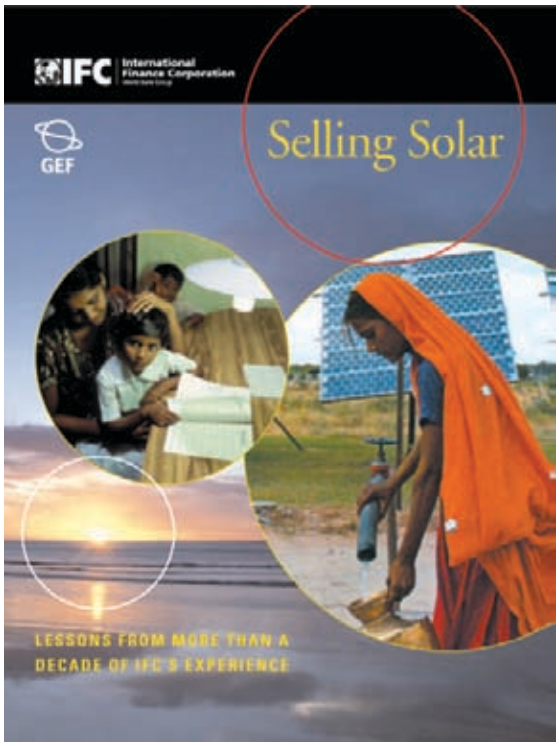
Selling Solar: Lessons from a Decade of IFC and World Bank Experience

Together the World Bank and the IFC constitute a major financier of PV in developing countries with projects valued at more than US$600 million that serve about 1.3 million households and other facilities in about 30 countries in Africa, Asia, and Latin America (see Table 2). They range from support for the installation of 400,000 PV systems in China, and financing solar lighting for teachers in remote areas of Papua New Guinea, to the provision of lighting and basic electricity services for rural Ethiopians to a grid-connected 1 MW PV system in the Philippines that demonstrates the value of conjunctive use of PV and hydropower. The chapter highlights lessons emerging from WBG experiences in supporting PV for development.



World Bank Group Solar Photovoltaics Projects

With its mandate to further economic development through the private sector, the IFC had its first involvement with investing in PV markets in 1989 when it made a US$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 by not only demonstrating confidence in viability of the PV technology, but also by focusing on commercializing the deployment of this technology in the developing world.

In the mid-1990s, the World Bank began supporting PV systems (or solar home systems, SHSs), as a least-cost alternative to grid extension for governments to deliver on promises of energy for development. The high priority accorded to rural electrification, the large numbers of unelectrified households, and the availability of financing through public programs also appeared to be potentially well suited to introducing PV for off-grid electrification on a large scale. World Bank experience is encouraging, with about 0.65 million installations completed out of its 1.2 million portfolio in 23 countries.

To date, the IFC has managed five GEF-funded solar PV initiatives: IFC/GEF Small and Medium Scale Enterprise Program (SME Program), Photovoltaic Market Transformation Initiative (PVMTI), Solar Development Group (SDG), Renewable Energy and Energy Efficiency Fund, and

Table 2: World Bank Group Solar PV Initiatives

Country	*Project*	*Target number of systems*	*Solar PV capacity (kWp)*	*Total cost (US$ million)*
Argentina	Renewable Energy in the Rural Market	30,000	2,843	36.0
Bangladesh	Rural Electrification & Renewable Energy Development	198,000	9,900	91.4
Bolivia	Decentralized Energy, ICT for Rural Transformation	60,000	2,600	38.6
Burkina Faso	Energy Access Project	2,100	100	2.0
Cambodia	Rural Electrification and Transmission	10,000	400	4.0
Cape Verde	Energy and Water Project	4,500	129	2.5
China	Renewable Energy Development	400,000	10,000	144.9
Ethiopia	Energy Access	6,300	407	5.4
India	Renewable Resources Development	45,000	2,500	24.0
Indonesia	Solar Home Systems	8,500	425	3.8
Lao PDR	Southern Provinces Rural Electrification, and Rural Electrification Projects	13,000	460	4.3
Mali	Household Energy and Universal Access Project	10,000	350	3.5
Mexico	Renewable Energy for Agriculture, and Rural Electrification (FY08)	8,345	1,767	27.6
Mongolia	Renewable Energy and Rural Access	50,000	520	5.2
Mozambique	Energy Reform and Access, and PV for Schools and Health Clinics	9,800	1,096	13.5
Nicaragua	Off-grid Electrification for Rural Development	6,000	215	3.0
Pacific Islands	Regional Sustainable Energy Finance	21,000	630	16.5
Papua New Guinea	Teachers Solar Lighting	2,500	100	2.2
Philippines	Rural Power and IFC 1 MW grid-tied project	135,000	10,000	120.0
Sri Lanka	Energy Services Delivery, Renewable Energy for Rural Economic Development (RERED), and RERED Additional Financing	180,000	7,200	62.3
Tanzania	Energy Development and Access (FY08)	11,800	800	20.0
Uganda	Energy for Rural Transformation	8,300	600	18.8
Zambia	Increased Access to Energy (FY08)	8,300	415	11.0
Multiple countries	IFC-financed financing facilities	100,000+	8146	25.3
Totals		1.33 million	61.62 MW	US$686 million

