6．ソーラー・ホーム・システム(SHS)の
普及に係る融資条件

RURAL PHOTOVOLTAIC ELECTRIFICATION

1. NEA GTZ FUNDED PER HOUSEHOLD (SEP) — UP TO 995 ONLY
(SOLAR PANEL USED IS 75 Watt-peak)

	A. NEA to EC	B. EC to CONSUMER
AMOUNT OF LOAN =	P6000.00	P12,000.00
INTEREST =	12%	12%
REPAYMENT PERIOD =	10 YEARS	10 YEARS
GRACE PERIOD	ONE (1) YEAR	
CAPITALIZED COST, (1 year)=	P 720.00	
TOTAL COST =	P 6,720.00	P 12,000.00
MONTHLY AMORTIZATION =	P96.50	
REVOLVING FUND =	**P2,160.50	2064
O & M COST PER MONTH=		P18.00
SERVICE FEE =		P190.00
ENERGY GENERATED PER MONTH=	*7.2 KWH	*7.2 KWH
ENERGY COST PER KWH =		P26.40

2. NEA FULL FUNDING PER HOUSEHOLD (PRESENT)
(SOLAR PANEL USED IS 75 Watt-peak)

	A. NEA TO EC	B. EC TO CONSUMER
AMOUNT OF LOAN =	P12,000.00	P12,000.00
INTEREST =	12%	12%
REPAYMENT PERIOD =	15 YEARS	
GRACE PERIOD	ONE (1) YEAR	
CAPITALIZED COST , (1 year) =	P 1,440.00	
TOTAL COST =	P 13,440.00	P 12,000.00
MONTHLY AMORTIZATION =	P160.00	
REVOLVING FUND	***P1,920.00	
O & M COST PER MONTH=		P18.00
SERVICE FEE =		P 178.00
ENERGY GENERATED PER MONTH=	*7.2 KWH	*7.2 KWH
ENERGY COST PER KWH =		P 24.70

NOTE : * A typical 75 Watt-peak Solar Panel generates 240 wh/day for a total of 7.2 KHW per Month.
** 50 % As Revolving Fund plus Accumulated Funds for the first year grace period.
*** Accumulated Fund for the first year grace period.

CONVENTIONAL RURAL ELECTRIFICATION
OF REMOTE BARANGAYS AND MUNICIPALITIES

LINE	COST/KM. (PESOS,P)	HH CONN. PER KM.OF LINE	LOAD, KWH PER KM.OF LINE	INVESTMENT COST/KWH
AVERAGE DATA				
3-PHASE	300,000	60	5000	P 60.00
2-PHASE	225000	60	3000	P 75.00
1-PHASE	175,000	50	1500	P 116.00

REFERENCE DATA: KAELCO, DANECO, ISECO, ILECO III
(ELECTRIC COOP. WITH SOLAR HOMES SYSTEM INSTALLATIONS)

7．フィリピンのSHSの販売会社リスト

NATIONAL ELECTRIFICATION ADMINISTRATION

1050 CDFC Building , Quezon Avenue
Quezon City, Philippines

SOLAR SYSTEM SUPPLIERS

SUPPLIER	CONTACT PERSON	TELEPHONE/ TELEFAX	REGIONAL OFFICE	SCOPE OF SERVICE PV PANELS
BP SOLAR(PHILIPPINES) Suite 76, ZETA Bldg. 191 Salcedo Street Legaspi Village, Makati	Ms. Deveza	815-9036/37	–	BP
C.C. UNSON COMPANY, INC. Triumph Building 1610 Quezon Ave., Quezon City	Mr. Barreto	920-7070	Manila	BP
FIRST PHIL. ENERGY CORP. 3/F Benpress Building Exchange Road cor Meralco Ave. Pasig, Metro Manila	Mr. Tejero	631-2419 632-3502 631-8024 631-4089	–	Solarex
FLORO ENT. INT'L CORP. 500- C Palanca St., Quiapo, Manila	Mr. Floro	742-4241 742-4495	–	Siemens
MACHINEN & TECHNIK, INC. L.M. Bldg. 106 E. Rodriguez Ave., Libis, Quezon City	Mr. Serafica	633-1401-09 817-1056 631-6681	–	Siemens
RURAL ELECTRIC CORP. 3/F 3J Heights Condominium Visayas Avenue, Diliman, Q.C.	Ms. Hizon	96-93-59	–	
SOLAR ELECTRIC COMPANY, INC. Ground Flr., Gold Bldg. Annapolis St., Mandaluyong	Mr. Puckett	722-7235 721-1980 722-7247	Iloilo	BP Solec
TOTAL SOLUTIONS TECHNOLOGY Suite 301 Menchavez Bldg. Escario St., Cebu City	Mr. Diola	212-352 219-231	Cebu	Solarex
YUPANGCO ELECTRONICS, CORP. 3rd Flr., Yupangco Bldg. Gil Puyat Avenue Makati, Metro Manila	Mr. Pineda	877-142	–	Kyocera
RENEWABLE ENERGY SOURCES 12 B3 Dacon, Kasibulan Cainta, Rizal	Mr. Larona	656-79-66	–	BP

8. SHS一式の参考価格(1995年1月)

Republic of the Philippines
NATIONAL ELECTRIFICATION ADMINISTRATION
Quezon City

January 9, 1995

MEMORANDUM

F O R : THE DIRECTOR, LOANS

FROM : THE DIRECTOR, AEDD

SUBJECT : UNIT COST OF SOLAR HOME SYSTEM

Hereunder is the unit cost of solar home system:

Item No.	Quantity	Description	Cost/Unit (Pesos)
A. (Loan Portion)		GENERATOR	
1.	1 unit	Solar Panels, BP275,75Wp	9400.00
2.	1 unit	Battery Control Unit	1250.00
3.	1 unit	G.I. Pipe(Sch.20,2" diam.)	550.00
4.	1 set	Aluminum Frame(incl. acc.)	400.00
5.	1 cut	Cable(Royal #12/2 x 15.0 m.)	400.00
	Sub-total		12000.00
B.		BALANCE OF SYSTEM	
6.	1 unit	Storage Battery, Motolite, 100Ah	1610.00
7.	1 set	Lighting Fixtures, BP 8W	550.00
8.	1 set	Housewiring materials	450.00
	Sub-total	—	2610.00
C.		ADDITIONAL LIGHTING FIXTURE	
9.	1 unit	Page PL Lamps 11W, PS 12W	620.00
10.	1 unit	Schuch, PL11	1100.00

For your reference in the preparation of statement of account on balance of system payment.

EDGARDO R. PIAMONTE
Director, AEDD

9. Aus AIDプロジェクト
Municipal Solar Infrastructure Projectの概要

Project/Activity	:	**Municipal Solar Infrastructure Project (MSIP)**
Counterpart Agency	:	Department of Interior and Local Government (DILG)
Eligible Contract Value	:	US$ 31,000,000
AusAID Funding	:	A$ 10,700,000 (Grant support for mixed credit; includes $500,000 for a buyer's agent)
Due to Commence	:	June 1997
Scheduled Completion	:	June 1999
Project Locations	:	
Australian Contractor	:	BP Solar (Australia) Ltd
Australian Project Manager	:	Dr Bruce Robins

Project Description :

The Project will install approximately 1,000 packaged photovoltaic (PV) solar systems in 400 barangays. Beneficiary villages will be remote from the material electricity grid, with no likelihood of connection for at least seven years. The PV systems will power community infrastructure (not private households), including district hospitals, rural health centres and clinics, municipal halls, schools, public lighting and community water supply systems. The Project will be community-based, applying demand-based beneficiary selection and social preparation, and training for stakeholders.

