

(12)

a) ability + willingness to pay of rural h/h's
slurveys/studies

b) EON - prepared w/
NGO + others?

Proposal for PDF Block B Grant

Country: All GEF and IFC Eligible
Project: *Photovoltaic Market Transformation Initiative (PVMTI)*
Requesting Agency: International Finance Corporation (IFC)
Amount of PDF Funding Requested: \$325,000

Cofunding: \$ 50,000 - U.S. AID
\$ 50,000 - U.S. DOE
\$115,000 - European Commission

Block A Grant Awarded: \$50,000 PDF Block A obtained to perform stakeholder consultation and in-country workshops during January and February 1996. Outcomes to date have included: specific country support of the program; and meetings with local private firms, government officials, and NGOs.

Summary Project Objectives and Description:

The goal of the *PV Market Transformation Initiative (PV MTI)* is to significantly accelerate the commercialization, market penetration, and financial viability of photovoltaic (PV) technology in the developing world, and provide a window for promoting large scale use of photovoltaics as one of the best long-term prospects for a low carbon energy future. The *PV MTI* envisions use of approximately \$60 million from the Global Environment Facility (GEF) to provide \$5-\$20 million in grants or other concessional finance arrangements on a competitive basis for each of three to six companies or consortia with the most innovative proposals for accelerating PV technology development and expanding commercial applications in eligible GEF countries in the developing world which have agreed to participate in the program.

The *PV MTI* initiative is fundamentally different from a donor designed and implemented program in that the primary innovation and implementation activity will come from private sector entities and consortia. GEF funding is expected to be used to address obstacles and opportunities in three key areas: market development, country partnering, and manufacturing. The program is expected to be implemented by the International Finance Corporation (IFC), the private sector affiliate of the World Bank Group. Management through IFC will afford greater speed and flexibility in implementation, increase potential financial leverage, and create movement towards wholly private sector financing of commercial PV-based renewable energy projects.

Key objectives of the *PV MTI* include large-scale commercialization of PV to enable long-term greenhouse gas emission reductions, demonstration of alternatives to fossil fuel-fired grid expansion in potentially viable market niches in the developing world, and enhancement of financing vehicles for PV (which may also benefit other renewables) to sustain long term diffusion efforts.

Description of PDF Activities by component for (i) GEF-funded and (ii) co-funded:

Additional funds from US government sources and a GEF PDF Block A grant have been used primarily to define basic program architecture and perform initial stakeholder consultations. *(A detailed concept paper is attached as Annex II).*

GEF PDF Block B funds of \$325,000 are requested to support further project concept development, including:

- Preparation of GEF documentation, including a draft IFC/GEF Project Identification Document consistent with GEF standards and suitable for GEF external review (by a Technical Review Panel and STAP);
- Estimation of direct and long-term greenhouse gas emission reductions under plausible scenarios of new PV market penetration and deployment related to the initiative;
- Estimation of GEF eligible incremental costs and rationale for GEF financing under current GEF financing policy, including development of suitable incremental cost criteria and private sector financing modalities that are consistent with GEF policies and achieve the program's long-term objectives;
- Development of a draft Request for Proposals (RFP) and proposal evaluation criteria and structure, including development and testing of evaluation criteria, determining modes for disbursement, and development of IFC implementation arrangements;
- Preparation of an Early Opportunity Notice (EON) to facilitate communication with stakeholders and gauge responses to the proposed initiative; and
- Provision of external expertise to IFC to provide support in program design, establish criteria for proposal evaluation process and scoring methodology, and develop supervision, monitoring, and evaluation procedures.

Additional co-funded activities will include:

- European Commission financing of expert advice to assist in program development and design with an emphasis on PV manufacturing and market development. These activities will include technical assistance and analysis, logistical support during EON preparation, participation in development of RFP evaluation criteria and scoring methodology, and support for additional stakeholder participation activities.

Eligibility: All countries which are both GEF (FCCC ratified signatories) and IFC eligible, and which have provided written endorsement of the program concept.

National Level Support:

The *PVMTI* has engendered strong interest from a number of developing country governments, including India, Pakistan, Thailand, China, Zambia, Indonesia, Brazil, and Algeria -- *(letters of support and interest in further concept development are attached as Annex I)*. Detailed national stakeholder input is being facilitated by a series of PDF Block-A and EC funded in-country workshops being held between January and April of 1996.

Stakeholder consultation at the government/utility level and the private sector commercial level will

continue through an Early Opportunity Notice process prior to issuance of Request for Proposals. Limited financing and technical assistance will be provided to small and medium scale indigenous private sector firms and NGO entities in eligible developing countries to facilitate cooperative arrangements with host governments and private firms for inclusion in *PV MTI* proposals. This support is proposed to be the subject of a future PDF Block C proposal later in 1996. Co-funding from a number of non-profit foundations in the amount of \$200,000 has already been secured for this element.

Justification for PDF grant:

Without this GEF initiative and complementary public/private efforts, PV technology investment and market penetration will likely remain slow and disaggregated, and electrical energy development in the developing world will continue to follow an unsustainable, western model of fossil fired grid expansion. GEF support will provide not just concessional funding but the stimulus for leveraging substantial activity and additional private investment capital. This can provide an attractive market incentive to PV investors, customers, and developing country government and utility stakeholders. Catalyzing significant new investment flows into further deployment of this important backstop technology will provide short term, long term, and programmatic benefits and provide future flexibility in sustainable energy investments. Use of private sector ideas, innovation, and implementation mechanisms is anticipated to be more cost effective, efficient, and sustainable than donor designed- and country-implemented initiatives.

There are numerous barriers to widespread PV dissemination. The current size of and dispersed nature of the market hinders investment, prices for end-use consumers remain relatively high, and the up-front financing requirements of this fuel-free technology place it at a cost disadvantage to diesel and fossil fuel-fired grid electric generating systems. In combination, these and other barriers result in high transaction costs and hinder additional investment in the technology. While current world annual PV production is small at 80 MW, the technology is expected to respond well to a market transformation intervention of the type proposed here. A number of important manufacturing economies of scale, accompanying price reductions, and potential market expansion could result from the proposed intervention. Preliminary estimates indicate that the *PVMTI* would approximately double the current size of PV manufacturing and accelerate commercialization of the technology by five or more years through significant price declines.

For the GEF, the *PV MTI* represents movement beyond pilot projects with serial impacts in individual countries towards a broader market intervention strategy to achieve long-term technical, market, and financial commercialization of an important zero-carbon technology. The *PV MTI* is directly consistent with the GEF Operational Strategy and its proposed operational programs, as follows:

- Operational Program #6 -- Removing barriers for technologies and promoting broad dissemination of commercially available climate-friendly energy technologies by building endogenous capacity and bearing the learning costs of non-traditional technologies; and
- Operational Program #7 -- Reducing long-term costs of promising, environmentally friendly energy technologies and improving their economic viability through the facilitation of manufacturing economies of scale and increased depth and breadth of markets.

As such, the *PV MTI* is fully consistent with the GEF's lead role in funding implementation of the Framework Convention on Climate Change (FCCC), and complements the World Bank Group's *Solar Initiative* and the emerging *Climate Technology Initiative*. It is also consistent with the GEF's policy in engaging the private sector, leveraging private capital, and expanding GEF's financing modalities.

The program builds a private sector financing bridge for renewable energy commercialization through the IFC, the largest source of multilateral financing of private investment in developing countries, accelerating IFC's growing interest in developing private investment vehicles as a means to achieve

Description of PDF Activities by component for (i) GEF-funded and (ii) co-funded:

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- Estimation of GEF eligible incremental costs and rationale for GEF financing under current GEF financing policy, including development of suitable incremental cost criteria and private sector financing modalities that are consistent with GEF policies and achieve the program's long-term objectives;
- Development of a draft Request for Proposals (RFP) and proposal evaluation criteria and structure, including development and testing of evaluation criteria, determining modes for disbursement, and development of IFC implementation arrangements;
- Preparation of an Early Opportunity Notice (EON) to facilitate communication with stakeholders and gauge responses to the proposed initiative; and
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Stakeholder consultation at the government/utility level and the private sector commercial level will

Annex I -- Country Letters of Support

sustainable development, including renewable energy and energy efficiency. Such private sector financing is critical to permit photovoltaic and other renewable technologies to reach market maturity and compete against fossil energy technologies.

In addition to the required GEF documentation preparation, this innovative project concept requires particular attention to the preparation of program architecture, including the RFP and evaluation criteria, to effectively implement the initiative, avoid sending conflicting signals to potential proposers and investors, and maximize program impacts.

Items to be financed:

PDF resources will be used to finance consultant support for: program development; PV manufacturing and market development expertise; additional technical assistance and review; and limited travel for effective communication with stakeholders during the program development process.

Cost Table:

ITEM	Total: \$325,000		
	PDF Grant	Other Sources	
(1) Consultant Services	\$275,000	\$ 80,000	European Comm.
(2) Travel Costs	\$ 30,000	\$ 20,000	European Comm.
(3) Stakeholder Participation	\$ 20,000	\$ 15,000	European Comm.

Outputs: As per *Description of PDF Activities*, above.

Expected Date of Preparation Completion: December 1996. (Project preparation through submittal to GEF Council [November 1996], final approval by IFC management [estimated to be November 1996], and implementation [December 1996]).

Special Features and Issues: The program is proposed to be executed by IFC either directly or through a management agent. IFC would retain financial and technical oversight concerning the program's implementation, award decisions, portfolio management, and supervision and evaluation following approval by IFC management. It is estimated that a considerable amount of in-kind support will be provided to the management and preparation of this activity by IFC staff from the Technical and Environment Department and Infrastructure Department and the Bank's Global Environment Division and Industry and Energy Department.

IA Representative

Date



EA Representative

02/07/96

Date

Attachments: Annex I (Letters of Support)
Annex II (Concept Paper)



Ajit K. Gupta (O. No. 32/386/95-PV/SPG
Advisor

भारत सरकार

अपारम्परिक ऊर्जा स्रोत मंत्रालय

Government of India

MINISTRY OF NON-CONVENTIONAL ENERGY SOURCES

BLOCK NO. 14 C.G.O. COMPLEX, LODI ROAD, NEW DELHI-110 003

ब्लॉक नम्बर 14, केन्द्रीय कार्यालय परिसर, लोदी रोड, नई दिल्ली-110 003

Fax : 011-4361298
Telex : 31-61653-DNES-IN
Telegram : RENEWABLE
Telephone :

दिनांक 21.12.95
Dated.....