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

Source: Anil Cabraal, 21st European Solar Photovoltaics and Solar Energy Conference, Dresden, Germany, September 2006 (with data updated, November 2, 2007).

the grid-tied solar power plant of the Cagayan Electric Power and Light Company (CEPALCO). Case studies on these PV financing initiatives, as well as examples of some of the projects that these initiatives supported, are available in an IFC publication, "Selling Solar: More than a Decade of the IFC's experience" (available on-line at http://www.ifc.org/ifcext/enviro.nsf/AttachmentsByTitle/p_SellingSolar/$FILE/SellingSolar.pdf). Although these programs have been responsible for the installation of more than 80,000 SHSs, they have been less successful from a financial standpoint, because they have not resulted in significant market transformation or a sizeable number of financially sustainable businesses.

In some of the initiatives the main challenge was not in the technology per se, but rather in accurately judging market reality and trends and the major risks that PV entrepreneurs face. There were also a number of unanticipated developments, including a failed prediction that the price of solar PV panels would decline markedly, a decrease in the supply of smaller modules, and several economic shocks that disrupted markets. Hindsight shows that the initial beliefs of many market players about a large scale, fully commercial solar PV off-grid market were overly optimistic even though such off-grid PV markets are slowly emerging, most notably in Kenya. Much more is now known about the type of financing required to support solar PV market growth and what it takes to develop a successful solar PV company and market. Perhaps one of the most important lessons is that supporting the solar PV market is far more complex than first envisioned, particularly because of the level of market segmentation that is rooted in income level, lifestyle, and various regional and geographical differences.

Key Lessons of Experience

Lesson 1: Project designs must remain flexible and adaptable to address issues of affordability, risks and other market constraints.

Affordability varies among market segments (such as relative income levels or market applications), and it remains a challenge for PV companies to sell to the niche market segments even where PV is the least-cost energy alternative for the consumer. High first costs, lack of financing, limited awareness are among the constraints faced. Project designs must therefore be able to quickly adapt to market conditions so that responsive solutions are created to address barriers. Four such examples are projects supported by the World Bank and GEF:

- Bangladesh Renewable Energy for Rural Electrification project where 8,000 solar home systems are being installed monthly.
- The Off-Grid Rural Electrification Project in Nicaragua brings electricity services to households, public centers, and productive uses by facilitating access to microfinancing and strengthening the institutional capacity to implement a national rural electrification strategy.
- Papua New Guinea Teachers Solar Lighting Project where financing for solar lighting systems for teachers posted in remote areas is provided through the Teachers Savings and Loan Society.
- The Sustainable Solar Market approach first introduced in the Philippines under the World Bank and GEF-assisted Rural Power Project and now being considered in Tanzania and Zambia (see Box 2).

In these and other solar projects, it was imperative during implementation to adapt to changing market needs, such as by extending the eligibility of PV system sizes to smaller, more affordable systems, such as solar lanterns, or by introducing loan guarantee facilities or capacity building support to entrepreneurs and microfinance institutions.

Lesson 2: PV must be considered as one of several options for rural electricity provision.

All consumers prefer access to unlimited supplies of electricity at low prices. As grid-based rural electrification is often a highly valued political tool, significant government resources are employed in grid extension, even when it is a drain on government budgets and where economic justification is weak. As a result of these subsidies the cost of grid electricity to the end user is significantly less than alternative options.