Major Australian Activities :

- Conduct of site surveys and long-list computation
- Management of community slef-selection process; undertaking of social preparation; installation; and operations and maintenance training
- Training of all personnel
- Site preparation
- Manufacture, supply and testing of PV systems
- Selection, purchase and supply of other infrastructure components such as water pumps
- Installation of systems
- Maintenance of systems for 12 months, including continuing on-the-job training for operators

THIS PROJECT IS PROBABLY THE LARGEST OF ITS TYPE IN THE WORLD. IT REPRESENTS A QUANTUM LEAP FOR AusAID, BP SOLAR AND THE PHILIPPINES GOVERNMENT INTO A TECHNOLOGY WITH ENORMOUS POTENTIAL FOR APPLICATION IN POOR AND REMOTE RURAL COMMUNITIES.

1. EXECUTIVE SUMMARY

Local Government Units (LGU) in the poorest Provinces on the Philippines have a very limited capacity to provide basic social services such as health and potable water. Typically remote municipalities have no electricity and therefore the LGU are unable to provide access to government programs nor gain involvement of the communities they serve in local development activities.

In order to improve the capabilities of LGU, the Department of Interior and Local Government will use solar energy as the enabling technology to provide stand-alone powered systems and appliances for 171 existing hospitals and health units, 272 local government offices, 221 schools and community centres as well as 108 communal area lights and 223 upgraded water supply systems. Packaged systems place control in the hands of the end user, empowering them to fulfill their functions and meet their responsibilities more effectively.

The DILG has established a set of criteria for selecting the recipient LGU with an emphasis on recognised needs and participation by the communities. Supply will be preceded by specific training in management, operation and maintenance of all systems and the recipient LGU will accept responsibility for all future costs to sustain the services.

Solar energy will be the source of electrical power for all systems, bringing the advantages of very low operating costs, high reliability, and suitability for operation in isolated communities. The packaged systems to be provided apply proven technology to the identified needs of basic social service providers. All equipment has a long operating life under the conditions prevailing in the areas targeted. Experience shows that people in developing countries are well able to monitor and service the equipment. The use of solar energy as the power source will ensure that the project has a benign impact on the environment and will in fact help to lower the demand for imported fossil fuels in the Philippines and hence contribute to a reduction in greenhouse gas emissions.

The intervention at local level by the DILG, which is a National Government Agency, arises from the commitment made under the Social Reform Agenda to help the poorest Provinces develop the capacity to cater for basic needs. Funding for the initial investment will be provided by the National Government as the costs are well beyond the resources of the LGU. As the services provided by the systems support social programs such as health, institutional activities and education no revenues will be generated by the implementing agency(ies) and the project cannot be financially or commercially viable.

Economic analysis shows that the DIFF project will generate significant benefits for the community and these can flow to the economy as a whole. The project is economically attractive and because of its impact on the quality of life of the people targeted by the Social Reform Agenda it is recommended that it be given the opportunity to proceed with DIFF funding.

10. ADBワークショップ(太陽光発電)の要約
(1996年2月開催)

BOARD OF DIRECTORS

ASIAN DEVELOPMENT BANK

IN.210-96
15 October 1996

REGIONAL WORKSHOP ON
SOLAR POWER GENERATION USING PHOTOVOLTAIC TECHNOLOGY

Attached for information is a synopsis of the Regional Workshop on Solar Power Generation Using Photovoltaic Technology held in the Bank from 20 to 23 February 1996, for which the Bank extended technical assistance (DOC.R105-95 of 7 June 1995 refers).

REGIONAL WORKSHOP ON
SOLAR POWER GENERATION USING PHOTOVOLTAIC TECHNOLOGY
20-23 February 1996 • ADB Headquarters, Manila, Philippines
- Synopsis -

A. Introduction

A Regional Workshop on Solar Power Generation Using Photovoltaic (PV) Technology was organized by the Asian Development Bank (ADB) and held in Manila 20-23 February 1996. The Workshop followed an ADB-financed study,[1] which assessed the status of PV technology and its feasibility for power generation in the next 10-15 years. The study also reviewed the roles of governments, public utilities, and development finance institutions in ADB's developing member countries (DMCs), and those of the manufacturing and trading firms in disseminating PV technology to consumers. The Workshop provided an appropriate forum for discussing the technical, institutional, and economic aspects of PV technology and for disseminating the findings of the study.

The Workshop was attended by 46 senior officials from energy ministries, utilities, and commercial banks in 22 DMCs.[2] The objectives of the Workshop were to (i) take stock of the status of solar PV technology in the DMCs; (ii) understand the experiences of aid agencies; (iii) perceive the industry outlook; and (iv) arrive at a consensus on the appropriate roles of industry, commercial banks, governments, and nongovernment organizations (NGOs), and the operational focus and policy stance that ADB should take to promote solar PV among the DMCs. The four-day Workshop was structured around four theme sessions and four plenary sessions, and focused on international solar initiatives on day 1, technical and economic issues on day 2, institutional issues on day 3, and financing issues on day 4. At the end of each day, there was a plenary session to provide a forum for discussions.

In addition to those made by the DMC participants, presentations were also made by ADB, the World Bank (WB), the International Finance Corporation (IFC), UN-Economic and Social Commission for Asia Pacific (UNESCAP, Thailand), Asian Institute of Technology (AIT, Thailand), Australian Aid for International Development (AusAID), Deutsche Gesellschaft fur Technische Zusammenarbeit (GTZ), Forum Secretariat (Fiji), Institute of Energy Economics (Japan), Ministry of Non-Conventional Energy Sources (India), Bharat Heavy Electrical (India), BP Solar South East Asia, Center for Application of Solar Energy (Australia), United States Export Council for Renewable Energy (US/ECRE), Solar Electric Light Fund (US), International Fund for Renewable Energy and Energy Efficiency (US), Credit Bank of Indonesia, IT Power (UK), Development Bank of the Philippines (DBP), Preferred Energy Investments (Philippines), NESTE Advanced Power Systems (Singapore), Siemens Solar (Singapore), Solar Power and Light Company (Sri Lanka), and Sarvodaya (Sri Lanka). Also in attendance were representatives from the Belgian Embassy in the Philippines, Department of Agrarian Reform (Philippines), Philippine National Oil Corporation, Renewable Energy Sources (Philippines), and Solar Electric Company (Philippines).

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1 Under TA No. 5518: Regional Study on Solar Power for $97,000, approved on 23 December 1992.

2 Bangladesh, Cambodia, People's Republic of China, Cook Islands, Fiji, India, Indonesia, Kiribati, Malaysia, Federated States of Micronesia, Mongolia, Pakistan, Papua New Guinea, Philippines, Solomon Islands, Sri Lanka, Thailand, Tonga, Tuvalu, Vanuatu, Vietnam, and Western Samoa.

In his opening address, Mr. Paul Dickie, Acting Director, Infrastructure, Energy and Financial Sectors Department (Region East), highlighted the benefits that rural communities can derive by having electric power for key uses such as lighting, health care, agricultural processing, and communications. He observed that the high cost of utility grid extensions and the low initial power demand in rural communities have constrained the delivery of electric power to many rural populations. He added that stand-alone diesel generation systems, which are an alternative power supply option in remote rural areas, require a complex service network to provide reliable fuel supplies, spare parts, and maintenance services in addition to the costs involved. He noted that solar PV technology does offer a feasible and simple alternative to meet essential demands for electric power in specific areas.

Mr. Peter Sullivan, Vice President (Region East), in his address pointed out that commercial energy sources account for a small share of the total energy consumption in rural areas because of the high costs associated with developing rural energy distribution networks. The key to augmenting rural energy supplies lies in developing an optimum mix of energy sources for each rural location based on the available natural resource endowment pattern. He also stressed that although solar PV technology is a viable option for applications where extension of grid power is uneconomic, the economic analysis of comparing this option with conventional grid supply needs to be realistic and should include all the costs as well as the environmental benefits. He noted that in view of the high front-end costs of renewable energy options to the consumer, some innovative financial techniques are needed to design repayment terms in line with the consumer's ability to pay. Mr. Sullivan concluded by saying that the Workshop was one of the steps being taken by ADB to stimulate greater awareness among ADB's member countries of the role of solar PV technology in rural energy development.