Dear Ms. Mansur,

TERI are proceeding ahead with planning of the PV Green Carrot Workshop at New Delhi on January 9, 1996. I understand that they are in close contact with you regarding the programme, list of invitees, etc.

For the Photovoltaic Market Transformation Initiative Workshop / country consultation, the consultants' cost of providing technical expertise would be \$5,700 (per diem and airfare prorated for India). This is in addition to the budget of \$4,859 for hosting the Workshop.

I hope that you would be able to have the necessary authority letter regarding reimbursement issued soon to the Resident Mission at New Delhi. I look forward to meeting you and others from the Bank at the Workshop.

With best wishes,

Yours sincerely,

Ajit Gupta

(Ajit K. Gupta)

Ms. Naima Mansur
Renewable Energy Specialist
Global Environment Coordination
The World Bank Group
Washington D.C. 20433
U.S.A.

Fax : (011)(202) 522-3256

FEDERATIVE REPUBLIC OF BRAZIL
PLANNING AND BUDGET MINISTRY
SECRETARIAT OF INTERNATIONAL AFFAIRS

FAX NR 3855/95

Brazilia (DF), 22/11/95

FAX MESSAGE

FROM: Leonardo Borba Neira
Monitoring Coordinator of Bilateral Financing
FAX: 061 -2254022

TO: Mr. Ken Newcombe
Chief - Global Environment Coordination Division
Environment Department
FAX: 001 (202) 522 3256

NR OF PAGES: 1 (INCLUDING COVER SHEET)
OBS: In case of bad transmission, please call (061) 225-7185

Dear Mr. Newcombe,

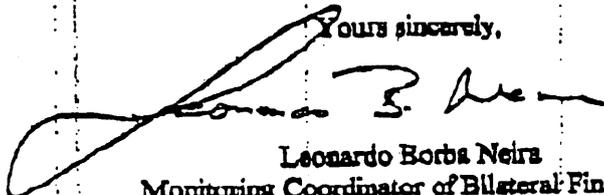
Reference is made to your letter dated October 25, 1995 in which the conduction of a one day workshop to introduce the Green Carrot had been proposed.

In this connection we are grateful to inform you that we are interested, in principle, in the workshop in case it could be conducted in March 1996.

We would appreciate if you could forward us the Workshop Program, informations concerning the people it will be addressed, in addition we would like to know the number of the participants and about the procedures that we have to accomplish in order to carry it on.

Looking forward in hearing from you, we remain,

Yours sincerely,



Leonardo Borba Neira
Monitoring Coordinator of Bilateral Financing

asecom/c

Asia Pacific
Solar Experts Meeting
 Renewable Energies for Development,
 Culture and Environment

December 18-21 1995
ISLAMABAD - PAKISTAN

Sponsors:

1. Ministry of Science & Technology,
Government of Pakistan
2. United Nations Educational Scientific
and Cultural Organization, (UNESCO)

Organisor:

National Institute of Silicon Technology (NIST)
 Ministry of Science & Technology, Islamabad, Pakistan

Participants:

Countries invited for participation include Afghanistan, Australia, Azerbaijan, Bangladesh, Bhutan, Brunei, Burma, China, India, Indonesia, Iran, Japan, Kazakhstan, Kirgizstan, Korea, Malaysia, Maldives, Nepal, New Zealand, Pakistan, Philippines, Sri Lanka, Thailand, Tajikistan, Turkmenistan, Uzbekistan and Vietnam.

Besides these countries representatives of UNESCO, UNIDO, ECO, SAARC, IFSTAD, Commonwealth Science Council and UN Commission on Science & Technology Development are also expected to participate.

Nominations are invited, one each, from the participating countries. Nominee must be a practical senior working scientist in any of the Solar Energy Technology fields.

**Date of Receiving
Nominations for
Participation:**

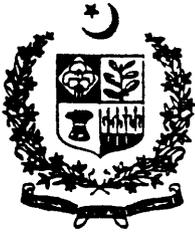
Sept 15, 1995.

**Date of
Submission of
Country Papers:**

October 15, 1995.

**For more details
please contact:-**

Dr. Atique Mufti,
 Director General,
 National Institute of Silicon Technology,
 25, H-9, Islamabad- Pakistan
 Phones: (Office) : 92-51-851987
 (Residence): 92-51-854817 & 853032
 Fax: 92-51-855942 Telex: 5538 NIE PK



ISLAMABAD November 21, 1995.

Subject: One day Photovoltaic Workshop in Pakistan

Dear Mr. Ken

I am writing this in connection with the implementation of the "Green Arrow" programme to be executed under the Global Environmental Facility (GEF), the details of which have been received through Naima Mansur, Energy specialist, of your Division. You may be informed that the Government of Pakistan takes keen interest in promotion of Solar Energy and in particular photovoltaic technology in the country and has established National Institute of Silicon Technology (NIST), Islamabad, which is engaged in the development of PV cells and dissemination of the solar (photo-voltaic) technology. NIST has established a solar house, a demonstration unit for use of photovoltaic technology to produce electric power for encouraging the private sector to pick it up for further promotion of this technology.

2. You may also be aware that this Ministry in collaboration with the UNESCO is organising a 4-day Asia and Pacific Regional Solar Experts Meeting on 18-21 December 1995 at Islamabad. The purpose of the meeting is to assess the capabilities of the region in the field of solar energy and formulate proposals for the promotion of solar technology at a national and regional level. Experts from countries belonging to AIC, EOC, SAARC, Asia and Pacific region and representatives of international agencies like UNESCO, UNIDO, PAC will attend the meeting. Copies of the First and Second Announcements of the meeting alongwith the list of important participants are enclosed for your kind perusal. Additionally both private and public sector industries/ Establishments have been insisted to participate in the Exhibition being organised and display their products. It is expected that the meeting will help in finding modalities and

ASIA - PACIFIC

SOLAR EXPERTS MEETING

RENEWABLE ENERGIES FOR DEVELOPMENT
CULTURE AND ENVIRONMENT

DECEMBER 18 - 21, 1995
ISLAMABAD, PAKISTAN



WORLD SOLAR SUMMIT PROCESS
PROCESSUS DU SOMMET SOLAIRE MONDIAL

SECOND ANNOUNCEMENT



Ministry of Science and Technology
Government of Pakistan



United Nations Educational, Scientific
and Cultural Organization (UNESCO)



National Institute of Silicon Technology
Islamabad, Pakistan

ASIA - PACIFIC

SOLAR EXPERTS MEETING
RENEWABLE ENERGIES FOR DEVELOPMENT,
CULTURE AND ENVIRONMENT

December 13-21 1995
Islamabad, Pakistan

Date and Venue

From December, 1995 in Islamabad (Pakistan).

Language

The official language of the meeting is English.

Passport and Visa

All persons entering Pakistan should have a valid passport and a visa issued by Pakistan Mission in their countries. For any further details, inquiry be made at the Pakistan Mission.

Health Requirements

Participants are advised to consult the Pakistan Mission in their own countries to obtain up-to-date information on health requirements.

Climate and clothing

In December, the weather in Islamabad is generally cold. Day temperature may vary between 10°C and 15°C. Warm clothing is recommended.

Currency

Pakistan's currency is "Rupee". The present exchange rate is around Rs. 32.00 to a US dollar. Exchange facilities are available at the hotels, airport as well as at commercial banks.

Insurance

The Organizing Committee will not accept any responsibility for accidents or illness incurred to participants, or loss or damage to their personal effects during the meeting time. This includes shuttle bus transfers, official sessions, technical tours, social and cultural functions, post-meeting tours, etc. For this reason, we recommend the participants to have an appropriate insurance prior to their departure for Pakistan.

Voltage

The domestic power supply in Islamabad is 220V - 240V, 50 cycles.

LIST OF IMPORTANT PARTICIPANTS ATTENDING ASIA- PACIFIC SOLAR EXPERTS MEETING, DECEMBER 18-21, 1995, ISLAMABAD

1. Mr Peter J. McKenzie
Managing Director
Siemens Showa Solar
Block 164, Hallang Way
No. 05-14/15, Kolam Ayer
Singapore.
2. Mr. Mandanjeet Singh
Special Adviser to Director General
UNESCO, 27 Quai de Grenelle
Paris 75015, France.
3. Prof. R. Hill
Newcastle Photovoltaics Application Centre,
University of Northumbria,
Elison Place,
Newcastle Upon Tyne, NE1 8ST,
U.K.
4. Prof. A.F.W. Willoughby,
Department of Engineering Materials,
University of Southampton,
Highfield, Southampton SO17 1EL,
U.K.
5. Dr. G.M. Lampert,
Solar Energy Research Institute,
Golden, Colorado,
U.S.A.
6. Mr. Rene Roy,
Secretariat,
ET Network of Expertise for the global Environment,
P.O. Box 5192,
Montreal, Quebec,
Canada H3C 4S7.
7. Mr. Robert T. Kelly,
Chief Executive Officer,
Amoco/Enron Solar Power Development,
P.O. Box 1198, Houston, Texas
U.S.A.

THE WORLD BANK GROUP
Headquarters: Washington, D.C. 20433 U.S.A.
Tel. No. (202) 473-1816 • Fax (202) 522-3256 • Telex No. RCA 248423

FACSIMILE COVER SHEET AND MESSAGE

DATE:	November 17, 1995	NO. OF PAGES: 23 (including cover sheet)	MESSAGE NO.: 1
TO:	Mr. S. M. Qureshi		FAX NO.: 92-51-825-376
Title:	Secretary Science and Technology		
Organization:	Government of Pakistan		
City/Country:	Islamabad, Pakistan		
FROM:	Naima Mansur		FAX NO.: (202) 522-3256
Title:	Renewable Energy Specialist		Telephone: (202) 473-4671
Dept/Div:	Global Environment Coordination		Dept./Div. No.: 655/37
Room No.:	S 2145		
SUBJECT:	Photovoltaics Workshop in Pakistan		

MESSAGE:

Dear Mr. Qureshi:

It was a pleasure speaking with you this morning. I am very happy to learn that Pakistan has developed such strong interest in solar energy. I am interested in learning more about the Solar Workshop/Seminar on December 18, 1995. I would truly appreciate if you can fax me any background papers or information on the participants of the workshop.

