation*	4.8
Global Environment Facility**	2.0
Others	48.0

*IFC–Environment and Social Development Department.

**Represented by IFC's Environment and Social Development Department.

TABLE 10. SDC SHARREHOLDERS

SHAREHOLDER	NUMBER OF A SHARES	NUMBER OF C SHARES	PERCENT
Global Environment Facility*	—	10,000	34.8
International Finance Corporation**	3,000	2,500	19.1
Others	11,500	1,750	46.0

*Represented by IFC's Environment and Social Development Department.

**IFC's Infrastructure Department.

SUNLABOB RURAL ENERGY SYSTEM CO., LTD.

SDG had an impact on the solar PV market beyond the provision of financing. SDF developed a consumer financing handbook that provided modeling tools and guidelines for the assessment of credit risk, which has proved effective.

Sunlabob Rural Energy System Co., Ltd., used this handbook in the development of its business plan for providing affordable and reliable solar energy through rental services in Lao PDR.

The World Bank awarded Sunlabob the Development Marketplace Award in 2005 for its work in developing a rental system that makes solar electricity affordable for the majority of rural households or villages without the use of subsidies.

PERFORMANCE AND OUTCOMES

The SDG initiative began in 1996 and ended in 2004. During those eight years, $2.85 million was disbursed to solar PV projects in over 20 countries. Though not quite the billion-dollar order-of-magnitude initiative that was initially called for, SDG was certainly an experience that has provided many valuable lessons for the future.

SDF, with its flexible, less risk-averse, and more affordable funding, was able to meet most of its investment objectives. SDF financing was provided to

help create a more enabling environment, increase the amount of consumer finance available, support enterprise growth, and support innovation within the industry. Following the beliefs that the challenges facing the market were more related to marketing and consumer financing than manufacturing and wholesale distribution, that retail operations more directly benefit the rural people, and that stimulating demand at the retail level would benefit the entire industry, retail distribution made up 80 percent of the SDF portfolio.

While SDF certainly had a positive impact on the solar PV industry, the foundation was insufficiently sizable to produce the large-scale change that SDG investors had envisioned and desired. Furthermore, SDF had been envisioned to be an entity to prepare companies for SDC investment. This simply did not occur.

SDC was to have made 28 investments over a 10-year period. Between 2001 and 2003, only six investments were approved by the SDC Board of Investors, totaling $3.9 million. Only $650,000 was ultimately disbursed to three countries: Kenya (investment went bankrupt in early 2005), Indonesia (investment terminated prematurely subsequent to the cancellation of the World Bank solar PV subsidy program in the country), and Bolivia (investment has been moderately successful, although only half of the approved funds have been disbursed). While the SDC management took its fiduciary responsibility very seriously, the market was as yet unprepared for the equity investments SDC was looking to make and, thus, it decided not to invest in unsatisfactory deals. SDC ultimately was able to return money to some of its investors upon project closure.

Many of SDG's shareholders had environmental mandates that served as motivation for their participation in the initiative. Solar PV has been trumpeted for many reasons, but one of the primary arguments has consistently been the positive environmental impact achieved through the implementation of RE technologies and the resulting reduction in CO_2 emissions. Measuring the environmental impact has proved difficult, however. In the case of SDG, few SHS systems were actually installed as a result of SDG investment, and it is therefore safe to assume that the environmental impact of SDG was negligible. Furthermore, SDG never set out to determine the number of solar PV systems installed as a result of SDG support; therefore, it would be impossible to determine the actual amount of CO_2 emissions that were displaced.

WHAT WORKED AND WHAT DID NOT

Shareholder Diversity Proved Problematic

Although the diversity of the different shareholders in SDG had been celebrated during the fundraising stage, it rapidly became apparent during implementation that it would be difficult to manage the various interests of such a diverse shareholder group. The separation of SDC and SDF had been designed to reflect the need to satisfy the different objectives of the for-profit investors, NGOs, and foundations (15 in total). With so diverse a composition (multilaterals, NGOs, SRIs, private individuals), SDG found it next to impossible to satisfy everyone's needs.