A summary of the proceedings of the Workshop is given as an Appendix.

B. Conclusions and Recommendations

The Workshop recognized that PV technology is emerging as a proven, affordable, and environmentally sustainable technology that can provide electricity to about 1 billion people in the Asian and Pacific region who at present cannot be supplied with electrical power. The main barriers to further market penetration of PV technology, where economically feasible, include (i) lack of information about the potential of PV technology, (ii) inadequate marketing efforts of PV technology suppliers, (iii) lack of financing sources, and (iv) focus of governments on large power projects that are seen as a requirement for economic growth. In this context, governments need to create units within their energy sector organizations to promote the adoption of PV technology in partnership with the private sector, as well as an environment that supports the installation of PV systems, with low interest loans to buyers of PV systems to offset the high front-end costs, and tax incentives and favorable loans for manufacturers and suppliers of PV systems.

The following specific recommendations were made by the participants for ADB to consider:

1. ADB should identify renewable energy applications in its operating sectors and require that all its DMCs draw up operational strategies and action plans specific to renewables.
2. ADB through its technical assistance (TA) projects should provide for capacity building and training in the DMCs and actively make available information on renewable energy, particularly PV.

3. Through its regional TA program, ADB should undertake a market assessment of PV potential among its DMCs. The market assessment would include PV applications for home use, water pumping, telecommunications, public applications (rural schools and clinics), vaccine refrigeration, water purification, distribution network augmentation and grid connection. The assessment would provide an estimate of the investment requirements to implement cost-effective PV application on a country basis.

4. ADB's assistance to the power subsector of DMCs should include TAs to evaluate benefits and costs of solar home systems (SHS) as an alternative to grid-based rural electrification. The analysis should include a calculation of the rate of return to the power utility on leasing and selling SHS compared with the return expected from residential customers using network-supplied electricity, taking into account all direct and life cycle economic and financial costs to the utility and customer.

5. ADB, through its TAs, should support pre-investment studies of PV or other renewable energy projects to develop a pipeline of investment projects. For this purpose, ADB should consider assistance to private sector players including NGOs that can play a key role in project development activities.

6. ADB should initiate a plan for PV investment among its DMCs, with attention being paid to the equitable distribution of finance for solar PV investment. Furthermore, through policy dialogue with its DMC governments, ADB should encourage them to level the playing field by removing taxes on renewable technologies and subsidies to conventional sources of energy.

7. ADB should consider a flexible lending structure that would reduce the number of intermediaries and allow end-customers to benefit from affordable ADB terms. Intermediaries could be utilities, private entrepreneurs, NGOs, and energy service companies.

8. ADB should consider establishing a Renewable Energy Fund with a concessional interest rate of 2-3 percent accessible to all DMCs, and developing guidelines along the lines of the Global Environment Facility for utilizing this fund.

9. ADB should design and implement renewable energy initiatives to increase the flow of funds through

   (i) public sector development financial institutions via "line of credit" for relending to renewable energy/PV projects; and

   (ii) private windows via direct lending to stronger players or the setting up of revolving capital investment funds in local private institutions, which can act as intermediaries for the retailing of funds. Guarantees and cofinancing arrangements may also be considered to bring about increased private sector participation.

10. ADB should design and implement initiatives for increased equity or quasi-equity provision by adding a "line of equity" to its current "line of credit" initiatives. This will assist local private entrepreneurs in developing more market-oriented instruments and vehicles for leasing or sale of PV systems. This will also encourage the entry of more entrepreneurs who may not have enough capital to undertake PV/renewable energy projects. In the implementation of these initiatives, ADB should target rural energy service companies or other entities that are able to integrate the necessary technical, financial, and organizational services to serve rural consumers.

A. Day 1 Proceedings

1. International Solar Initiatives Presentations

a. Ms. Carolyn Tager, ASTAE, World Bank

Ms. Tager provided the participants with an overview of WB's new lending windows available for renewable energy development through use of the (i) Global Environment Facility (GEF), (ii) WB Asia Alternative Energy Unit (ASTAE), and (iii) WB Solar Initiative. She spoke about WB's Solar Initiative that was launched in 1993, which seeks to promote renewable energy use in developing countries via two programs. The first is an operational program to further integrate commercial and near-commercial renewable energy technologies into WB and GEF project pipelines. The second is a research and development program to encourage shifts in solar energy research and development to attract reliable funding. She also spoke of WB's involvement in the Indian Renewable Resources Development Project in 1993, the proposed 200,000 Solar Home System (SHS) Project in Indonesia, and the Sri Lanka Energy Services Delivery Project, which includes a credit line for solar PV systems. The ASTAE report titled, *Best Practices for PV Household Electrification Programs* was also referred to.

b. Mr. Dana Younger, Environment Division, IFC

Mr. Younger explained that, while in the past GEF funds were principally available as grant funds, there is now scope for GEF financing to be extended for leveraging loans to developing countries. He explained GEF's most recent operational strategy on renewables, which permits paying for the cost of removing barriers and supporting the cost of developing technologies. As regards solar PV, it was pointed out that the main obstacle to worldwide dissemination of PV technology was the hesitation of small industry players to commit to investing in and maintaining sales, distribution, and financing mechanisms for PV applications. He noted that the majority of rural customers had about 50 kilowatt-hour (kWh) per month of electricity consumption, while a typical power utility's breakeven point is in the range of 200-300 kWh/month, and that in these circumstances, solar PV is an attractive choice for the electrification of rural households. Mr. Younger also discussed IFC's PV Market Transformation Initiative to accelerate the commercialization, market penetration, and financial viability of solar PV technology.

c. Dr. Kyi Lwin, ESCAP

Dr. Lwin informed the participants that ESCAP has been implementing solar PV projects for the past decade under four programs: (i) the Regional Energy Development Program; (ii) the Pacific Energy Development Program; (iii) the Biomass, Solar, and Wind Energy Network; and (iv) the Program for Asia Cooperation on Energy and Environment. He said that ESCAP's experience shows that PV schemes are feasible when there is strong political will and support from the government and that ESCAP's approach to program development is based on regional cooperation with focus on intercountry cooperative initiatives.

d. Mr. Heinz-Wolfgang Böhnke, GTZ

Mr. Böhnke described the technical assistance provided under the Philippine-German Solar Energy Project (SEP), which concentrated on two elements: (i) confidence building with

information on demonstration of the technology in the field, and (ii) risk identification to convince the rural electric utility management that PV electrification is not an undue risk. It was explained that, in SEP, the rural electric cooperatives (RECs) owned the solar home systems. To date about 10 pilot cooperatives have installed a total of 975 systems, while 41 additional RECs have requested another 1,918 systems. Results show that SEP can provide a satisfactory level of electrification at costs lower than grid extensions and that most rural users can afford the full financial cost. He stressed the need for policy recommendations such as reducing subsidies to conventional energy sources, prioritizing solar PV technology in rural electrification plans, and providing concessional funding.

e. Mr. Nick Wardrop, Forum Secretariat

Mr. Wardrop said that the Forum Secretariat has seen solar PV systems improve from an often unreliable and costly technology in the early 1980s to a more reliable and competitive technology in the 1990s. He said that many of the technical, economic, and institutional barriers have been or are being overcome. Mr. Wardrop outlined three solar PV programs presently being administrated by the Forum Secretariat. These are supported by European Union, Australia, and New Zealand and provide support to solar PV-related project activities and training.