Thank you for expressing interest in hosting one-day workshop on a "Green Carrot" market transformation proposal for photovoltaic technology (solar energy). The goal of the "Green Carrot" program is to advance photovoltaics to a status of being a sound bankable investment. The program would accelerate commercialization and market penetration in the developing nations, and initiate large scale intervention to reduce greenhouse gas emission (GHG). The program would take the form of an International Finance Corporation (IFC) managed fund totaling approximately \$60 million from the Global Environment Facility (GEF). The program would provide \$5-20 million grants for each of three to six companies or consortia with the most innovative proposals for expanding photovoltaic technology development and commercial applications in the developing world. This proposal is unique in the sense that the primary innovation and activity will come from the private sector in both North and South. The country partnering aspect of the proposal is focused towards broadening the range of developing country photovoltaic players, ranging from local battery manufacturers to the NGO delivery systems and credit financing or leasing schemes, which would enhance the purchasing power and product appreciation of the end consumer. Thus, over the long run the proposal aims towards providing the photovoltaic technology firmer footing in the developing nations. A copy of the proposal, *Cultivating the Green Carrot: A Market Stimulus for Photovoltaic Technology*, is attached.

Transmission authorized by:

If you experience any problem in receiving this transmission, inform the sender at the telephone or fax no. listed above.

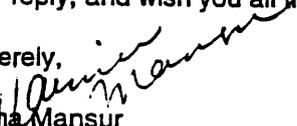
November 17, 1995

Our country's written expression of interest is required for obtaining Global Environment Facility's financial assistance for the workshop. I would very much appreciate an early response, as we would like to make the necessary arrangements to facilitate participation. We would like to schedule the workshop sessions soon after January 2, 1996, as Ramazan starts on or about January 20, 1996. Expression of interest should be sent via facsimile to:

Mr. Ken Newcombe
Chief
Global Environment Coordination Division
Environment Department
The World Bank
Fax No.: (202)-522-3256

If you have any questions, please do not hesitate to contact me at: (202)-473-4671. I look forward to your early reply, and wish you all the very best in your efforts to promote renewable energy in your country.

Sincerely,


Naima Mansur
Renewable Energy Specialist
Global Environment Coordination Division
Environment Department

Attachment

cc: Mr. Charles Feinstein (ENVGC)

PERMANENT MISSION OF ALGERIA
TO THE UNITED NATIONS
NEW YORK

البعثة الجزائرية الدائمة لدى الأمم المتحدة
نيويورك

The Permanent Mission of Algeria to the United Nations presents its compliments to the World Bank and with reference to the letter addressed on October 1995 to the G.E.F. council members regarding the "P.V. Green Carrot project" has the honor to express the interest of Algeria to host in January in 1996 a one day workshop on photovoltaic technology.

The Permanent Mission of Algeria to the United Nations avails itself of this opportunity to renew to the World Bank the assurances of its highest consideration.

New York, the 20th of November 1995

Mr. Ken NEWCOMBE
Chief/Global environment coordination division
Environment Department
World Bank.

BB

Ref.:MA/on/297/95



All communications should be addressed
to the Director of Department of Energy

In reply please quote:

Telephone: 254686/251337/254491/252339
Telegrams: ENERGY, RIDGEWAY
Telex: ZA 40373/41680
Facsimile: 252339
254491

No. _____
DE/102/1/54



REPUBLIC OF ZAMBIA

DEPARTMENT OF ENERGY

OFFICE OF THE DIRECTOR

29 December 1995

P.O. BOX 36079
LUSAKA

Mr. Ken Newcombe
Chief
Global Environment Coordination Division
Environment Department
The World Bank
1818 H Street N.W.
Washington, D.C. 20433
U.S.A.

Fax: 00-1-202-522-3256

Dear Mr. Newcombe,

RE: PV Green Carrot

We have just received your correspondence dated October 26, 1995 in connection with the above subject.

The Zambian Government through the Ministry of Energy and Water Development and the Department of Energy is interested in the development of energy resource base on an environmentally sound and sustainable basis. We feel that the above initiative is in line with Zambian Government Energy Policy on the development of renewable energy sources especially solar photovoltaic as a source of energy. The Ministry has already taken some initiative in promoting the widespread adoption and use of solar photovoltaic through the installation of solar PV equipment in rural areas for lighting, refrigeration and water pumping. However, a lot more remains to be done. Therefore, the Green Carrot initiative ties in very well with our desire to develop and promote the PV in the country. The above programme is therefore timely and welcome.

In light of the foregoing, the Department of Energy wishes to express its utmost interest in the PV Green Carrot initiative and in hosting a one day workshop in 1996.

This late response to your letter is beyond our control and regrettable. We look forward to receiving your favourable response.

W. Serenje
ACTING DIRECTOR
DEPARTMENT OF ENERGY

c.c: The Acting Permanent Secretary
Ministry of Energy and Water Development
Mulungushi House
LUSAKA



AGENCY FOR THE ASSESSMENT AND APPLICATION OF TECHNOLOGY
(BPP TEKNOLOGI)
 Jl. M.H. Thamrin No.8 Jakarta, 10340 - Indonesia
 Tel : 316-9749 TELFAX : 61331 BPPT LA Fax : 316-9765

FACSIMILE COMMUNICATION

DATE	December 11, 1995
TO FAX No.	202 522 3256
TO	Global Environment Coordination Div. The World Bank
ATTN	Ken Newcombe
FROM	Drs. Agus Salim Dasuki M.Eng Director for Energy Technology, BPPT
SUBJECT	Photovoltaic Workshop in Indonesia
No. of PAGES	1

Dear Mr. Newcombe,

I would like to apologise for late reply. Referring to the fax. from Ms. Naima Mansur about Photovoltaic Workshop in Indonesia, we would like to inform you that we accept the offer to be the host of the workshop.

In order to conduct the workshop, we need some information as follows:

- How many days do you need to conduct the workshop.
- Who will be the speakers and participants (domestic or international)
- How many participants do you expect to join the workshop.
- Do we have to arrange accommodation for the speakers and the participants.

I would be grateful if you could send us the proposal of the workshop at your earliest convenience

Drs. Agus Salim Dasuki M.Eng.

国家经济贸易委员会
STATE ECONOMIC AND TRADE COMMISSION
26 Xuanwumen Xidajie, Beijing 100053, P. R. China

FACSIMILE

TO: Mr. Ken Newcombe
Chief
Global Environment Coordination Division
Environment Department, The World Bank

FAX: 202-522-3256 not working

FROM: Zhu Junsheng
Chief, Renewable Energy Division,
Energy Conservation & Resources
Utilization Department, SETC

FAX: 10-3045326, or 10-3045961
E-mail: lhpeng@public.bta.net.cn

Page(s): 2 (including this page)

Date: Nov. 29, 1995

MESSAGE:

Dear Mr. Ken Newcombe:

In Response to the PV Green Carrot Workshops

I just read the letter you sent to the Ministry of Finance, the GEF Operational Focal Point in the country on PV Green Carrot initiative dated October 26, 1995. On behalf the State Economic and Trade Commission (SETC), I would like take this opportunity to express our willingness to involve in the initiative and to be the host of the one day workshops in Beijing, China.

The State Economic and Trade Commission (SETC) is the leading government agency to promote the renewable energy commercialization and industrialization in China. Attached is a brief introduction to the main functions and responsibilities of the SETC. We are seeking to get the GEF support to accelerate the renewable energy development, particularly in the commercialization and market penetration. Actually, we have had a joint study project with the World Bank on Renewable Energy Development Study. The Study will include: (a) an assessment of the economic viability of renewable energy technologies compared with competing conventional technologies; (b) a review of issues and policy barriers affecting public and private sector development of these technologies; and (c) an outline of priorities for international assistance and technical assistance support through multilateral lending and bilateral aid programs, expended private sector participation, and the GEF. So, I think of the

appropriate for China to held the Workshops. we would be appreciated very much if you could make the decision to place the workshops in Beijing, China.

In this case, we proposed that the one day workshops to held in the last week of January, 1996 for good preparation.

Thanks and best regards.

Attac.

Brief Introduction to the State Economic and Trade Commission (SETC)

Main Functions:

- participating in the study and formulation of strategic objectives for the national economy development and drawing up of medium and long term economic programs
- annual plan on industry and communication as well as trade formulation
- industrial policy making
- taking charge of enterprise affairs, organizing the design and implementation of enterprise reform
- market building
- business administration
- technical improvement and transformation
- guiding and promoting energy conservation and resources comprehensive utilization technology
- quality control
- administering the nation's import and export of machinery and electric products

Role in the Renewable Energy Development

- formulation of regulations and policies concerning renewable energy industry development
- jointly plan formulation on National Renewable Energy Development
- in charge of commercialization and retrofitting existing industries
- maintaining close and extensive contacts with industrial and commercial circles and playing a strong role in enterprise training
- promoting and building renewable energy products market



สำนักงานที่ปรึกษาด้านวิทยาศาสตร์และเทคโนโลยี
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Royal Thai Embassy
1024 Wisconsin Ave., N.W.
Suite 104
Washington, D.C. 20007-3620

Facsimile Transmission

Page one of

4

To : Ms. Nirma Mansur Date : 1/19/96

Fax No. : 202-522-3256

Address : The World Bank Group

From : Somchai

Text :



No. 0806/ 17906

Office of Environmental Policy
and Planning
Soi Phibun Wattana 7
Rama VI Road, Bangkok 10400

28 December B.E. (2538) 1995

Dear Mr. Naina Mansur,

I am writing on behalf of the Ministry of Science, Technology and Environment of the Royal Thai Government to formally inform you of our interest in hosting a one-day workshop on Photovoltaic Technology under the PV Green Carrot Program.

Due to other prior engagements, please be advised that we will not be available to organize the workshop on 23 January 1996 as suggested. In this connection, we would like to propose the date to be any day between 12-16 February 1996. We have enclosed an estimated budget breakdown as requested for your further consideration.

Your future communication on this matter should be directed to Mr. Sunthad Somchevita, Secretary General of Office of Environmental Policy and Planning. For more enquiries concerning the organization of the workshop, please contact Ms. Orapin Wongchumpit, Director of International Environmental Affairs Division. She can be reached at phone (662) 271-4322 and fax (662) 271-4322, 271-3226.

2/...

Mr. Naina Mansur
Renewable Energy Specialist
Global Environment Coordination
The World Bank Group Headquarters
Washington, D.C. 20439, U.S.A.