This is perhaps one of the greatest (non-market-related) reasons for the limited success of SDG, an issue from the very beginning.[43] The initial structure of SDG was designed so that SDF and SDC would provide complementary services; SDF would "prepare" companies for SDC investment. Yet, with each entity having a separate board of directors, each wound up with its own mandate, and not one single SDF investment graduated to SDC. In fact, SDF transcended on the SDC project pipeline, evolving into more of a soft financing vehicle, providing working capital rather than providing the seed capital and market development assistance originally intended. When it became apparent that the structure and investment guidelines were inappropriate, it proved impossible to reach consensus among the shareholders on the restructuring, despite a year of attempts.

Strategic Alliances Were Not Developed

It is interesting to note that while the diversity of shareholders was difficult to manage, it also could have been used to advantage. Strategic alliances could have been developed along a number of lines. In fact, most potential investees expressed that they were equally interested in the contacts of SDG. Most solar PV companies are SMEs, often family owned, and have grown without the benefit of technical training. The opportunity to consult with solar PV sector experts was very attractive to SDG investees; however, this type of relationship between SDG shareholders and SDG investees did not materialize, given that SDG shareholders did not stay invested in the initiative long enough to cement relationships.

Along these same lines, SDG omitted to take significant advantage of its relationship with the World Bank Group and other shareholders in the creation of an enabling market environment (supportive policy and regulatory environment, avail-

[43] While perhaps not a direct cause of SDG's lack of profitability or overall success, the diversity of SDG shareholders forced a management structure that was not only cumbersome, but one in which the intended relationships did not materialize.

ability of end-user finance, knowledge and awareness of solar PV). Furthermore, other groups (the United Nations, for example) were also involved in solar initiatives, although there was no coordination between the different projects. An enabling environment is necessary for sector development, but it is costly and requires significant resources, as well as enthusiasm by local governments for solar PV. The regulatory and policy environment will not alter until this occurs. While the World Bank is in a position to impact and promote local government support of solar PV initiatives, this relationship was not taken advantage of by SDG.

Need to Focus on Market Development and Capacity Building

Despite the fact that there was, and is, a clear need for market development and capacity building in the solar PV sector, the reality was that SDG was focused more on individual businesses. Had more attention been paid by SDF to develop the enabling environment, SDC may have found more investment opportunities, and SDG would have had a greater overall impact. Early recognition of market reality would have led to a smaller loss of funds.

Perhaps one of the greatest lessons that can be drawn from SDG is one that resulted not from a failure to achieve investment goals, but rather from the response to this failure. SDC management was quick to recognize that the initial investment criteria were too stringent, and it worked with shareholders to revise them. Rather than making bad deals, which could have jeopardized the reputations of those involved, it failed to make any deals, resulting in little investment loss. Management was correct in making this decision, providing a lesson on the merit of restraint. When it became apparent that the market could not produce opportunities that met the revised investment criteria, SDG was disbanded.

CONCLUSION

SDG's initial goal was to increase the delivery of SHS to rural households in developing countries and to support the development of the solar PV market. While SDF is seen as having had a positive impact on the solar PV industry, SDC failed to accomplish any of its goals, and, overall, SDG came up short.

The two entities that made up SDG had very different experiences. SDF, the not-for-profit arm, which provided loans, guarantees, and grants, was largely able to meet its investment goals, while SDC, the private equity fund, did not even come close. Solar PV markets simply were not mature enough for equity investments, and the family-owned nature of most solar PV SMEs further limited the possibilities for equity investment. At this stage of market development, different financing instruments and long-term patient capital was needed; SDC, with its ten-year fixed life and return expectations, could not provide this.

Like many other projects implemented around the same time, SDG grossly overestimated the market and the number of business opportunities that existed within it. In hindsight, it is easy to state that the focus of the project was too narrow, that the project should have focused on other RE technologies in addition to solar PV, and that additional financing instruments should have been provided. At the time the project was implemented, however, those involved in the industry truly did believe that the solar PV market was poised to take off. Had the solar PV sector actually performed as forecast, the SDG experience would surely have been quite different.