f. Mr. Andrews, AusAID

Mr. Andrews discussed AusAID's solar PV experience with the 1990 Pansiyagama Project in Sri Lanka, which aimed to (i) provide energy; (ii) demonstrate the viability of the technology; and (iii) transfer the technology, particularly in aspects of manufacturing. He indicated that an evaluation of the project in 1992 revealed that some of the beneficiaries did not fall into the lower or middle income category as envisaged by the project and that the PV systems should have been designed and installed as a complete package. He also noted the need to establish an effective administrative structure for operations, maintenance, and collection of fees in solar PV projects, but pointed out the need for subsidization of the initial installation. Therefore, he said, AusAID views solar PV applications as a solar infrastructure program rather than a rural electrification program.

g. Questions from the Floor

Mr. Böhnke was asked if there was an income ceiling for the beneficiaries under the SEP and what action was taken if they defaulted in their monthly dues. Mr. Böhnke replied that SEP focused on selected remote areas where the potential households had the capacity to repay the cost of the PV systems. He said that a service fee of about 10 percent of their nominal monthly income was charged and it was surprising to find that affordability in the Philippines is very high. In addition, it was observed that the people were willing to make extra efforts to acquire a reliable solar PV system. In project areas where a strict collection scheme and disconnection policy were enforced, the collection efficiency was high and the program worked well. When asked about how SEP's solar water pumping projects were designed and managed, Mr. Böhnke responded that the Photovoltaic Pumping Project had installed 15 pumping stations in the Philippines for village water supply in the last four years; the PV pumping systems ranged from 1 kilowatt-peak (kWp) to 2.5 kWp; each village household had to pay a monthly water fee to recover the cost of the system during its lifetime; and the women in the villages prefer this mode of water supply since they had to walk to collect water before.

On the question as to why AusAID looks at solar PV in terms of social development rather than from a rural electrification perspective, Mr. Andrews replied that AusAID has traditionally pursued community development projects and social infrastructure projects where solar PV was promoted as a subsidiary objective. Ms. Yeneza from the Preferred Energy Investments (PEI) called for addressing the need for subsidy in solar PV projects, given the market forces. Dr. Lwin added that if subsidies being provided to conventional sources of energy supply can similarly be provided to solar PV projects, then far more PV projects could be planned and implemented in the remote areas. In response to a question on the extent of the subsidy in conventional energy supply, Ms. Yeneza replied that in the Philippines the National Power Corporation loses around 800 million pesos per year in subsidizing the small island grids and that the rural electric cooperatives also cross-subsidize their operations in the losing sites with more profitable customers. Mr. Wardrop added that in the case of the Pacific Island countries, the subsidy is about 50 percent.

2. **International Solar Initiatives - Plenary Session**

Mr. Dana Younger, Chairperson

Mr. Younger introduced to the participants IFC's new equity and debt fund (Renewable Energy and Energy Efficiency Fund), which aims to support off-grid rural electrification projects that are more private sector in nature. A feasibility study done by IFC on renewable energy and energy efficiency markets on a global base had indicated a very sizable pipeline of potential investment projects. The fund would be about $100 million to $200 million and would be available for projects requiring development support. He also mentioned the pilot phase of the GEF-funded and IFC-managed fund of about $4.3 million which can make concessional loans of $100,000 to $200,000 to small enterprises.

Dr. Lwin emphasized the need for regional cooperation by networking mechanisms or through regional working groups comprised of three to four similar neighboring countries. Mr. Wardrop suggested the possibility of creating an association of PV utilities similar to the regular utilities, which would then help strengthen the capability for in-country PV manufacturing. Mr. Böhnke stated that to fully utilize the available international support, there is a greater need to disseminate the information through more workshops. Also, developing countries need to look for grants to finance such projects rather than promote projects that are based on total cost recovery. As a consequence, there is a need for more cooperation among aid agencies, multilateral financing institutions, and DMC governments to work in the same direction.

Mr. Jude noted that relatively few multilateral bank-assisted renewable energy projects have taken off the ground largely because of difficulties with having a suitable executing agency to implement such projects. He also added that ADB does not have easy access to GEF funds and therefore does not have the leverage that WB has to provide blended loans to developing countries to implement such projects.

Mr. Younger mentioned that the GEF project preparation development facility is a fast-track response mechanism for grants with turnaround times of 1-3 months and is open to all proposals involving eligible renewable energy technologies. He added, however, that this is a subsidy program with a specific intent to accelerate the penetration of climate-friendly technologies and that GEF's sponsors have decided that this is a sufficiently important objective. Mr. Wardrop pointed out that, to facilitate member countries' access to these funds, there is a need to liberalize the criteria for meeting this assistance.

Mr. Younger said there is evidence that customers have withheld purchases of their systems believing there might be more favorable terms available through subsidy/grant programs and that this has had a negative impact on the market for private operators.. This was confirmed by Mr. Lalith Gunaratne, a private solar operator from Sri Lanka, who has been selling PV systems on a cash basis for the last nine years. He said that politicians who go around promising grid-electricity supply to rural people are a barrier to solar PV promotion. He felt that subsidies should be given to promoters to create infrastructure for marketing, establish the distribution channel, and train people to install the systems. He added that, for example, Honda has about 50,000 generator outlets in South India while there are less than 5,000 outlets for PV systems.

Mr. Böhnke further added that externally funded projects have indeed been distorting the market and care must be taken to avoid direct competition with promoters. In the case of the Philippine-German SEP, the systems were procured from the domestic market and helped bring private PV companies to cooperate with the solar PV utilities and provide better after-sales service. Ms. Yeneza of PEI added that one way to resolve the issue of price reduction is to be creative in the repayment schemes. She added that on a three-year amortization, one has to pay about P500 per month, but in the service fee concept the costs are brought down to about P190 per month. If subsidies are given, they should be given at the level of promotion to subsidize development cost rather than the end user so as not to distort the market.

In response to a question on establishing local manufacturing of PV panels, Mr. Younger replied that PV panel prices are being driven by global competition and it is not viable to compete with highly industrialized manufacturing plants in developed countries. He added that, on the other hand, there are better opportunities with the manufacture of balance-of-systems, i.e., battery manufacturing, which is being undertaken in a lot of developing countries. This view was generally supported. A representative of the Department of Agrarian Reform (DAR) in the Philippines said DAR is supporting farmer communities with PV projects not only for household lighting, but also for potable water supply and small irrigation; he inquired whether these projects are eligible for GEF funding where the hardware could be supplied on a loan while the social preparations and institution building could come from the grant component. Mr. Younger replied that PV projects are eligible for GEF funding and that institution building would probably be more in UNDP's area.

B. Day 2 Proceedings

1. Technology and Economic Overview

a. Mr. Anthony Derrick, IT Power

Mr. Derrick presented the findings of the ADB-financed three-part study covering the technology, economic, and institutional aspects of PV power generation. During this session, he dealt with the reports on technology and economics. He explained the workings of PV technology, provided an insight into the different PV cell technologies and their efficiencies, and discussed the major technical issues related to the balance-of-system components, such as power conditioning units, harmonic filters, grid interface equipment, and the safety measures. He also discussed the advantages of different hybrid systems such as PV-diesel, PV-wind, and PV-diesel-wind systems. On the economic aspects of PV power generation, he discussed the cost structure of PV systems and the prospects for cost reductions, examined the cost effectiveness of PV systems, and compared a number of stand-alone applications relative to the alternative power supply systems commonly used. He concluded that large-

scale power generation through PV systems by utilities will be uneconomic during the next ten years, but may become cost-competitive in the following decade, particularly when the environmental costs of producing electricity from fossil fuels are taken into consideration in planning power plants.

b. Mr. Gordon A. Thompson and Dr. Dilawar Singh, CASE

Mr. Thompson informed the participants that the Center for Application of Solar Energy (CASE) was established in January 1995 to promote the application and commercialization of all forms of renewable energy technology in developing countries. A clear differentiation between the role of CASE and equipment suppliers is that CASE is able to take a holistic view, which starts from the needs analysis, financial packaging, supply of appropriate technology, training, and implementation of support systems. A key strategy of CASE is the provision of education and training programs to overcome lack of knowledge on renewable energy options at the policy level. CASE is playing an important role in demonstrating remote area power supply systems, solar-wind-diesel hybrid systems, and stand-alone solar PV applications for domestic lights, street lights, water pumps, and running community television in Thailand, Malaysia, and India.

c. Mr. Dewey Bosworth, US/ECRE

Mr. Bosworth introduced US Export Council for Renewable Energy's (US/ECRE's) Asia-Pacific Initiative (API), which is an industry-government effort to build bridges in promoting renewable energy and energy efficiency in the region. ECRE is an umbrella organization representing about 15,000 member companies of the US industry incorporating geothermal, wind, solar, biomass, biofuels, and the National Association of Energy Service Companies. They work on barrier mitigation at the government and financial level and target the Asian markets in the People's Republic of China, Indonesia, Pakistan, India, and Philippines. Prior to the API, ECRE launched the Renewable Energy in Americas initiative, which resulted in getting 20 ministerial level signatories and project proposals for 175 projects.