However, there is now an increasing appreciation by governments and rural electrification authorities that PV is an economic least cost option

Box 2: Sustainable Solar Market Packages

The Sustainable Solar Market Package (SSMP) is a contracting mechanism that provides for the supply and installation of PV systems along with a maintenance and repair contracts (five years with option to extend) to schools, clinics, and other community facilities in a defined rural area, bundled with requirements and incentives for commercial sales to households, businesses, and other nongovernmental customers in the same area. By bundling institutional, community, and household applications in a particular area, the SSMP approach addresses some of the important affordability and sustainability issues of the past PV projects: standardization, reduced transactions costs, and larger business volume, and reduced risks. In the Philippines, 7 SSMP contracts to benefit 76 villages are under implementation with more SSMP packages under preparation to benefit 572 villages. In Tanzania and in Zambia, under World Bank projects that will be approved in FY08, about 10 SSMP packages are planned to be implemented in each country.

for rural electricity provision, especially where the alternatives are small generators, batteries or kerosene lighting. With oil prices exceeding US$90 per barrel, and kerosene subsidies becoming untenable, PV's attractiveness is increasing. The Philippines, for example, has a formal rural electrification planning process that demarcates villages where grid extension is not viable.

Where solar PV is least cost, market and willingness to pay studies must be conducted to confirm that consumers will indeed demand these systems before PV financing programs are established. Subsidies to buy down first costs, access to financing through rural banks or microfinance organizations may be necessary to enhance affordability.

Lesson 3: Private equity is not the most appropriate financial mechanism for investing in PV businesses in developing countries.

An important lesson for the IFC was that, while private equity and venture capital firms are heavily involved in the manufacturing of PV for developed country markets (Box 3), the risks and economics of PV in the developing world mean that the returns that such investors typically seek are less than they could obtain in other ventures. Nevertheless, China is an exception, where PV dealers depend primarily on private equity to finance their businesses. As experiences from China, India, the Philippines, and several other countries show, there are profitable opportunities for entrepreneurs in developing countries to supply PV modules to developed-country markets that are highly subsidized.[6]

Lesson 4: Good government relations and support are strong success factors

Although there are examples of companies able to establish successful PV rural electricity ventures without government support, those companies fortunate enough to operate with such support (or with some form of subsidy or market aggregation support) tended to be more successful than companies operating without explicit government support. Given the value of mobilizing private enterprises to extend PV electricity services as an economic alternative to grid extension, public-private partnerships for risk sharing or to buy down the first cost of PV systems can be effective. Such commercial retail market opportunities do exist in developing countries, as experiences in China, India, Kenya, and Sri Lanka, among others, have demonstrated.

Lesson 5: Quality must not be compromised

The most expensive form of electricity is a power supply that is not working. Quality of systems and ability to obtain spare parts and repair services must be an integral part of any PV electricity program. The World Bank was a pioneer in introducing quality requirements enforcement beginning with a project in Indonesia. All World

Box 3: 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 80 MW in Greater Noida, India. The IFC has recently approved a US$22.5 million long-term loan to the company to support a total investment of US$92 million. The project has the potential to avoid 80,000 tons of CO2 emissions annually and will contribute to the creation of about 600 new jobs.

[6] See the report, "Renewable Energy Network for the 21st Century," on power generation policies at http://gsr.ren21.net/index.php?title=Power_Generation_Promotion_Policies.

Bank–funded projects now rigorously enforce quality requirements. In both Indonesia and China, the project specifications eventually were adopted as national standards. In China, additional support was provided for technology improvement (Case One) and they have introduced a "Golden Sun" quality mark to help consumers identify quality-certified products.

Lesson 6: Access to financing is essential

Solar PV is capital intensive—both for manufacturers of key components, such as PV modules, and for consumers who purchase PV products. Therefore financing and financing vehicles that reach the target consumer are essential.

On the supply side, financing is needed to increase manufacturing capacity, supply 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 (such as lighting with LEDs). Demand for larger utility-scale PV may also emerge, especially for reducing peak electricity demands. The IFC is well positioned to provide its own funding on commercial terms, without reliance on donor subsidies, to support such ventures through its Infrastructure Department, as well as solar PV module manufacturing companies through its Global Manufacturing Department.