CASE STUDIES 4

Cagayan Electric Power & Light Company

Cagayan Electric Power & Light Company (CEPALCO), a private electricity distribution company on the island of Mindanao in the Philippines, received $4 million in funding from GEF (through IFC) in 2002. The purpose of the project was to demonstrate solar PV's effectiveness (through a conjunctive-use application) in addressing distribution system capacity issues. The funds were used to build a 1 MW distributed generation solar PV power plant, which was integrated into the 80MW distribution network of CEPALCO, and operated in conjunction with an existing 7 MW small, run-of-the-river hydroelectric plant.

BACKGROUND

Mindanao is the second largest island in the Philippines. The electrical grid on the island is well developed, but isolated, and it has a total generating capacity of 1,800 MW. Most of the generation capacity is from hydroelectric plants, with seasonal changes in generation capacity occurring. The transmission infrastructure on Mindanao is unable to transport large amounts of power over 200MW across large distances without compromising system reliability. As a result, CEPALCO and other distribution companies on the island must obtain large portions of their power supply from local sources.

In 1998, CEPALCO was in discussions with IFC for general corporate financing[44] to assist with the company's expansion plans.[45] The environmental review undertaken identified the possibility for a solar PV-based project. A pre-appraisal mission took place in the Philippines in December 1998 by the then IFC's Environmental Finance Group, with the goal of investigating suitable applications for solar PV-based generating equipment within the distribution network of CEPALCO. Distributed solar PV technologies, which are by their very nature small and situated near load centers, were believed to offer the potential to address seasonal generation capacity issues. They were also considered compatible with CEPALCO's needs and the geography of the transmission system.

Based on the findings of the December 1998 pre-appraisal mission, IFC proposed to GEF a project that would use GEF funds to partially finance the installation of a nominal 1 MW solar PV-based power plant, which would be integrated with the CEPALCO power distribution network. The stated objective of the project was to demonstrate the technical, operational, and economic feasibility of using solar PV electricity supplies for supplementing and firming up the productive capacity of an existing hydro project.

The solar PV plant was designed to operate in conjunction with the recently built 7 MW Bubunawan Hydropower Plant Project, a small run-of-the-river hydroelectric power plant, which was already supplying power to CEPALCO's system. The hydroelectric plant was to operate as a load follower, varying its output with the availability of solar PV power. The water saved, when solar PV power was being produced, would be held in small ponds available at the Bubunawan plant, to be utilized for power generation during peak load periods when solar PV was not available. The addition of the solar PV plant would reduce the need for CEPALCO to purchase thermal energy during peak load periods, thus reducing CO_2 emissions. In total, the 1 MW plant was estimated to lead to a reduction in CO_2 emissions on the island of Mindanao

[44] After the solar PV plant became operational, IFC's Infrastructure Department provided CEPALCO with a local currency loan (the first provided in the Philippines) in an amount equivalent to $15 million. The funds will allow CEPALCO to pursue its expansion program through a more stable financing structure.

[45] Designed to ensure that the company remained competitive in a newly privatized environment, CEPALCO's expansion plans included forming a partnership with a subsidiary of Hawaiian Electric Industries, an international utility with private power investment objectives in the Pacific Rim, and planning an investment program geared toward efficiently expanding its system and attracting a larger customer base.

of approximately 1,200 metric tonnes annually.

The project was endorsed by the GEF Council in December 2002. CEPALCO received a $4 million convertible loan from IFC, using GEF funds, and financed the remaining $1.8 million in construction costs from CEPALCO's own cash flow and interest savings. The GEF funds were initially provided as a loan, with the understanding that the loan would be forgiven after five years of satisfactory project operation.