2. Market Assessment

a. Dr. Herbert Wade, AIT

Dr. Wade started his presentation by stating that there are several markets for PV applications. First is the institutional market (schools, hospitals, community centers, and government offices); second is the big rural household market; third is the commercial market, which is willing to spend money for telecommunications and commercial development; and last is the high income domestic market of rural families who are willing to pay for their solar systems. He pointed out that in each of these cases, people are looking for electrical service and not solar PV systems. While too much note has been taken of the price of solar PV systems, it is not the primary barrier as rural people indicate that they can often come up with the money if they can get what they want and, in this case, it is electrical service. He also pointed out that people are willing to make the extra money available if required. The real barrier to solar PV in the market place is its past poor performance as evidenced by many unsuccessful projects. For the long term, promotion of solar PV should be oriented toward after-sales service and to providing people with what they want at a price they are willing to pay. Also, the solar PV system should not be promoted in the concept of pre-electrification where it is to serve only as an interim system. Sales made should be geographically concentrated as scattered installations cannot be serviced at a reasonable cost.

b. Mr. Peter Mckenzie, Siemens

Mr. Mckenzie's presentation centered on the training requirements for solar PV projects. He mentioned that building awareness, imparting knowledge, and training are necessary for educating the end users to further the market development of PV in developing countries. Government and regulatory bodies must be aware of the commercial successes of PV and its economic viability. Financial organizations must also be aware of their role in assisting the growth of the PV market. Engineers, designers, tradesmen, builders, architects, bankers, utilities, etc., must have the in-depth technical knowledge of PV technology and system design to actually apply it to their roles.

3. Country Papers

a. Mr. Xin Mingyi, People's Republic of China

Mr. Xin presented an overview of the present situation of the solar PV industry in the PRC. Although the PRC's solar PV manufacturing capacity had reached 4 megawatt-peak (MWp) per annum, the annual utilization was only about 500 kWp because of (i) low market demand for PV, (ii) relatively high price and low financial capabilities of the regions where electrification has not been realized, and (iii) technology gap between the PRC and the developed world in PV manufacturing.

b. Mr. Somchai Stakulcharoen
Department of Energy Development and Promotion, Thailand

Mr. Stakulcharoen gave the current status of research, development, and utilization of solar PV technology in Thailand. PV projects are undertaken independently by different government agencies. The Provincial Electricity Authority owns and operates three stand-alone PV power plants, two with a capacity of 60 kWp, and one with 30 kWp, for village electrification. The Electricity Generating Authority of Thailand uses solar PV systems mainly for tower and buoy warning lights, survey camp lighting and communications, microwave repeaters, and grid-connected demonstration plants. The Telephone Organization of Thailand has already powered more than 50 microwave repeaters with about 100 kWp PV modules, and an upcoming rural telephone project will also be solar powered. The Ministry of Education has introduced about 20 kWp of PV systems for use in remote rural schools to provide educational programs on radio. Given that more than 1,000 rural villages are not electrified because of nonviability of grid supply, the Government has drawn up a program to provide solar PV electrification to these villages.

c. Mr. K. S. Srinivas, Bharat Heavy Electricals Ltd., India

Mr. Srinivas said that annual PV module production in India has grown from 1 MWp/year to over 7 MWp in the last five years. Although industrial production is almost entirely confined to single crystal silicon PV technology, efforts are under way to commercialize the thin film technologies. Application of solar PV is mainly in the telecommunication industry (52 percent), street and domestic lighting (30 percent), water pumping (6 percent), and railway signaling, microwave repeaters, low power TV transmitters, and offshore oil platforms (12 percent). It was pointed out that off-grid rural applications for lighting, drinking water, agriculture, and telecommunications would continue to be the major application areas in the years to come. The Government supports the PV industry by providing concessional import duties; exemption from excise duty on solar cells, modules, and PV system; exemption from

sales tax; 100 percent depreciation benefit, and soft loans to users and manufacturers. The Ministry of Non-Conventional Energy Sources and the Indian Renewable Energy Development Agency are launching large-scale implementation programs and expects the demand for PV modules to double within the next two years and open up a market of over 100 Mwp by the year 2002.

d. Mr. B. Chadraa, Mongolia

Mongolia has about 200,000 rural nomadic families and the Government feels that it cannot meet the electricity needs of the nomadic population by using small diesel generators. Given the nomadic life style of these families who are mostly herdsmen, solar PV seems to be the appropriate technology to provide power to them. In 1995, the Government of Mongolia allocated about 1 percent of the national income as financial source for the development of solar PV systems and small, wind-based battery chargers. Although the nomadic families do not have convertible currency, they do own an average of 50 to 2,000 head of cattle and sheep, which could be sold to pay for the solar PV systems.

e. Mr. M.P.T.P. Fernando, Sarvodaya, Sri Lanka

Mr. Fernando informed the participants that Sarvodaya is the largest NGO in Sri Lanka, working with about 10,000 rural communities. With only 60 percent of the households in the country having access to grid-supplied electricity, Sarvodaya began its solar project in 1991 in two phases. The first phase consisted of demonstration projects in selected rural areas to create awareness of solar PV among villages. The second phase involved the installation of 150 solar PV systems in selected areas with an easy monthly repayment scheme to the households: an initial 20 percent down payment and the balance amortized over 60 months. Mr. Fernando explained that the success of the program was due to the establishment of rural solar technical services, which provided the valuable maintenance and service requirements in the areas.

f. Mr. B.C. Fernando, National Housing Development Authority, Sri Lanka

Mr. Fernando gave an overview of the National Housing Development Authority's (NHDA) solar PV project. The project, funded by the Australian Government, involved the installation of 1,000 domestic solar PV systems consisting of 20 watt-peak (Wp) and 52 Wp systems. However, the systems failed because of defective equipment and the people were not educated on the proper handling of the systems. NHDA, therefore, had to employ a qualified maintenance contractor to look after the maintenance work and train local technicians from the villages where the systems were installed. With the lessons learned from the project, NHDA undertook another solar PV project under which 24 solar PV rural water supply schemes were installed, and 100 infrastructure centers such as rural hospitals, maternity clinics, schools, community centers, and temples were provided with solar PV systems.

g. Mr. Maderson Ramon, The Federated States of Micronesia

In 1995 on the Mwoakiloa Atoll in the state of Pohnpei, about 47 households, each with two 50 Wp solar modules, were electrified with financing from the French Government. To ensure the sustainability of the project, a solar Committee composed of Mwoakiloa representatives and officials of Pohnpei Office of Energy was created. The Committee is responsible for the operation and maintenance (O&M) of the systems and the collection of $5

per month system fee from each household. With this success, the Government approved $196,000 to finance a PV project for 120 households in another atoll (Pingelap). The Government considers the use of solar PV technology to be an appropriate electrification option for its outer islands, given the low load demand, as PV energy is cheaper and more cost-effective in providing electricity than kerosene lanterns or small stand-alone generators.

h. Questions from the Floor

To a question on cost recovery, O&M, materials and warranties of solar PV systems, Dr. Wade replied that, in general, warranties are worthless because the cost of getting the materials in and out usually exceeds the value of the warranty. With regard to cost recovery, he said that this is no different from a utility that charges on a periodic basis for the service rendered. Normally, payments are based on the actual cost amortized over a period of time, reasonably the lifetime of the system. In the case of systems prepaid by aid agencies as a capital subsidy, the cost recovery should be for O&M cost plus the replacement of components.