Proposed Budget for the Organization of
 A Workshop on Photovoltaic Technology
 February 1996
 Bangkok, Thailand

Estimated Budget Breakdown

<u>World Bank Granted</u>	<u>Baht</u>	<u>U.S.S</u>
1. Lunch and Coffee Break (60 persons x 550 B/person)	33,000	1,320
2. Lecturers' Fee (1500 B/person x 7 persons)	10,500	420
3. Exhibition (Posters, paper, pens, inks, etc.)	10,000	400
4. Bags (@ 350 x 70 pieces)	24,500	980
5. Supplies (paper, pens, ink, disk, etc.)	5,000	200
6. Others (phone, faxes, postages, etc.)	4,500	180
<u>Total</u>	<u>87,500</u>	<u>3,500</u>

Cost Sharing from the Royal Thai Government

	<u>Baht</u>	<u>U.S.S</u>
1. Staff times (5 persons x 10 days x 400 B/day)	20,000	800
2. Office Space and Materials	5,000	200
<u>Total</u>	<u>25,000</u>	<u>1,000</u>

- 2 -

Thank you very much for your kind cooperation. I look forwards to hearing from you soon.

Sincerely yours,

Chirawan Pipitphoka
(Miss Chirawan Pipitphoka)
Deputy Secretary-General
Acting Secretary-General

Annex II -- Concept Paper:
The Photovoltaic Market Transformation Initiative

The Photovoltaic Market Transformation Initiative

Overview

The goal of the *PV Market Transformation Initiative (PVMTI)* is to significantly accelerate the commercialization, market penetration, and financial viability of photovoltaic (PV) technology in the developing world, and provide a window for promoting large scale use of photovoltaics as one of the best long-term prospects for a low carbon energy future. The *PVMTI* will take the form of a total fund of approximately \$60 million contributed by the Global Environment Facility (GEF), providing \$5-20 million grants to each of three to six companies or consortia with the most innovative proposals for accelerating PV technology development and expanding commercial applications in the developing world. This initiative is fundamentally different from a donor designed and implemented program in that the primary innovation and activity will come from the private sector. The grants in the program are expected to be used to address obstacles and opportunities in three key areas: market development, manufacturing, and country partnering.

Pending approval by management, the program is expected to be managed by the International Finance Corporation (IFC), the private sector affiliate of the World Bank Group. Management through the IFC will afford greater speed and flexibility in implementation, increase potential leverage, and create movement towards wholly private sector financing windows at the IFC and elsewhere. In order to avoid inadvertent exclusion of potential innovative approaches and to provide adequate time for the required business arrangements to be made, a broadly defined "early opportunity notice" (EON) will be issued to outline the program structure and provide an opportunity for information exchange. This EON will be accompanied by limited financial, technical, and business planning assistance to facilitate proposal preparation and ensure participation by all interested and qualified developing country entities.

PVMTI: The Problem and the Opportunity

In its efforts to address greenhouse gas emission (GHG) problems, the Global Environment Facility (GEF) has provided technical assistance and pilot project development support to a range of efficiency, conservation, carbon sequestration, and emission avoidance approaches. While these approaches are akin to "buying time," GHG accumulation continues because net emission rates in the industrial countries remain large and those in developing countries continue to grow. For example, if per capita emissions of the non-OECD countries rise to those of the OECD countries, worldwide carbon emissions would quadruple.⁽¹⁾ *Figure 1* illustrates a status-quo fossil fuel development path resulting in emissions of approximately 3.5 times the 1990 level (of approximately 6.5 giga-tons annually) within about 50 years; even aggressive development of alternative technologies will take approximately 25 years to exert a measurable downward effect on emissions.

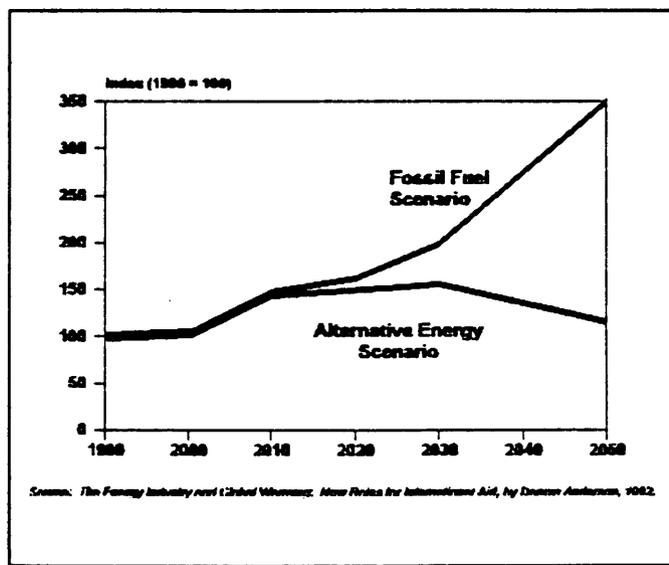


Figure 1: Carbon Emissions Under Two Scenarios

In terms of the immediate goal of holding year 2000 GHG emissions to the 1990 level, GEF pilot phase projects have addressed less than 0.4 percent of required emission reductions. Consistent with revised draft operational strategy, the GEF is now reallocating its resources to new "technological lifeboat" solutions -- technologies that have high present costs but enormous future potential (including PV, solar thermal electric, wind, biomass gasification, and fuel cells). Zero emission technologies such as PV have a particular benefit as "decumulator" technologies should atmospheric concentrations of CO₂ trigger environmental consequences that can only be addressed by reversing emission rates.

This initiative is fully consistent with the GEF's lead role in funding the implementation of the Framework Convention on Climate Change (FCCC). During the Conference of the Parties (COP) meeting in Berlin in March 1995, the *PVMTI* was offered to the FCCC by the World Bank as one of several options available to support clean technologies and address climate change. It received positive commentary from both government and nongovernment organizations and delegates.

The *PVMTI* is affiliated with the World Bank's *Solar Initiative*, which is intended to develop internal commitment and project development capability within the World Bank as well as provide an external liaison role in coordinating strategic activities in accelerated research, development and demonstrations of renewable energy technologies. The *PVMTI* also represents ideals of the emerging *Climate Technology Initiative*, a linked set of unilateral and multilateral programs designed to accelerate the development and diffusion of technologies with global benefits through joint government and private sector activities.

The *PVMTI* adopts a fundamentally different approach to previous World Bank and GEF approaches. Rather than pursue one-time emission reductions through technical assistance or pilot projects, the *PVMTI* entails a moderately large intervention (relative to existing markets) to initiate long-term GHG avoidance and reduction. *PVMTI* projects will be designed and implemented largely by the private sector. Rather than a "top down" approach that might expire when funds are exhausted, the proposed channeling of GEF funding through the IFC can stimulate PV players to stretch their technological and marketing capabilities in pursuit of their own long-term private interests. The flow of business deals and technology transfer resulting from the *PVMTI* is intended to complement these initiatives, not by changing World Bank Group investment policy but by advancing PV to the status of a sound, bankable investment in a broader range of conditions than is now the case.

PV Technology Potential

Photovoltaics is a zero-emission technology which has enormous potential for mass production and dissemination. By stimulating PV commercialization, the initiative is expected to provide -- to energy decision-makers and potential PV customers in the developing world -- a significant precedent in establishing renewable energy as a viable alternative to conventional energy technologies and grid extension. PV technology is arguably the most modular in meeting the broadest range of energy needs in the developing world, benefits from a consistent energy resource throughout the developing world, and has high prospects for broad acceptance as a consumer product as well as for mainstream and dispersed grid applications. Market-scale demonstrations or commercial deployment of other renewable energy technologies such as solar thermal electric, wind power, and biomass power tend to be more limited to grid applications and are closer to being commercial. It is likely that these technologies will require only a relatively small number of successful demonstrations to become commercially mainstreamed. PV remains a relatively small and dispersed technology but is expected to be most responsive to increases in both manufacturing scale and sustained market development.

Manufacturing Improvement Potential

Technically, PV technology is a relatively mature technology, but it remains pre-commercial in many locations. While PV costs have dropped tenfold in the last 20 years and have shown good response to manufacturing initiatives (see *Figure 2*), current prices of approximately \$4.00 to \$5.00 per peak watt remain too high for the technology to compete except in high-value markets. PV manufacturing is capital intensive, and manufacturing plant size is currently less than optimal because of the relatively small size of the market. And while fully installed costs of \$10-15 per peak watt in the developing world may be competitive with or cheaper than many diesel generators, further cost reduction would open additional markets.

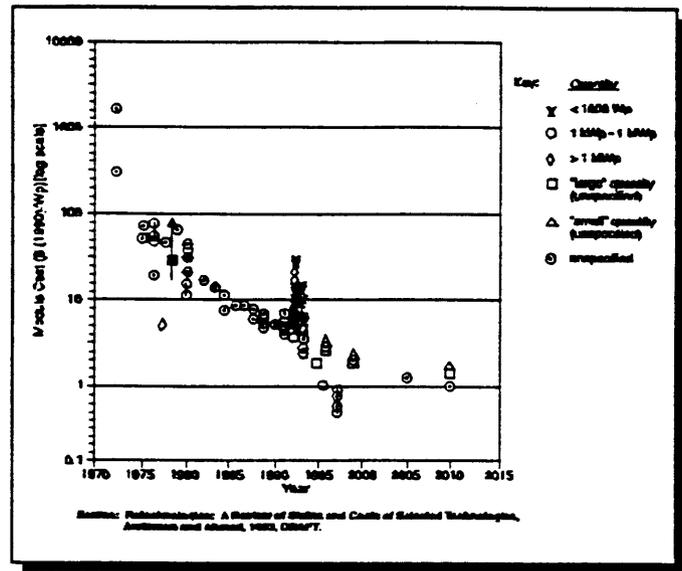


Figure 2: PV Cost Trends

Cost reductions can be attained through technology improvements, process improvements, input substitution, economies of scale, and reductions in input prices, as well as by optimizing labor and management organization. There are also a number of stages of PV manufacturing that can be integrated into joint ventures in developing countries that would lower costs further, including module assembly, manufacture and/or assembly of balance of system (BOS) components, and integration of complete systems.

