平成 11 年度

(ニューサンシャイン計画)

新エネルギー・産業技術総合開発機構委託業務成果報告書

太陽光発電システム 実用化技術開発
国際協力事業

IEA 太陽光発電プログラム タスク IX に関する情報収集

平成 12 年 3 月

太陽光発電懇話会

（技術開発項目）
太陽光発電システム実用化技術開発
国際協力事業
IEA 太陽光発電プログラムに関する情報収集

太陽光発電懇話会
平成 12 年 3 月　　４１９頁

技術開発目的

IEA 太陽光発電プログラムに関する研究開発、実証、分析情報交換、導入促進等の協力を通じて情報収集を行う。

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I.　ま え が き

Ⅰ．まえがき

ＩＥＡ　タスクⅨはＩＥＡ（国際エネルギー機関）のＰＶＰＳ（太陽光発電システムプログラム）実施協定の下で、国際的な情報交換・調査研究の一環として、タスクⅢの成果の有効利用を図るため、1999/5のＩＥＡ執行委員会にタスクⅨ新設の上程がなされ、承認決定を受けて、正式にタスクⅨの活動がスタートした。

タスクⅨのタイトルは“Deployment of PV Technologies : Co-operation with Developing Countries（開発途上国との協調によるＰＶ技術の普及）”である。

開発途上国に太陽光発電システムを導入する際の技術的・経済的課題について、これまでの経験を生かした推奨ガイド（ＲＰＧs）を取り纏めると共に、モデルとなる開発途上国にてワークショップを開催し、様々な援助機関との連携を図る事を活動目標としている。

本年は５年計画の初年度として、活動目標に基づく基本計画の構築が中心に行われた。即ち　・メンバー（国）の確認　・ワークプランの基本計画立案　・作業区分とその分担（Subtask 10/20/30）　・関連タスク並びに援助機関との連携の在り方等の検討が行われた。

以下に専門家会議（海外）とその対応策を検討する作業部会（国内）における情報収集活動成果を報告する。

II. 成 果 の 概 要

Ⅱ. 成果の概要

1. 和文概要

1.1 目　的

Deployment of PV Technologies : Co-operation with Developing Countries （開発途上国との協調によるＰＶ技術の普及）をタイトルとして、開発途上国に太陽光発電システムを導入する際の技術的・経済的課題について、これまでの経験を生かした推奨ガイドを取り纏めると共に、モデルとなる開発途上国にてワークショップを開催し、様々な援助機関との連携を図ることを目的とする。

1.2 活動内容と期間

主な活動内容は次のテーマとし、調査・分析検討期間は5ヶ年間とされた。

- 開発途上国でのＰＶ導入経験に関する情報収集と分析
- 推奨実践ガイド（Recommended Practice Guides）の作成
- 援助機関との連携、協力
- 開発途上国におけるＰＶシステムの技術的及び経済的な面の検討

1.3 専門家会議等における検討

専門家会議（海外）を２回及び作業部会（国内）を３回開催し、初年度の活動目標に対応した検討を行った（夫々の検討会議についての概要は後述する）。

1.4 まとめ

本年度は５年計画の初年度として、活動目標に基づく基本計画の構築を中心として次の活動を行った。

即ち
- メンバー国（１２ヶ国）及び 機関（２機関）の確認
- ワークプランの基本計画の立案
- 作業区分とその分担(Subtask10/20/30)
- 対象とする開発途上国の選定
- 関連Ｔａｓｋ並びに援助機関との連携の在り方

2.英文概要

Ⅱ. Progress Report

1.Overview in Japanese

1.1 Objective

Under a title of "Deployment of PV Technologies: Cooperation with Developing Countries", it is attempted to compile a recommendation based on the previous experience on the technological and economical problems for introducing the PV systems to developing countries, to organize international workshops and to coordinate the collaboration among supporting organizations.

1.2 Activities and Period

The activities include the following themes, and the period of investigation and analysis was set to 5 years.

・Collection and analysis of information on the experience of PV deployment in developing countries.
・Preparation of a recommended practice guideline.
・Linkage and collaboration with supporting organizations/
・Investigation of technological and economic problems of PV systems in developing countries.

1.3 Examination of Meetings

The Overseas Experts' Meetings were held twice, and the Domestic Working Group's Meetings three times, to discuss on the expected activities for the first fiscal year.
(Summary of these meetings will be reported at II 4 & II 6).