Dr. Wade was asked whether he agrees that PV lighting systems are really not as good as grid electricity, are less convenient and more messy than normal electricity, and more difficult to sell. He replied that there should be no difference between grid electricity and the associated problems with solar PV systems. Dr. Wade confirmed that a lot of current problems with solar PV stemmed from technical people who neglected to understand the needs of the rural people. He added that, regrettably, in many cases, governments have obstructed rather than supported solar PV applications development partly because governments are ignorant of the potentials of solar PV technology. Another problem is the lack of support in terms of subsidy, and tariff problems and custom duties do not lend support to the PV market. Hence, it was hoped that the participants will return to their countries and inform their governments of the possibilities for solar PV technology and what needs to be done to make it work. Dr. Wade was asked if the appliance service delivery approach could also be applied to solar PV systems in the rural areas. His reply to this was negative, because people who buy solar PV systems simply do not have the knowledge to operate them continuously.

4. Marketing Strategies - Plenary Session

Dr. H. Wade, Chairperson

Mr. Parnell from NESTE, pointed out the replacement problems of imported PV system components purchased with foreign aid and suggested that local components be designed and purchased from a local distribution system even if the components do not last as long. They might only last half as long, but the overall cost and availability are much better. Mr. Gunaratne from the Solar Electric Company in Sri Lanka shared his experience in the past eight years, installing in remote villages solar PV systems that are still working well. His business has been sustained because of a strong service network that educates and trains the rural people. The components are locally developed and maintained by local technicians who have the incentive to make sure more sales are made because the installation charge goes to them.

Mr. Gunaratne also said that household-owned PV systems seem to be the most acceptable market for PV systems as opposed to leased systems. He, however, indicated that government, private sector, and funding agencies should coordinate in the promotion of solar PV systems as the private sector cannot assume the burden alone. A suggestion was made

from the floor that where governments are unable to provide electricity through grid extension, the governments should make loan schemes available to rural households to buy the alternative energy supply.

C. Day 3 Proceedings

1. Institutional Aspects

a. Mr. Anthony Derrick, IT Power

A third report on the institutional aspects of solar PV applications was presented by Mr. Derrick, who discussed the financing and institutional arrangements necessary to handle the high front-end costs of PV installation and their sustainability. Past roles of bilateral and multilateral agencies, developing country governments, utilities, development finance institutions, NGOs, and manufacturers and traders in promoting PV use were examined.

b. Honorable B.R. Prabhakara, Secretary Ministry of Non-Conventional Energy Sources, India

Mr. Prabhakara presented the role played by MNES in promoting renewable energy in India and the status of the country's solar energy program. An important initiative of MNES was the establishment of the Indian Renewable Energy Development Agency (IREDA), which is a public agency funding renewable energy projects. European development agencies as well as WB and GEF have given funds to IREDA both for technical assistance and soft lending. Mr. Prabhakara mentioned that one of the key incentives given by the government to renewables was the 100 percent depreciation in the first year of the installation and this has generated a lot of activity. He further mentioned that a program on solar lanterns initiated and subsidized by MNES to replace the use of kerosene lamps by rural households is gaining public acceptance. A total of 400,000 lanterns have been sold in the last five years.

c. Mr. Takayuki Tani, The Institute of Energy Economics, Japan

Mr. Tani presented an overview of the Japanese Government's policy in promoting the use of solar PV and cited a program proposed by the Japan Photovoltaic Energy Association in early January 1996 to increase the number of solar PV installations from 4 MWp in 1995 to 400 MWp by the year 2000 and further to 4,600 MWp by 2010. He stated that the government subsidizes the cost of rooftop solar PV systems by 50 percent. These rooftop solar PV systems range from 2 kW to 4 kW per household and the excess electricity is sold to utilities. It is planned that as the number of installations increases, the 50 percent subsidy currently provided will be gradually withdrawn. Mr. Tani pointed out that the program is also extended to public buildings where larger rooftop solar PV systems of more than 20 kW are installed. For these programs, the government subsidizes two thirds of the installation cost. Again utilities are obliged to buy the excess electricity from these establishments. He also mentioned the technical assistance the Japanese Government has provided in solar PV technology through the Japan International Cooperation Agency (JICA) in countries such as Indonesia, Kiribati, Mali, Pakistan, Syria, and Thailand.

d. Dr. Jessie C. Elauria, Department of Energy, Philippines

In his paper, Dr. Elauria presented the Philippine experience in research, development, promotion, and commercialization of renewable sources of energy. The paper also highlighted

the Government's mandate, policies, plans, and programs on renewable sources of energy. The Department of Energy and other government and private companies have drawn up programs/projects to promote the large-scale use of renewable energy, which include the (i) renewable energy power program, (ii) financing energy services for small-scale users, (iii) 1,000 household solar PV program, (iv) MILIEV PV program, (v) the Agrarian Reform Communities PV program of social reform agenda, (vi) solar municipal infrastructure program, and (vii) RP-India NRSE technology cooperation.

e. **Mr. Mark Cherniack, Solar Electric Light Fund, USA**

Mr. Cherniack dealt with the role of SELF and the pilot PV projects it has launched in China, India, Kenya, Nepal, Sri Lanka, South Africa, Uganda and Viet Nam which showcased solar home systems (SHS). The program has demonstrated rural credit mechanisms that allow purchase of SHS through revolving credit funds managed by a variety of players, from local village cooperatives to rural development banks. He mentioned that SELF is currently expanding these pilot projects to become commercially sustainable public service enterprises.

f. **Mr. Ferdinand P. Larona, Project Manager, Special Energy Program, Philippines**

Mr. Larona presented the Gregorio Del Pilar PV project, which is considered one of the successful PV projects in the Philippines and is now on its third year of operation. Its success is attributed to a blend of affordable credit schemes coupled with sound business principles, product information and support given to the people, which have motivated them to work for the success of the project. PV systems have become a part of the physical infrastructure in the area, while PV lighting has become common in the user households. The project was financed through a credit scheme under a payback period of three years and an interest rate of 16 percent per annum; user equity covers the balance.

g. **Mr. Lalith Gunaratne, Solar Power & Light Company Limited, Sri Lanka**

In 1980, the Government of Sri Lanka through the Ceylon Electricity Board embarked on the promotion of solar PV systems for rural domestic use. Since then, solar PV use has gained recognition as a viable alternative to rural electrification, thereby attracting the private sector. The NHDA administered pilot projects such as the Pansiyagama 1,000 home program and the Uva Infrastructure Project, which have given the local promoters further valuable insight into how and how not to promote solar PV systems. He also mentioned the establishment of community-based solar PV programs by NGOs, such as the Sarvodaya Shramadana Society and the newly formed Solanka Associates.