Sufficient experience and data exist to predict PV market expansion under a "business-as-usual scenario." The cost-effective exploitation of niche markets is expected to result in a global market expansion of about 19 percent per year until 2010, only somewhat faster than the 16 percent average rate of increase since 1983.⁽²⁾ Several sources indicate a progress or learning curve of about 80 percent for PV; i.e., for each doubling of production, market prices drop about 20 percent. Using the 80 percent experience curve, this expansion of sales to about 200 MW per year would still leave prices at about \$3.00 Wp.⁽³⁾ With additional incentives, however, it is expected that PV prices could be brought to \$1.00 Wp within the next 10 to 15 years, with comparable cost reductions in BOS costs. At this level, PV electricity could be delivered at \$0.05-0.06 per Kwh in areas with adequate insolation, becoming nearly competitive with grid power supply prices.

It is important to note that while learning curve effects are based primarily on cumulative production, early years of production are not necessarily good indicators of the learning effects of moving from R&D or small manufacturing to large-scale, optimum scale operation. With the jump to large-scale manufacturing under competitive market conditions, much greater improvements could occur.

Currently, a factory producing 2 MW of amorphous silicon modules annually would cost about \$12.5 million to build (see *Figure 3*). A factory with 40 times this capacity would require an investment of only 6 times as much at \$81 million. The projected production cost would be about \$1.25 per peak watt, and this price could significantly expand markets for PV.

While the industry is now poised to build a number of 10-MW and larger plants in both crystalline and thin-film technologies, there is still little experience with plants of this size. The largest PV plants currently operating are at the approximately 15- and 8-MW level; these are crystalline technology plants that are not necessarily fully optimized. Projections from the companies actually engaged in manufacturing is proprietary, making it even more difficult to determine accurate data points, especially in the out years and for larger plant sizes. And while the relationships of plant output and the costs of plants and modules appear to be real, it is important to recognize that learning curve effects remain, and simply doubling plant size in a very brief time period will not result in the same cost reductions for plant or product as would a doubling that occurred after some period of cumulative production and de-bugging. Finally, while the costs and outputs from a potential 80-MW plant are attractive, they are less relevant to the *PVMTI* than creating a cogent flow of sound business deals simultaneously addressing manufacturing scale-up and market development.

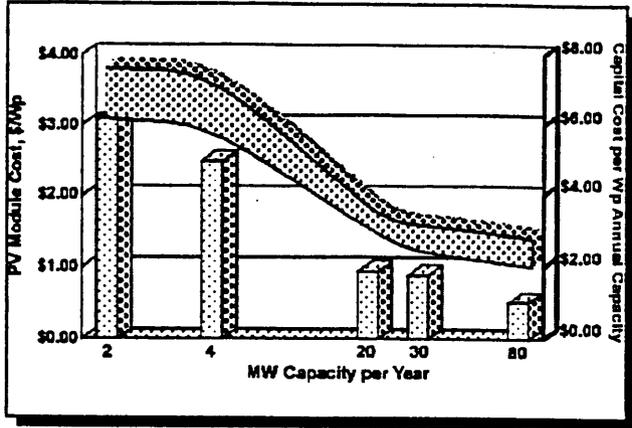


Figure 3: Manufacturing Plant and Module Cost

Each layer of cost reductions from manufacturing improvements enables tremendous market growth. The near-term area of opportunity for the PV industry, and the "zone of influence" for the GEF, is indicated in the shaded area in Figure 4, where simultaneously increasing investment and commitment to market development can accelerate access to expanded markets. The construction of substantial new electrical infrastructure in the developing world, combined with the relatively low level of electric grid maturity and relatively high electricity tariffs, offers unique opportunities to apply photovoltaic technology as an alternative power source.

Market Development Potential

Each layer of cost reductions from manufacturing improvements enables tremendous market growth. The near-term area of opportunity for the PV industry, and the "zone of influence" for the GEF, is indicated in the shaded area in Figure 4, where simultaneously increasing investment and commitment to market development can accelerate access to expanded markets. The construction of substantial new electrical infrastructure in the developing world, combined with the relatively low level of electric grid maturity and relatively high electricity tariffs, offers unique opportunities to apply photovoltaic technology as an alternative power source.

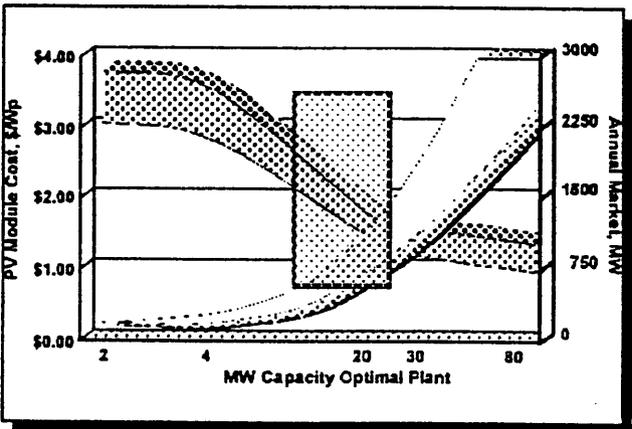


Figure 4: Module Cost and Market Expansion

Electricity demand for the developing world overall is projected to increase at 7 percent per year, with growth rates for the more industrialized of these countries in excess of 10 percent per annum, and those of some Southeast Asian countries exceeding 15 percent per year.⁽¹⁾ The financial requirements to meet growing energy demand in the developing world (mostly with fossil plants) are estimated to be at least \$100 billion per year. Currently, \$50-60 billion is spent each year in this sector, leaving an annual deficit of as much as \$50 billion. This cumulative deficit poses a significant bottleneck for economic development in the developing world.⁽¹⁾

⁽¹⁾ These estimates do not account for the potential role of energy conservation and efficiency investments which are currently unrealized; actual requirements could be less.

In the urban areas of the developing world, marginal costs of electricity are around \$0.10 per kWh, while in rural areas it is often \$0.20-0.40 per kWh. Still, customer prices tend to fall short of costs (around \$0.04 to \$0.05 in 1990), and peak-load pricing is rarely charged.⁽⁵⁾ Failure to account for the cost of line extensions in areas of low customer density, usage, and connections has resulted in enormous financial and technical losses in many developing country utilities, and has failed to deliver the expected benefits. In India, for example, nearly 80 percent of villages have been connected to the grid, but the number of *households* connected is just 22 percent. Grid power under these circumstances is often unreliable and/or of poor quality, with very low load ratios and high losses. Even without considering the subsidized tariffs which exist in many countries as an element of social policy, revenue collection does not cover actual costs.

Opportunities in Rural and Off-Grid Markets

Rural applications -- where grid connections are unavailable or unlikely to be available within the next few decades -- are the fastest growing niche and represent over 50 percent of the market for PV. These markets are expected to offer the best potential to mainstream PV technology as an alternative to grid extension. While not necessarily a requirement of the initiative, it is generally expected that many *PVMTI* proposals will address off-grid rural markets.

These unelectrified customers account for 300-400 million households in the developing world. While massive efforts to electrify rural areas have resulted in an increase of rural electric coverage from 18 percent in 1970 to about 33 percent in 1990, the overall rate of connections has just kept pace with population growth, leaving the estimated number of unelectrified people constant at about 1.7 billion.

Nearly 1 billion people in the developing world also lack access to safe water supplies; combined with a number of other small and medium water-pumping applications for agriculture, this represents another important market where PV is often a least-cost solution. In addition, there are hundreds of thousands of off-grid schools and health clinics throughout the developing world where PV can provide small amounts of power through government and donor financed programs.

As developing countries grow and become more integrated with the world economy, the costs of unreliable and poor-quality grid service become an obstacle to development. A variety of applications exist in transmission, distribution support, and baseload and peak power to supply commercial operations that place a premium on dependable electrical power. PV can be an important part of an integrated, least-cost utility strategy to meet such requirements. The *PVMTI* is thus a step towards a new paradigm for electrical power development that places greater emphasis on decentralized, environmentally superior energy services rather than central station grid connected supply options.

The Nature of the Rural Market

In the absence of government or multilateral initiatives to promote renewable energy dissemination, PV commercialization efforts have taken a nonaggressive marketing approach, selling to the small class of relatively wealthy customers able to purchase systems on a cash basis. Enersol Associates (a non-government organization and affiliated commercial companies performing PV installations in the Dominican Republic and Honduras) has described a pyramid structure for the larger number of off-grid rural customers that can be served through additional financial services.

In *Figure 5*, the top layer represents relatively high-cost and high-value commercial applications in telecommunications, water pumping, and specialized applications; this niche market is small but continues to grow. Below this, there are several layers of customers included within the approximately 400,000

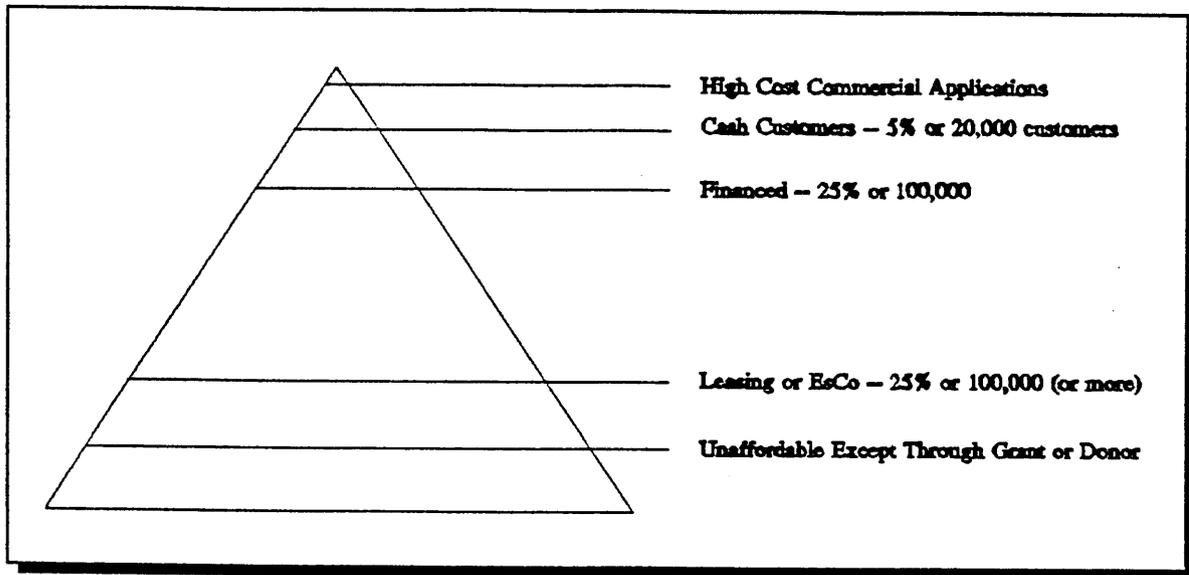


Figure 5: Rural Market Pyramid Structure

households in the off-grid market. The first 5 percent or approximately 20,000 households are either unserved or dissatisfied with grid service and are able to pay cash for small PV systems. Below this, approximately 25 percent or 100,000 can afford systems financed with a down payment and time payments. Lease financing (or energy service company approaches) with no significant down payment can address another 25 percent or 100,000 of the household customer pool, while the remainder will generally find PV unaffordable without significant grant contributions. Commercial service to each of these layers builds the sales, technical, and financial infrastructure that supports expansion in each successively larger layer. While these percentages cannot be casually extrapolated to all developing countries, they are an indicator that large, attainable PV markets exist. In poorer countries, the bottom of the pyramid will be larger; in more affluent countries there will be higher levels of affordability.