Demand for PV for rural electricity will grow. World Bank financing for solar PV will be primarily provided as part of rural electrification programs, where PV is considered a least cost supply option. Financing, often through microfinancing institutions, will be coupled with efforts to remove policy and price distortions. Addi-

tional support will be provided to strengthen the capacity of governments, the private sector, nongovernmental organizations (NGOs), and financial intermediaries.

IFC support for PV for rural electricity will continue. Instead of solar PV–focused initiatives, such as the SDG and PVMTI, the IFC will employ financial vehicles open to a wider range of clean energy opportunities, such as the Environmental Business Finance Program and the Sustainable Energy Facility. Important features are a more streamlined approval process and emphasis on debt instruments over equity, with convertibility features to take advantage of any potential upside.

Future Support for Photovoltaics

Having extensively evaluated not just its own experience, but also the experience of several important players in the solar PV business, the WBG remains cautiously optimistic that it is not a question of "if," but "when," the goal of a self-sustaining solar PV market in developing countries will be reached. We also recognize that PV is but one rural electricity option and therefore should be offered as one option on a menu of options to meet rural electricity service goals. Moreover, we recognize that electricity is merely an intermediate product and that it is the services rendered by electricity that matters for operating motors, lighting, refrigeration, communications, and so forth. To this end, the World Bank and IFC have embarked on a joint project, Lighting Africa (Case Two). It will catalyze local and international lighting-related companies into offering the unelectrified population greater access to modern and affordable off-grid lighting products while displacing fuel-based lighting products, such as kerosene lamps or candles, for which developing-country consumers spend about US$40 billion annually. PV technology is expected to be a principal source of power for such off-grid lighting applications.

Case One
Stimulating Solar Technology Improvement in China

China, along with the World Bank and GEF, launched the China Renewable Energy Development Project (REDP) in December 2001. Since then, the Photovoltaic Market Development and Technology Improvement Components of this project have achieved impressive results. By June 2007 it had supported the installation of 374,000 PV systems with a total PV module capacity of about 9 MW, benefiting more than 2 million people in the northwestern provinces. More than 30 companies have established dealerships throughout these provinces, which provide PV components and systems that meet the project's quality standards.

The Technology Improvement Component offered Chinese PV companies assistance in research, development, demonstration, and innovation. It has helped improve the quality of PV components and systems through a number of means including cost-shared research and development, national standards setting and enforcement, strengthening testing and quality monitoring.

The REDP introduced two innovations: a Competitive Grant (CG) Facility and a Quick Response (QR) Facility that specifically addressed the problem of low-quality PV components and systems found in the Chinese market before the REDP. The design of these facilities was based on the successful Netherlands Research Program PV (NOZ-PV) from 1997 to 2001.

The CG and QR facilities received about 200 proposals seeking US$3.3 million. These funds leveraged US$8.3 million from the proponents. The supported projects have had direct impact on the market by rapidly introducing into the Chinese and international markets high-quality and innovative PV products. Results from two of the beneficiaries are outlined below.

Beijing Sunpu developed a new Solar Home System "plug and play" unit built of durable plastic. The plastic casing gives the PV system an attractive appearance and provides room for including a radio, VCD or DVD player, and speakers. Two casing sizes have been developed—one for small systems (10–30 Wp) and one for larger systems (30–60 Wp). The total project cost was Y 572,000 (US$77,000), with a CG Facility grant of Y 150,000 (US$20,000).

Ningbo Solar Electric Power Company developed a new silver paste for its PV cell production process using CG funding. The increased performance permitted the company to increase the rating of their large PV modules from 160 to 170 Wp at a lower unit cost. The total project cost was Y 844,000 (US$114,000), and the CG Facility grant was Y 250,000 (US$34,000), which amounted to 30 percent of the project cost.

The technology improvement approach has been replicated under the World Bank/GEF–assisted China Renewable Energy Scale-Up Program (CRESP) where a CG Facility is used to facilitate technology transfer of wind turbine technology to China, improve the technology of biomass energy equipment manufactured in China, and demonstrate innovative renewable energy technologies.

The companies surveyed have also reported that they invested about US$75 million equivalent in 2004 and 2005 in their companies and manufacturing facilities to produce these new and improved technologies.