In the period leading up to the final approval of the funding, CEPALCO issued an international request for proposals for the construction of a turnkey 1 MW grid-tied solar PV plant. The contract was awarded to Sumitomo Corporation of Japan, which utilized solar PV modules supplied by Sharp Corporation. Construction started in August 2003 and was completed on schedule. President Arroyo of the Philippines inaugurated the plant in December 2004. Today, the CEPALCO solar PV facility represents the largest solar PV installation in the developing world, and it has been operating without incident since its commission. It remains the only solar PV power plant in the world that is operational in a conjunctive-use application with a hydro plant.

WHAT WORKED AND WHAT DID NOT

The IFC/GEF project with CEPALCO has had a strong local presence, both through the in-country IFC representative office in Manila and through the efforts of the CEPALCO management and staff, which was critical to the success of the project. The Philippine staff at CEPALCO and the contractors from Sumitomo Corporation did an impressive job, not only of obtaining more than 50 permits and licenses in place for the facility, but also of complying with a host of project finance disbursement requirements and, finally, learning to successfully operate the project since completion of construction.

During project implementation, it quickly became evident that both the local permit process and the typical project finance structure were not geared to a small 1MW-solar PV investment. On the permit side, the Philippine regulations did not make the distinction between the solar PV plant and the much larger fossil-based plants, despite the obvious environmental benefits and the proven nature of solar PV technology. As a result, the CEPALCO solar PV project management team was required to perform tasks and submit reports that were not relevant to an RE project. The convertible loan structure (grant

convertible to loan) of the project called for a rigid disbursement structure. It became apparent, however, that, in order to ensure timely completion of construction, the prescribed disbursement structure would have to serve as a guide only.

It was widely recognized at the time the project was developed that there were more cost-effective technologies available to address peak load energy supply issues. In fact, the GEF grant, provided through IFC, served to subsidize approximately 70 percent of the construction and startup costs of the CEPALCO solar PV plant. The CEPALCO solar PV project never intended to compete head-on with other alternative energy generation technologies on the basis of cost efficiency, but it did intend to demonstrate that solar PV could be used as an effective and technically reliable source of power that could be cost effective if solar PV prices declined sufficiently. Furthermore, the CEPALCO project intended to demonstrate that there are technical advantages to the operation of such a plant in conjunction with an existing small hydro plant with limited storage capacity. The plant, which has operated without incident since its inauguration in 2004, appears to date to have been successful in proving solar PV to be an effective and technically reliable technology to address peak-load energy supply issues.

CONCLUSION

The CEPALCO experience is an interesting one. Unlike other IFC/GEF climate change mitigation programs and projects, many of which were designed as market transformation initiatives, CEPALCO was designed as a stand-alone experiment to demonstrate the appropriateness of the solar PV technology (through a conjunctive-use application) in addressing distribution system capacity issues. To date, the CEPALCO solar PV plant has made a strong technical case for the reliability of utility-scale solar PV power plants. Furthermore, by avoiding the need to purchase alternative thermal energy, the CEPALCO solar PV plant has resulted in a significant reduction in greenhouse gas emissions. The plant is expected to displace 24,000 tonnes of CO_2 over its lifetime.

When the financing was provided, it was expected that solar PV prices would decrease and that solar PV technology used on a utility scale would therefore become more cost effective. Had the price of solar PV gone down as was expected (and it is still predicted to occur in the future), CEPALCO would have been a project with a high potential for replication. However, with solar PV prices having increased, the potential for replication without significant subsidization is limited. Perhaps the most important demonstration value of the CEPALCO project is that solar PV works effectively in a conjunctive-use application. It also illustrates the fact that the technical solution is not always the best market solution.

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Authors

Natalia Magradze, Alan Miller, Heather Simpson

Reviewers

Anil Cabraal, Bernard McNelis, Shilpa Patel

Editorial Team

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Please address questions or comments to Alan Miller (amiller2@ifc.org) or Natalia Magradze (nmagradze@ifc.org).

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International Finance Corporation
2121 Pennsylvania Avenue, NW
Washington, DC 20433
USA

Telephone: 202-473-1000
Facsimile: 202-974-4384
www.ifc.org