The "ability to pay" of rural people in the developing world is often higher than average income or GDP figures might suggest. Cyclical farming income and cash remittances or gifts by relatives in urban areas often provide a surprisingly high ability to pay cash for PV systems, evidenced by widespread purchases of motorcycles, televisions, and other consumer durable goods. (Kenya is an example where a wholly private approach to PV sales has resulted in the installation of over 25,000 household systems, mostly on a cash basis, despite some of the highest import duties on PV equipment in the world). For those unable to pay cash, amortizing costs through private or public utility service or leasing plans can effectively channel existing expenditures for lighting fuels and batteries to support PV systems. Many rural area households remain poor by definition and cannot afford PV, and no degree of innovative financing or institutional arrangements can address this without a grant component. In many cases, however, a PV approach can still help minimize subsidies already being paid by utilities.^{(6),(7)}

The largest obstacle to widespread PV dissemination is not capital constraints on system purchases or even the price of systems themselves; it is the hesitation of relatively small industry players to commit to investing in and maintaining far-flung sales, distribution, and financing networks when only small and dispersed levels of sales opportunities exist. While 1.7 billion people without electrical services represents an enormous latent market, the mere fact that they remain unelectrified indicates how rural they are, and how difficult they may be to reach through conventional market pathways. This does not mean that these markets should be ignored:

"... the world outside the reach of the electricity grid is far from one of passive energy deprivation. There is, rather, a complex and dynamic evolution of energy demands with time, economic development, fashion, and rising aspirations. These demands are met by local entrepreneurs and traders, responding often with considerable ingenuity and initiative to the changes taking place in the energy market."⁽⁹⁾

There are numerous opportunities to serve off-grid applications not addressed by country utilities. In addition, there are emerging opportunities for private energy companies to offer services on a franchise basis, with benefits to both customers and utilities that are relieved of the responsibility to serve customers far off the grid. In order to organize markets and bring the required financing to dispersed rural customers, the objective is to catalyze the nascent network of intermediaries in the private, NGO, and government sectors to effect lasting reductions in transaction costs for PV systems. Success in these efforts will signal the commercial viability of PV throughout national and world markets, and spur incorporation of PV projects and applications into normal financial channels.

PV Market Barriers

Current world PV production (approximately 75 MW), associated balance of systems equipment, and design and installation services, are valued at \$1 billion annually. Private investment in PV is estimated at over \$2 billion, and has been supplemented with like amounts of government investment, but only a few companies are considered profitable. Cumulative terrestrial power installations of over 300 MW remain a small fraction of the approximately 2.6 million MW of installed electric generating capacity worldwide,⁽⁹⁾ and the technology is in many ways contrary to established patterns of centralized generation and grid distribution of electricity.

While essentially a commercial technology, costs remain high, and the industry is only now making the jump from R&D-level production to one of large-scale manufacturing. Incremental development of far-flung niche markets is difficult and expensive. A number of PV companies still do direct sales; even those that have a widespread world distribution network and use in-country distribution channels have not made the large commitment to broadening distribution in the developing world for a number of reasons:

- **Investment:** While there is not a macro-level capital constraint on PV, and while a number of PV companies have partners or parent companies with significant financial resources, it has been difficult to mobilize capital for manufacturing investment without reasonable assurances that the market will absorb output and that the returns on such investments will be competitive with other investment opportunities.
- **Financing:** Even when cost-effective on a life-cycle basis, PV represents a high front-end capital investment. This increases financing requirements from commercial or private sources, and it is more difficult to organize financing on a dispersed basis for individual PV customers. Financing institutions tend to be conservative and most still view PV as unproven or noncommercial and are unwilling or unable to provide innovative or alternative financing mechanisms for PV sales.
- **Subsidies:** Grid power and diesel generators benefit from significant tariff support, tax and investment policy, and fuel subsidies. In both the developed and the developing world, conventional power generation technologies enjoy well-established patterns of investment and institutional support, and have had 50-75 years to diffuse into the market. Unless efforts to

rationalize energy systems take hold, market distortions will continue to negatively impact *all* renewable and many energy efficiency technologies.

- **Transaction Costs:** Low customer density in given service territory makes sales, installation, service, and payment collection expensive and difficult, resulting in transaction costs that are about 30 percent of total system costs. This reduces affordability, undermines sustainability of systems, and reduces the market impact of even dramatic cost reductions in modules.
- **Customer Awareness:** There is often a lack of knowledge of PV's capabilities among end-use customers, and utilities remain conservative in regard to all small, decentralized technologies and departures from standard practice.

In spite of these institutional and market barriers, PV cells and modules are taking on the characteristics of a commodity market. A broad array of systems integrator companies has formed to distribute and install completed systems, and there are emerging companies providing a variety of consumer and energy services. Such companies source cells and modules from the least-cost supplier on a competitive bid basis.

PVMTI Strategy

The Financial Incentive

The closest parallel to the *PVMTI* is the Golden Carrot Super-Efficiency Refrigerator Program (SERP), in which a single \$30 million award was made following a competitive procurement. For the photovoltaic industry, a "winner takes all" approach is not considered to be as useful as a number of more diversified grants. In order to hedge risk, encourage multiple approaches in different markets, and attract a variety of recipients, 3 to 6 grants are anticipated in the range of \$5-20 million each. This grant size is a significant and appropriate contribution for attracting investment and partners for manufacturing scale-up or long-term market development activities. This size of grant is also believed to be proportional to the scale of opportunities in PV. *PVMTI* proposals are expected to achieve leverage of 5 to 1 or somewhat higher.^[2] Because leverage increases total project size, too large an average grant size could artificially inflate projects.

Two aspects of leverage are important for the *PVMTI*. The first is the leverage that a consortium can bring to bear on combining funds from different entities, including equity, debt finance from commercial sources, venture capital, and its partners' in-country government investment or in-kind services in the form of tax relief, tariff reform, or other incentives. The second is the level of activity the consortium proposes to undertake with that capital. This could be significantly expanded depending on the timeframe, the proportion invested in manufacturing or system integration, the level of commitment to developing and sustaining market distribution and service infrastructure, or the amount dedicated to the establishment of revolving loan funds or other financing mechanisms and the rate of recovery, and thus, the lifetime of those funds. The best use of the grant component will be a matter for the bidding consortia to determine and justify in their proposals. The *PVMTI* competitive grant process is expected to maximize financial leverage; IFC as the proposed manager would be in a strong position to evaluate the financial viability and integrity of the proposals.

^[2] GEF pilot projects achieved leverage of approximately 3 to 1, and current GEF contributions to the Indonesian and India PV projects are achieving leverage closer to 4 to 1.

Desired Results

While the *PVMTI* has some qualities of a demonstration project, and it is not anticipated to fully mainstream PV technology opportunities over the program lifetime, its leveraged scale of some \$350 million is expected to provide a significant intervention to the business-as-usual scenario. The overall goal of the initiative is to expand technology penetration and accelerate manufacturing improvements and scale-up by 3-5 years. Projects resulting from the *PVMTI* grants will likely add at least five new PV module assembly plants producing 10 MW or more annually. This would effectively double current world output for terrestrial power modules, facilitating the transition to large scale manufacturing over a particularly elastic range of the manufacturing investment/module price function. Market development to place this additional product in sustainable applications solidify market activity and send positive signals to potential investors for additional expansion.

The result will be a more widely accepted substitute for conventional grid extension and greater reduction or avoidance of GHG emissions than would result from a business-as-usual approach. The desired outcome is the creation of several significant, innovative projects capable of being replicated either commercially or at a much lower level of support, as well as a flow of commercial business deals that will firmly establish PV as an attractive, viable investment. In addition to emission reductions, the initiative is anticipated to result in increased employment in photovoltaic and associated businesses, local social and economic development, and to provide other downstream benefits. Strategic factors of interest to the *PVMTI* include but are not limited to:

- Stimulation and acceleration of price reductions through expanded markets, greater manufacturing economies, and increased PV system performance;
- Increased technology transfer and developing country capabilities in PV market development and manufacturing;
- Service, training, and institutional development sufficient to support widespread and long-term technology dissemination;
- Introduction and validation of new financing mechanisms;
- Significant recipient country partnering, potentially including co-financing, in-kind services, guarantees, and/or policy modifications; and

Golden Carrot Refrigerator Program: Lessons Learned and Comparison

The "Golden Carrot" Super-Efficient Refrigerator Program operated by the U.S. Environmental Protection Agency and a consortium of U.S. utilities offered a \$30 million financial incentive to stimulate R&D, reduce risk, and provide an implicit subsidy to the final product. Recognizing that their individual DSM programs were too small to change the market, 40 utilities came together to develop a significant market-pull program using a financial incentive and guarantee of a sizable market to induce manufacturers to participate. The source of 20 percent of average household electric use, refrigerators were targeted for a 25 percent efficiency improvement coupled with an accelerated compliance with the phase-out of CFCs. Fourteen manufacturers submitted bids, and after a run-off the award was made to Whirlpool. The reward, equivalent to about \$100 per refrigerator, was disbursed on a pro-rated basis as new refrigerators were distributed. While the technological hurdles facing PV technologies are different, similar results are attainable for PV. The "Golden Carrot," however, did not attempt to significantly alter the already large market for refrigerators or patterns of distribution. Lessons offered by the Golden Carrot include the importance of building coalitions, necessity of an independent program structure, and the value of competition and market forces to obtain financial leverage and induce lasting advancements.