The Grant from REDP can be regarded as the fire in snowing winter. Our company sold the PV integrated system with a metal case in the domestic market. The shape of the metal case was often distorted because of the pressure it was under during transportation. And it always led to a refund.

Under the support of TI component of REDP, our company developed a plastic case for the PV integrated system. It solved the problem mentioned above, won the satisfaction of the dealer and user, and doubled our sales. At the same time, we improved the outward appearance and the coherence of the system. The improved system also sold abroad, for example, in Southeast Asia.

So, we will say thanks to the Project Management Office of the REDP, wish REDP will continue in China.

—Mr. Mingshan Xiao, Chief Marketing Officer, Sanpu

Case Two
Lighting Africa: Catalyzing Markets for Modern Lighting

For the poorest of the poor, lighting is often the most expensive item in their energy budget, typically accounting for 10–15 percent of total household income. The "energy poor" in Africa spend about US$17 billion a year on fuel-based lighting sources (Box 4).

Beyond household use, commercial use of fuel-based lighting can have even more acute economic impacts. Fishermen on Lake Victoria in Kenya, for example, often spend half their income for the kerosene they use to fish at night. Yet, while consuming a large share of scarce income, fuel-based lighting provides little in return.

Fuel-based lamps, such as kerosene lamps, are costly, inefficient, and provide poor lighting. The smoke they emit is directly linked to health issues associated with inhalation and eye damage. The flames from kerosene lamps are responsible for thousands of severe burns among children annually and untold numbers of devastating house fires.

Lighting Africa aims to catalyze by the year 2030 access to modern, non fossil, safe and low cost lighting to 250 million people in Sub-Saharan Africa who rely on fuel-based (typically kerosene-fueled) lighting systems due to a lack of access to reliable electricity.

Lighting Africa is supported by significant contributions from the GEF, European Commission, ESMAP, PPIAF, Norwegian Ministry of Foreign Affairs, Renewable Energy and Energy Efficiency Partnership and Good Energies Inc.

In Lighting Africa, the Bank Group seeks to unleash the potential represented by newly emergent lighting technology, including light-emitting diodes (LEDs), whose ability to deliver high-quality light

Box 4: The Price of Poor Lighting

As a result of surging kerosene prices, schools in rural Senegal are running out of light. The schools are not connected to the electricity grid, and they rely solely on fuel lamps. With the oil price shock in 2006, fuel for lighting became too expensive to buy. In Thiancone Bogual, a town in northeastern Senegal, some 690 km from the capital, Dakar, students must squeeze in the few houses equipped with solar energy to read after dark. According to the headmaster of the local school, 100 percent of the students finished elementary education in 2005, but in 2006 when the school could no longer pay for fuel, just 60 percent got their elementary certificate.

Source: Integrated Regional Information Networks (IRIN), U.N. Office for the Coordination of Humanitarian Affairs, October 23, 2007.

with very low levels of electricity input offers an alternative to fuel-based lighting using a variety of renewable sources of electricity where the electric grid is unavailable. Because of the energy efficiency and low power requirements of these lights, self-generated packaged lighting systems that include a solar cell or mechanical hand crank, for example, can be priced at an affordable level—and marketed on self-sustaining commercial terms. Thus, Lighting Africa is not a give-away program, but rather undertakes a number of market-catalyzing actions to do what the industry cannot efficiently do itself in aggregating market demand, capturing market information, catalyzing consumer and supplier financing, and ensuring product quality in the market.

The initiative will facilitate the transition to modern lighting services in the following ways:

- **Catalyzing the private sector**, including strengthening ties between the international lighting industry and local suppliers and service providers to profitably manufacture, market, and distribute significantly lower cost products.
- **Facilitating consumer access** to a range of affordable, reliable, and high-quality lighting products and services—for example, by providing consumer education services and consumer finance, and by executing a product quality assurance program.
- **Improving market conditions** for the scale-up of modern lighting products by reducing existing technical, financial, policy, information, and institutional barriers. This includes the development of methods for obtaining CDM credits for distributed lighting.
- **Mobilizing the international community**—governments, private sector, international organizations and NGOs—to aggressively promote the use of modern lighting services for the poor in Africa.

See http://www.lightingafrica.org for more information.

Night market shoe seller in Dar es Salaam (Tanzania), with handmade kerosene tin lamp (left), and 1-watt LED (right)