2. **Country Papers**

a. **Mr. Terubentau Akura, Solar Electric Company, Kiribati.**

The Solar Electric Company (SEC), a USAID-funded private corporation, was originally established in 1984 to act as a retail outlet for solar PV applications and to provide technical assistance where needed for their installation and maintenance. In 1989, when SEC faced bankruptcy, it became clear that the private market-oriented approach to PV rural electrification was not a success in Kiribati and external assistance was sought to advise the Government and the Board of Directors of SEC as to what should be done. The recommendation was to

convert SEC from a sales-oriented organization to a service organization based around a rural electricity utility concept. As a result, about 250 PV systems have been installed by the utility, but presently there is insufficient revenue to cover all the costs of their O&M. The breakeven point would be about 500 PV systems, but the shortfall in revenue is presently being made up by SEC's other business.

b. Mr. Solomone Fifita, Ministry of Lands, Survey and Natural Resources, Kingdom of Tonga

Tonga now has about 141 solar PV systems , 34 of which were funded through grant aid from the French Government, while the remaining were funded by the European Union (EU). About 314 PV systems will be installed in 1996 on the island of Vava'u Group and an additional 300 PV systems will be installed on the Ha'apai Group before the end of 1997. Although solar PV use has certainly raised the living standards in the remote islands, the financial commitment of the islanders and that of the Government and funders toward the long-term sustainability of these projects is not transparent. He reported that some of the installed solar PV projects are now facing problems and their long-term sustainability is in question.

c. Mr. John Gorosi, Ministry of Energy, Mineral and Mines, Solomon Islands

Mr. Gorosi pointed out that several agencies such as the Telekom, NGOs, and private electrical companies carry out PV projects in Solomon Islands independent of each other. It was only recently that the Government formulated a rural electrification policy that includes solar PV technology. However, despite the presence of personnel with solar PV expertise within the Ministry of Energy, the high cost of solar PV systems and the lack of financial resources are limiting factors to its success on the islands.

d. Mr. Victor Jona, Energy Department, Ministry of Industry, Mines and Energy, Cambodia

Solar PV technology has been identified by the Cambodian Government as one of the ways of providing power to remote villages with a minimum environment impact. To date, there are solar PV systems in five district hospitals, and 40 PV lighting systems in the capital. The Cambodian Government is now offering low import duties and taxes on PV equipment. However, expertise in solar PV technology is still lacking and funding assistance would be most welcome for project financing and for study and information dissemination to the people.

e. Dr. Ngo Duc Lam, Institute of Energy, Viet Nam

Since 1989, Viet Nam has been promoting solar PV use through two state-funded programs for residential lighting, communication, signal lamps, and running the clocks of public institutions and schools. Although the technology is proven, financing has been a constraint. The Government initially funded the cost of training, education, and installation of demonstration PV projects in selected provinces and the people got interested. The Government agreed to subsidize part of the PV system costs, while the remaining cost was to be paid by the recipient household. Soft loans were made available to households, but it was found out that given the current cost of PV systems, most people in the rural areas were too poor to afford the systems.

f. Mr. Ahsan Maqbool, Ministry of Planning and Development, Pakistan

Mr. Maqbool in his presentation provided an analysis of solar PV projects for (i) a solar town, and (ii) a village each in Balochistan and Punjab Province. The proposed solar town is to cover an area of 6 square miles and would have about 10,000 homes, 450 businesses, and one big industry located in the area that is not connected to the grid. The total load of the solar town would be about 33 MW. He also provided the economic life cycle analysis for the three project designs.

g. Mr. James M. Conway, Ministry of Finance, Tuvalu

In 1979, solar PV application was first introduced in Tuvalu to power the interisland telecommunications system. Following the success of Telecom's PV program, the Tuvalu Solar Electric Co-operative Society (TSECS) was formed in 1984 to provide solar PV lighting to outer island households, which at the time were illuminated exclusively by kerosene lamps. The TSECS has since grown despite major technical flaws with systems provided by international aid agencies and the long delays encountered as the aid agencies corrected these flaws. TSECS's success is attributed largely to its well-managed organizational structure, being community-oriented and with access to external resources.

h. Mr. T. Wichman, Ministry of Energy, the Cook Islands

The first solar PV projects on the island of Mitiaro in 1983 were not very successful as 90 percent of the systems failed. In 1985, the UNDP funded an extension of the project on the island by providing each household with better batteries, lights, and two panels instead of one. But none of the households wanted the systems because of the earlier experience. A project postevaluation conducted in 1990 indicated that the system's problems were due to (i) wrong wire sizes, (ii) shading of panels, (iii) poor maintenance of batteries, and (iv) the inexperience of the persons who installed the system .

i. Mr. Moli Janjea, Ministry of Natural Resources, Vanuatu

Solar PV is a relatively new technology in Vanuatu. In the last three years, a small number of solar PV systems have been installed for lighting and communications by the Ministry of Natural Resources, and a number of private and community systems in the country have been installed by private agencies. In 1997, a large solar PV project will be funded by Caisse Francise de Developpement (CFD), a French agency, to cover about 50 households, 60 schools, 20 health centers, and a couple of solar water pumping systems. In the meantime, a modest project for about 20 PV systems will be installed in primary schools in the rural areas. With these planned projects in the pipeline, the Government will continue its efforts to disseminate information and implement rural electrification projects .

3. Institutional Aspects - Plenary Session (Mr. Mark Cherniack, Chairperson)

Mr. Prabhakara pointed out that bilateral projects are generally seen as one-time demonstration-type projects that do not offer any follow-up to learn and effectively improve system quality and reliability. Mr. Cherniack mentioned that the testing and standardizing of components are made difficult by the fact that manufacturers change their products frequently and that few manufacturers are willing to improve their products on feedback from the field. Mr. Mckenzie pointed out that most of the investment in the PV industry was from the oil companies, which realize that one day oil will run out and solar energy would be the alternative

choice and that it is about time to concentrate on promoting the widespread utilization of the technology instead of wasting limited resources on preparing papers, studies, and conferences. Mr. Jude said that this workshop would assist the Bank in designing suitable PV projects for implementation in its DMCs. The representative from the Philippines suggested that the Bank could provide technical assistance to development financing institutions to develop in-house capability to appraise renewable energy applications more efficiently.

D. Day 4 Proceedings

1. Financing

a. Dr. Ir. Harijono Djojodihardjo, BPPT, Indonesia

Dr. Djojodihardjo said that given the current rate of rural electrification under the five-year plan, only 45 percent or 9 million households in Indonesia can be electrified by 1998. The remaining 11 million rural households will be without electricity. To achieve the goal of rural electrification, solar home systems have been identified by the Government for rural electrification through a project called "Fifty Mega Watt Peak (50 MWp) Photovoltaic Rural Electrification." The objective of the program is to provide electricity through SHS within the next ten years to about 1 million rural households who have no electricity. The remaining 10 million may receive electricity through the national utility grid or through private systems. He also mentioned WB's program to provide finance for 200,000 SHS, which is expected to be approved in the later part of this year.

b. Dr. Russell J. deLucia, International Fund for Renewable Energy and Efficiency

Dr. deLucia presented perspectives on the challenge of financing market penetration of technically and commercially viable solar PV systems in the developing countries. He focused on systems that serve households and other small-scale energy service needs. Attention was placed on matters related to transaction finance mechanisms such as cash, term payments, and leases. He made suggestions on roles for ADB and other multilateral entities in meeting this challenge.

c. Ms. Grace Yeneza, Preferred Energy Investments

About half of the Philippines' rural population remains unelectrified because of the high cost of grid extension to remote communities. In the last 10 years, solar PV technology has moved from an experimental stage to the threshold of commercial maturity. It is, however, hampered by a number of barriers, among which are the limited affordability to end consumers, high market risks, and difficulty in recovering development and transaction costs. The private sector has therefore been shying away from dispersed rural markets and focusing their activities on urban markets. She discussed the primary risks involved in the financing of PV projects and how projects can be packaged to mitigate such risks. It was pointed out that governments, project developers, PV suppliers, and financing institutions all have a role to play in advancing the cause of PV technology.

d. Dr. Arnauly Aminullah, Bank Indonesia, Indonesia

Dr. Aminullah said that the promotion of solar PV use in Indonesia is still at the pilot stage. To date, only a few pilot projects have been implemented and most of the projects have

been handled by the Government. Four different financing models are being developed and tried in several pilot projects currently being implemented. These are (i) outright grant; (ii) partial Government subsidy in terms of capital cost of equipment, waiver of taxes, income tax, and the remainder being paid by the households, (iii) hire purchase; and (iv) a combination of the previous three.

e. Ms. Eufemia C. Mendoza, DBP, Philippines

The Development Bank of the Philippines (DBP) believes that rural electrification through nonconventional/renewable energy can be undertaken efficiently if given the development support it needs. DBP embarked on financing this subsector in 1988 by providing financial assistance through its Window III Program to develop viable projects that cannot be financed by traditional banking facilities for these reasons: lack of collateral and equity, long gestation periods, and perceived high risks. Funding for Window III projects comes mainly from the net profit of the Bank after tax. Since 1986, DBP has been setting aside up to 30 percent of its net profits after tax. Repayments of funded projects are plowed back to the Fund. DBP's first assistance to the Renewable Energy Sector was given to a solar PV home system project on Burias Island in 1988.