- High levels of financial leveraging to augment GEF and private capital resources, expanding the impact and duration of the initiative, and creating favorable conditions for replicability.

Creating lasting expansion of PV markets and applications will require significant participation from a diverse set of private industry, developing country, and investment partners to overcome institutional barriers. There are three important areas to be addressed by all proposals:

Market Development: *PVMTI* grants can be applied as working capital to help overcome a company's or consortium's reluctance to make a commitment to developing distribution, sales, and service infrastructure in a country or region; and as a foundation for providing partial subsidies to end-use consumers and/or creation and operation of revolving credit facility to leverage system purchases over time.

Manufacturing: The grants could be used as base capital with which to attract further financing for significant manufacturing scale-up, to address particular R&D or manufacturing areas considered to have extraordinary payoff in terms of product price or manufacturability, or working capital with which to enter into joint-venture manufacturing and distribution activities.

Country Partnering: While primarily a private sector-driven initiative, significant country endorsement could achieve additional leverage and effectively stage operations. Participation could take the form of a license or franchise to operate in a country or region, joint venture activities with a country utility, public commitment to support PV in public programs (in water pumping, housing, water, supply, and health) endorsement to use existing finance networks, or financing enticements such as suspended import taxes, accelerated depreciation, and favorable rate treatment. Synergistic effects between market development and country partnering offer particular opportunities for expanding photovoltaic applications.

Potential Participants

It is expected that high competition for *PVMTI* grants will drive applicants to form broad-based consortia combining in-country organizations and expertise, manufacturers and system integrators, financial intermediaries, and investors. The lead organization must be incorporated or chartered in a GEF-eligible recipient country and act as the controlling entity. A variety of corporate joint ventures or teaming arrangements could be made between companies, NGOs, cooperatives, agricultural or commercial banks, and leasing companies. Equity shares should be contributed by teaming partners in proportion to their financial abilities.

In order to increase leverage and expand potential applications in a country or region, it is anticipated that many proposals will generate additional ties with in-country financial intermediaries to attract investment and/or develop apex credit structures, and with utilities to gain franchise territory or engage in cooperative efforts. Country governments may be approached for policy support, additional credit enhancement or investment, and additional GEF endorsement.

The *PVMTI* is not a mass-buy program, and is not limited to manufacturing companies. Product manufacturers are not necessarily well-suited to the grassroots-level business development, distribution chain, and consumer credit activities necessary to bring PV to developing countries. A number of NGOs have these skills, but lack the large-scale project management experience and overhead cost coverage that manufacturing partners bring to the table. Commercial or agricultural banks in the developing world offer knowledge of the customer base and have mechanisms to provide rural system financing. PV

companies, system integrators, and in-country utilities and system houses can all offer a consortium the technical expertise required to develop and support widespread dissemination of systems.

India Project for Photovoltaics

Another GEF-supported photovoltaic project with the India Renewable Energy Development Agency (IREDA) provides examples of some of the difficulties in donor-supported projects. IREDA's intent was to wean the renewables away from heavy government grant subsidies and supply interventions, by providing energy consumers and producers credit that initially featured concessional terms and gradually approach commercial rates as the technology gains wider acceptance. However, existing subsidized PV programs in water pumping served to "distract" PV dealers from developing commercial markets in other areas. Implementation of \$4 million in technical assistance component of the World Bank loan was slowed by bureaucracy, and insufficient "pipeline" development" to identify projects that would take advantage of IREDA financing. Additionally, World Bank's procurements above \$3 million are typically subject to international competitive bidding, making the IREDA finance mechanism unattractive to local institutions with established partnership with specific suppliers. The greatest obstacle has been with IDA funds passed to IREDA through the GoI's Central Bank. When the original pass-through rate was negotiated, India's inflation was high. Both inflation rates and costs of capital have since declined, but to control inflation the GoI has resisted reducing the interest rate at which they pass on funds to parastatals. Consequently, the potency of the GEF grant was diluted, and traditional World Bank policy has been to recommend that pass-through rates not be adjusted for sectoral concerns. The interest rate on IREDA funds been recently been reduced to 2.5%, allowing new movement in loan funds.

Country Partnering

The *PVMTI* has engendered broad support among potential GEF-eligible recipient countries (those signing the Climate Change Convention). The current phase of *PVMTI* preparation includes soliciting specific inputs from a variety of developing countries, including a formal endorsement of the *PVMTI* concept. It is expected that a number of governments and possibly their utilities will be willing to provide incentives for the private sector to take the lead in providing decentralized public electrification, such as lowering import duties, reducing subsidies on kerosene and diesel fuel, improving commercial laws, and other forms of support. However, the unique technology intervention focus of the program will hinge on private sector interests first selecting country or regional markets of best opportunity, and then securing the additional government, utility, and NGO support and resources to construct a highly leveraged proposal. Competition for *PVMTI* grants will thus take place both at the private sector level within countries and among different countries.

Outcomes: Potential *PVMTI* Projects

Examples of potential *PVMTI* projects could include, but would not be limited to:

- An in-country technology vendor joint-venturing with a photovoltaic manufacturer to develop a range of assembly and/or manufacturing operations, with additional government minority investment, distributing the product through prior license or franchise with a government-owned utility.
- An energy service company or leasing approach operating either independently or with a country utility addressing a mixture of concentrated high-value markets in water pumping, T&D applications, and peak/backup power for commercial buildings.

Country Partnering: Renewable Energy for Off-Grid Concessions

In the Province of La Rioja, Argentina, the Sub-secretary of the Electric Sector has put out to bid a radically new formula for private power development. Under their "Supply Program for the Rural Dispersed Population," territories have been broken down into concentrated and dispersed area concession markets. This move provides services to distinctly different groups of customers with distinct needs offers users assured access while directing existing subsidies to the most cost-effective applications.

The central element is the award of 15 year private power concessions (renewable up to 45 years) to private entities to provide power through photovoltaics, small wind, micro-hydro, and diesel systems. Awards will be made on the basis of minimizing the subsidy required to provide power to a growing basket of customers, with costs born 45 percent by users, 25 percent by existing provincial subsidy funds, and 30 percent by national funds. This reallocation of funds – called "shared responsibility," opens up new options to supply power but acknowledges that a level of payment much closer to real costs is required. Ultimately, 300,000 users (1.4 million people) and 6,000 schools, clinics, civil services, and water systems are expected to be served under this program.

This is an excellent example of how country partnering could offer assurances of significant scale markets to *PVMTI* consortia. The separation of mandates between concentrated areas and dispersed rural populations and the elimination of cross subsidies between grid customer pools and rural off-grid customers helps provide power on a sustainable basis to areas that would otherwise not be served. At the same time, it permits private sector entities to take a nonconventional approach to providing service and demonstrate – on a scale basis – the cost-effectiveness of PV and hybrid applications in off-grid rural applications.

- An agricultural or rural credit bank teaming with existing supplier networks and/or an NGO, buying product through large orders on the world market and developing a subsidized credit scheme to distribute PV systems. Such a proposal would not necessarily have a manufacturing element of its own but would nevertheless stimulate large, competitively priced orders.
- A commercial systems house teaming with a manufacturer, allocating part of the grant to a significant capital investment for an innovative manufacturing scale-up, and the remainder to a revolving finance fund, delivering systems to commercial and rural applications through expansion of existing distribution.
- Teaming between in-country private power producers and a variety of renewable energy vendors to develop renewable/diesel hybrid village systems and battery-charging centers to improve cost profile and reduce fuel use.
- An agricultural service or telecommunications company teaming with a manufacturer to develop and aggregate large, high-value applications of communications, productive-use applications, or lighting services on a franchise basis.

Virtually all approaches would require development of comprehensive in-country private sector supply networks to install and service systems, and additional mechanisms to deliver credit, lease arrangements, and/or cost reductions to customers. Mixtures of each of these approaches are possible and may provide unique and valuable synergies. For instance, a significant manufacturing capacity in a country could be justified in part by an assured independent power purchase contract, providing the in-country presence, viable utility relationships, and technical capability that would justify using the remainder of the product stream to serve smaller, more dispersed markets. Such an approach could add particular value to a developing country utility seeking solutions for both its grid-connected and rural electrification challenges.

Other approaches, instead of linking with a specific manufacturer, might involve competitive procurement for equipment and services at volume prices to drive down end-user costs.

PV Technology Choices

There are various arguments as to the maturity of different PV technologies for developing world applications. Crystalline and polycrystalline technologies have proven 20-year+ lifetimes demonstrated in harsh environments, and serve nearly all outdoor power applications to date. However, these technologies are relatively material- and capital-intensive, and are relatively mature in terms of manufacturing process. Thin-film technologies serve about one-third of the market (mostly in watches, calculators, and other small consumer devices), but are relatively unproven in the terrestrial applications anticipated in the *PVMTI*. However, there are cogent arguments that thin-film technologies offer vastly greater potential for future cost reductions, and the technology is well enough understood to attract a majority of the R&D and manufacturing investment expected in the near future.

The GEF and IFC are both expected to remain neutral on technology choice, and will evaluate projects on the strength of their individual business plans. It is recognized that the boundary between R&D and operational investment is not a strict one, and that market-driven investment in technical innovation is necessary to avoid "freezing" PV to a particular technology level. The technology chosen will basically be irrelevant to the development of the market as long as prices are acceptable, financial leverage is demonstrated, and the products and systems perform well. The *PVMTI* recognizes that the government and institutional track record of selecting technology winners is not strong, and that ultimately, "the winners may well be technologies that are not yet on the market."⁽¹⁰⁾

Management and Implementation

Pending a positive decision by its senior management, the *PVMTI* is proposed to be implemented and managed largely by the International Finance Corporation (IFC), the private sector affiliate of the World Bank Group. The IFC is the largest multilateral source of financing to private sector investments in developing countries, and can act as an executing agency for GEF funds on behalf of the World Bank. ?

The *PVMTI* initiative is intended to have a strong private sector orientation throughout. The source of project ideas will be the private sector, and the commitment and risk, and formation of consortia and joint-venture teaming will be a private sector responsibility. It makes sense, then, to make this private sector basis consistent by applying private sector management and investment standards as much as possible to move PV towards a full commercial basis. There are several benefits to having the *PVMTI* managed through the IFC:

- **Flexibility** not attainable through the World Bank/GEF project cycle, where project feasibility terms are not necessarily designed to aid commercialization, and avoidance of international procurement guidelines that have hindered similar projects.
- **Leverage** with other private sector sources of investment, including co-financing and possible syndication. While the *PVMTI* awards are grants, IFC is not a grant-making organization and provides a valid commercial perspective from which to evaluate financial proposals and attract and manage other financial sources. The private sector accounts for a high percentage of investment in renewable energy in OECD countries, and venture capital tends to be regionally based; the *PVMTI* incentive and IFC can help attract these and other sources.

- **Speed and efficiency** in evaluating proposals, disbursing funds, and making management decisions, reducing the possibility of delays that would diminish the commercial appeal of the *PVMTI*.
- **Commercial independence** resulting from private sector business activity, avoiding some of the administrative inertia and other problems that have resulted from operating programs through recipient governments.

From the GEF perspective, both long-term interventions and private sector orientations are now seen as key to creating and sustaining greater global environmental benefits than its pilot phase projects. From the IFC perspective, this program has clear-cut developmental objectives, and is aligned both with expansion of financing activities to include small-scale innovative technologies that have future investment promise, and growing ties between IFC's Infrastructure Department's Power Division and the Technical and Environment Department's Environment Division. As an executing agency for private-sector projects eligible for GEF grant funding through the World Bank, the IFC has begun to develop a pipeline of prospective private-sector activities to leverage GEF and other projects, including:

- **Poland Efficient Lighting Project** to encourage dissemination of compact fluorescent lightbulbs in an emerging market through financial incentives and market education via market transformation model (using unit rebates in an approach similar to the Golden Carrot Super-Efficient Refrigerator Program).
- **The GEF-funded Small\Medium Private Sector Enterprise Project** with financial intermediaries, bundling small projects to achieve operational economies of scale on global warming and biodiversity projects that would otherwise be too small for GEF support and IFC co-financing;
- **A \$100-200 million Debt\Equity Fund for Renewables and Efficiency** to invest in renewables as commercially attractive long-term investments. The GEF and IFC are working to determine the best mix of grant and concessionary funds and establish a pipeline of renewable and efficiency investments in order to establish a strategic presence in emerging private power markets while building local technical and financial expertise.

If management and implementation of the *PVMTI* role is undertaken by IFC, its role in management decisions on *PVMTI* grants will mean that it cannot provide direct equity investment for *PVMTI* projects; nor will it be able to make a priori commitments of its capital as debt funds. It would, however, be able to consider providing debt finance to winning projects provided there is at least 50 percent private sector ownership and the venture is operated commercially, and could make nonbinding offers of support for conventional financing on winning projects subject to later validation.

Early Opportunity Notice

It is understood that the *PVMTI* will involve the formation of complex projects that will require both significant corporate decisions and the identification and cultivation of lasting relationships with consortia partners and country government or utility partners where appropriate or desirable. This process will require the investment of both time and money. In addition, the nature of this procurement makes it difficult to envision every potential proposal, and the GEF and IFC have a special interest in avoiding premature or inadvertent exclusion of potential innovative approaches.

To address these concerns, a phased approach is anticipated. This will be accomplished by issuing a broadly defined "early opportunity notice" (EON) to gauge interest in the program and solicit feedback on potential projects and project types, and allow participants to perform some groundwork before the Request for Proposals (RFP) is actually complete. The EON process will also provide opportunities for greater information flow between the IFC as the proposed manager, potential partners, and stakeholders in recipient countries on the magnitude and types of country partnering possible.

Partnering Assistance Component

The success of the *PVMTI* competitive solicitation will be maximized if opportunities to respond are afforded to a broad range of developing country PV players, from local battery manufacturers and systems integrators, to the NGO delivering the PV based energy service through credit financing or leasing schemes. There is a need to provide resources to level the playing field between local developing country actors, in both the private and NGO sectors, and international actors. For this purpose, the World Bank/IFC is preparing a GEF Project Development Facility grant request of approximately \$750,000 to fund a small grant program that will be operated in parallel with the EON. Approximately 15-25 small grants developing country entities are envisioned for business assistance to potential participants, including business planning, proposal preparation, and technical assistance in development of market oriented responses to the *PVMTI*. This service will also provide communication outreach to build awareness among potential respondents on the idea, goals and process before the Request for Proposals is released in early 1997. Preliminary negotiations are underway to solicit additional foundation funding to enhance this approach, and provide additional resources to assist matchmaking between southern and northern players in identifying appropriate entities to with which to partner.

Evaluation Criteria

Criteria for the evaluation and selection of winning proposals will be kept as simple as possible to encourage innovation. Development of these criteria is one of the central tasks involved in developing the program's RFP, and will benefit from information generated through the EON.

Responses to the *PVMTI* RFP will take the form of business plans submitted to the management entity; presumably IFC. For evaluation and scoring, they will be subject to the same financial and technical due diligence IFC uses to evaluate investments of its own funds, and proposals submitted will need to demonstrate an adequate basis for the promised financial and technical performance. Where appropriate, IFC can also evaluate proposals for IFC loan funds along side GEF grant funds.

An additional screen applied to the evaluation of *PVMTI* proposals will address a number of other criteria intended to evaluate acceleration of PV commercialization, progress towards GHG emission reductions, and durability of the GEF intervention. While megawatts of accelerated production or number of systems delivered to end-users remains very relevant to the desired *PVMTI* outcome, gross installations will in themselves have little meaning except in a context of viable applications, market aggregation and density, and lasting mechanisms to transform the institutional and policy setting for future PV dissemination. Some specific factors representing these GEF objectives will include:

- **Sustainability of installations** -- Proposers must show evidence of placing real equity in their venture, and clearly indicate how this equity investment reflects a long-term commitment to building sustainable activities. Manufacturing scale-up should endure beyond the short term market enhancement provided by the *PVMTI* grant. A high degree of ownership and involvement by end-users, as well as the strength of local training, maintenance, and supply capabilities is

expected to contribute heavily to a project's sustainability. Other local upstream and downstream economic benefits will also be considered.

- **Degree of overall market enhancement and replicability** -- Proposals must identify key barriers and how they will be overcome, and should include reference to future replication efforts as an integral part of project execution. The degree of market penetration and leverage will depend to a large degree on the minimization of subsidies, the level of customer payback and regeneration of GEF funds, and the type and scale of partnerships with recipient countries or other entities.
- **Acknowledgement/accommodation of existing PV distribution and sales** -- Overpowering or failing to account for existing PV sales, distribution, and entrepreneurial activities in a country or region is not in the interests of long-term PV market development. While the *PVMTI* recognizes that there will be winners and losers in both manufacturing and country markets, the preference is for wide participation in a competitive process that and carefully considers the role of existing PV market participants in building sustainable markets.

Proposers will also be asked to provide information to assist the GEF in validating the incremental cost eligibility of the grant funds as applied for particular projects. Information required will include a review of the particular barriers faced in the target markets, the level of activity that would likely have been undertaken in the absence of the *PVMTI*, and descriptions of how the project will contribute to sustainable PV commercialization in the country or region. Such incremental cost information is important to ensure that grant-funded activities are new and additional and are not distorting the stream of development benefits that would have otherwise gone to recipient countries.

Timeline -- October 1995 through April 1997

	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A
	c	o	c	a	e	a	p	a	u	u	u	e	c	o	v	e	a	e	a
	t	v	c	n	b	r	r	y	n	l	g	p	t	v	c	n	b	r	r
Concept Development	■	■	■																
IFC Concept Approval				■															
Stakeholder Input				■	■	■	■	■	■	■	■								
Early Opportunity Notice					■	■	■	■	■	■	■	■	■						
Partnering Assistance					■	■	■	■	■	■	■	■	■						
GEF Council Review														■	■				
IFC Mgmt. Review															■	■			
RFP Issued																	■	■	
Bid Evaluation																		■	■
Awards																			■

Disbursement

Disbursement schedules are expected to be specific to each proposal as a function of their business plan and will be subject management review. To assist in capital formation, provide working capital for market development activities, or establish revolving credit facilities, a portion of each grant will be provided up front. Thereafter, disbursements will be made on a performance basis with additional transfers of GEF funds provided in relation to delivery of product, completion of an operational plant, or other significant milestone in developing distribution networks.

Evaluation Phase

Parallel with the development of the RFP, the GEF and IFC will cooperatively develop evaluation criteria for the overall program as well as its sub-project grants, to be applied throughout the period of disbursement and project supervision and at program completion. This evaluation will include analysis of the intervention and its market acceleration impacts, greenhouse gas emissions avoided (both directly and indirectly), other environmental and development benefits, and prospects for replication through follow-on activities.

Conclusion

PV technology and markets are often described in terms of great potential and vast opportunity. But by definition potential and opportunity are not real -- they represent prospective benefits that have not yet been achieved, problems that have not been solved, and challenges that have yet to be overcome. The *PVMTI* is a measured response to helping solve the problems and overcoming the challenges that stand between PV's technical potential and market opportunity and the real benefits which PV can deliver in the form of affordable energy services that improve quality of life, reduce air pollution and greenhouse gas emissions, and spur economic development.

Potential and opportunity also carry risk and uncertainty. The *PVMTI* approach requires a balance between accelerating and distorting PV markets. If *PVMTI* projects only create temporary changes in energy markets and temporary shifts in PV price and performance, it will only succeed in creating false expectations followed by disappointment, which would be worse than not intervening at all. The *PVMTI* must stimulate lasting demand for PV technology; not temporary demand for a GEF subsidy.

The *PVMTI* is a unique attempt to drive technology development and markets through activities in the developing world, and medium to long-term price reductions for PV systems will require both time and sustained market signals. It will be important for the *PVMTI* to accommodate small players and existing market activity, and the scale of the *PVMTI* may fail to include some participants that, for reasons of scale or commercial status, are not ready to participate. But while the *PVMTI* will attempt to minimize setbacks for the losers, it is not expected that winners will "consume" the market; rather, they will pave the way for others to follow.

The success of the *PVMTI* depends on taking advantage of the fact that PV is a technology that is susceptible to improvements through manufacturing scale-up and market aggregation, similar to the Golden Carrot program. It also depends on the fact that there is a vast need for clean and affordable energy in the world -- that is not being met because of financial, bureaucratic and technical barriers that can be changed -- if an incentive structure like the *PVMTI* can encourage accelerated deployment. The necessary elements for success are present in the market and the technology -- the *PVMTI* represents an appropriate catalyst to bring more of PV's potential to fruition.

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