2. Country Papers

a. Mr. A. Matakiviti, Department of Energy, Fiji

Mr. Matakiviti said that after having gained confidence through a series of demonstration projects, the Department of Energy decided to include solar PV technology as a rural electrification option in the country's rural electrification policy. The policy is structured to expedite the proliferation of solar energy as a viable power source in rural areas. Under the policy, the Government subsidizes the capital cost of a solar PV system by 90 percent.But because of the high installation cost, emphasis is being placed on assisting communally based houses as opposed to individual houses.

3. Financing - Plenary Discussions

Anthony J. Jude, Chairperson

Ms. Araneta pointed out that banks lend to people who have a proven track record and that efforts must be made to give private entrepreneurs or local cooperatives who have track records support to enable them to package suitable projects. Dr. De Lucia singled out DBP as an the example with some history of credit management, but added that local intermediaries, in most cases, have little working capital and do not have a balance sheet that allows lending against capital-intensive projects of the scale being proposed.

Ms. Yeneza remarked that when assessing Philippine Renewable Energy Power Programs, one of the basic things the Department of Energy brought up was the issue of interest rates. Since the money comes from a pension fund, it could not be lent at lower than 11 percent per annum. Adding to that a spread of 4 percent per annum by the banks, the end user interest rates were basically around 15 -16 percent per annum. However, she added that after reviewing a number of renewable energy power projects, it was found that the projects in fact had internal rates of return of over 20 percent. Hence, while an interest rate of 16 percent may be questioned, it is not the main issue.

Abbreviations

kWh	-	Kilowatt-hour
kWp	-	Kilowatt-peak
Mwp	-	Megawatt-peak
Wp	-	Watt-peak
ADB	-	Asian Development Bank
API	-	Asia-Pacific Initiative
ASTAE	-	Asia Alternative Energy Unit
AUSAID	-	Australian Aid for International Development
BPPT	-	Agency for the Assessment and Application of Technology
CASE	-	Center for Application of Solar Energy
CFD	-	Caisse Francise de Developpement
DBP	-	Development Bank of the Philippines
DMC	-	Developing Member Countries
ECRE	-	Export Council for Renewable Energy
ESCAP	-	Economic and Social Commission for Asia and the Pacific
GEF	-	Global Environment Facility
GTZ	-	Deutsche Gesellschaft für Technische Zusammenarbeit
IFC	-	International Finance Corporation
IFREE	-	International Fund for Renewable Energy and Energy Efficiency
IREDA	-	Indian Renewable Energy Development Agency
JICA	-	Japan International Cooperation Agency
MNES	-	Ministry of Nonconventional Energy Sources
NESTE	-	NESTE Advanced Power Systems
NGO	-	Nongovernment Organization
NHDA	-	National Housing Development Administration
NRSE	-	New and Renewable Sources of Energy
O&M	-	Operation and Maintenance
PEI	-	Preferred Energy Investments
PRC	-	People's Republic of China
PV	-	Photovoltaic
RECs	-	Rural Electric Cooperatives
SEC	-	Solar Electric Company
SELF	-	Solar Electric Light Fund
SEP	-	Special Energy Program
SHS	-	Solar Home System
TA	-	Technical Assistance
TSECS	-	Tuvalu Solar Electric Co-operative Society
UK	-	United Kingdom
UNDP	-	United Nations Development Programme
US	-	United States
WB	-	World Bank

11. フィリピンにおける小水力発電所リスト

EXISTING MINI-HYDROELECTRIC POWER PLANTS				
REGION	LOCATION	PLANT NAME	CAPACITY (kW)	DEVELOPER/ OPERATOR
I	Pagudpud, Ilocos Norte	Agua Grande/Mabogabog	4,550	INEC
	La Union	Amburayan	200	LUELCO
CAR	Sablan, Benguet	Bineng 1	2,800	HEDCOR
	Sablan, Benguet	Bineng 2	1,800	HEDCOR
	Sablan, Benguet	Bineng 2B	750	HEDCOR
	Sablan, Benguet	Bineng 3	4,500	HEDCOR
	Sablan, Benguet	Ampohaw	8,000	HEDCOR
	Tuba, Benguet	Asin 1	1,200	HEDCOR
	Tuba, Benguet	Asin 2	880	HEDCOR
	Tuba, Benguet	Asin 3	970	HEDCOR
	Tuba, Benguet	Irisan	1,200	HEDCOR
	Itogon, Benguet	Sal-angan (Omico-Cauyas)	2,400	HEDCOR
	Bakun, Benguet	Lower Labay	2,400	NMHC
	Bakun, Benguet	Lon-oy	3,200	NMHC
	Bakun, Benguet	Engr. F.L. Singit (U. Takbo)	6,400	NMHC
2	Ramon, Isabela	Magat A	1,440	ISELCO I
	Ramon, Isabela	Magat B	1,080	ISELCO I
	Ramon, Isabela	Baligatan	6,000	NIA-Reg. II
	Tumauini, Isabela	Tumauini	250	ISELCO II
3	Nueva Ecija	Peñaranda	300	NEECO I
4	Baco, Oriental Mindoro	Dulangan	1,600	ORMECO
	Nagcarlan, Laguna	Balugbog	650	PHILPODECO
	San Pablo City, Laguna	Palacpaquin	400	PHILPODECO
	Kalayaan, Laguna	San Juan River	145	Kalayaan Ice Plant
5	Sangay, Camarines Sur	Coyaoyao	350	CASURECO IV
	Buhi, Camarines Sur	Barit	1,800	NAPOCOR
	Sorsogon, Sorsogon	Cawayan	400	SORECO II
	Bato Catanduanes	Balongbong	1,800	FICELCO
6	- - -		- - -	- - -
7	Barili, Cebu	Mantayupan	500	CEBECO I
	Barili, Cebu	Basak	500	CEBECO I
	Badian, Cebu	Matutinao	720	CEBECO I.
	Loboc, Bohol	Loboc	1,200	NAPOCOR
	Balilihan, Bohol	Janopol	5,000	BOHECO I
	Negros Oriental	Amlan	800	NAPOCOR
8	St. Bernard, Southern Leyte	Henabian	810	SOLECO
	Lawaan, Eastern Samar	Amanjuray	1,000	ESAMELCO
	Oquendo District, Samar	Tou-ok	1,080	SAMELCO I
9	Lamitan, Basilan	Balactasan	270	BASELCO
	Lantawan, Basilan	Kumalarang	680	BASELCO
10	Bukidnon	Agusan	1,600	NAPOCOR
	Valencia, Bukidnon	Mountain View College 1	300	MVC
	Valencia, Bukidnon	Mountain View College 2	500	MVC
11	Calinan, Davao	Upper Talomo	1,200	HEDCOR
	Calinan, Davao	Talomo	2,500	NAPOCOR
12	- - -	- - -	- - -	- - -
ARMM	Malabang, Lanao del Sur	Matling	1,500	MICC
		Total	77,625	

* As of 31 March 1997