1.4 Conclusion

In fiscal 1999, the first fiscal year of 5-year Task activities, efforts have been concentrated on the build-up of basic plan in line with the target of the Task, involving:

・Registering of 11 member countries.
・Drafting of the basic work plan.
・Division of works and allocation (Subtask 10/20/30).
・Selection of target developing countries.
・Cooperation with related Tasks and supporting organizations.

3．ＩＥＡ　太陽光発電プログラム　タスクIX　作業部会メンバー

リーダー　　　：谷　　隆之［(財) 日本エネルギー経済研究所］

サブリーダー：吉野　量夫［吉野コンサルタント事務所］

メンバー　　　：鳥喰　貞次［シャープ(株)］

　　　　　　　　桜井　勝　［昭和シェル石油(株)］

　　　　　　　　本多　潤一［京セラ(株)］

事務局担当　　：原田　恒久［太陽光発電懇話会］

4．専門家会議について

4．1　第1回　専門家会議［1999/10/14～16 ｵﾗﾝﾀﾞｰﾕﾄﾚﾋﾄ、谷ﾘｰﾀﾞｰ 及び 事務局(原田) 出席］

新タスクの発足に伴う、キックオフ会議として5年間の基本計画を検討した。

・3つの Subtaskを編成し作業を進めることとし、リーダー国を選任した。

－Subtask 10：Deployment Infrastructure （開発基盤）リーダー国：オランダ

－Subtask 20：Support & Co-operation（援助と協力）　リーダー国：スイス

－Subtask 30：Technical & Economic Aspects　　　　リーダー国：日本(暫定)

（発展途上国におけるPVの技術的・経済的状況）

・各リーダーを中心に5年間のワークプランの骨子を作成することを確認した。

4．2　第2回　専門家会議［2000/2/8～9 USA ﾜｼﾝﾄﾝDC、吉野ｻﾌﾞﾘｰﾀﾞｰ 及び 事務局(原田)出席］

・Subtask10/20の作業を効率的に進めるという観点から両Subtask が連携して作成したワークプラン（案）の提案がなされた。

・Subtask30 は日本から暫定リーダー辞退の申入れを行った。
その申入れに伴い、リーダーの希望を募ったが、希望はなく保留となり、OA（運営推進者）を中心に検討する事となった。

・開発途上国における世界銀行の活動状況報告及びタスクIXと世界銀行の連携のとり方についての意見交換が行なわれた。

5．参加国 及び 機関

参加国 及び 機関は現在下記の12ヶ国 及び 2機関である。

・オーストラリア　・カナダ　・デンマーク　・フィンランド　・フランス

・ドイツ　・イタリー　・日本　・オランダ　・スイス　・英国　・米国

・ＵＮＤＰ　・世界銀行

６．作業部会開催状況

６．１　第１回　作業部会（平成11/10/5）

ＮＥＤＯからの委託に伴う、事業内容の説明並びに推進計画の検討を行った。

- ＩＥＡ　ＰＶＰＳ並びにタスクⅨの位置付け等の概要説明。
- テーマ「ＩＥＡ　太陽光発電プログラム　タスクⅨに関する情報収集」
- 事業推進体制の検討と整備を行い、リーダー：谷　隆之(日本エネルギー経済研究所)　及びサブリーダー：吉野量夫(吉野コンサルタント事務所)を選任した。
- 第１回　専門家会議への対応策についての検討を行った。

６．２　第２回　作業部会（平成11/11/12)

- 第１回　専門家会議の報告
- Subtask 30のリーダーとして日本が暫定との条件付きではあるが、第１回　専門家会議の場にて推挙された事を受けてワークプラン（案）の検討を行った。

６．３　第３回　作業部会（平成12/1/19)

- 第２回　専門家会議への対応策の検討
- Subtask 30ワークプラン（案）の見直し
- ＯＡから配布された“Target Country Matrix”に基づく検討
- ＮＥＤＯ“平成１１年度　第１回　ＩＥＡ／ＰＶ対策部会”の報告

III.　本　論

Ⅲ. 本　論

1. 概　要

1.1　経　緯

これまでＰＶＰＳ（Photovoltaic Power Systems）では開発途上国関連の調査はタスクⅢ「独立型及び離島用太陽光発電システムの応用」のＤＣ（Developing Countries）チームが任意の活動として進めてきた。

その活動を基に開発途上国に対しての技術的分野及びＰＶ導入支援策を議論する場として、新たなタスクの設立が提案され、1999/5のＰＶＰＳ執行委員会にて決定された。以上の決定を受け我国においても、ＮＥＤＯ　ＩＥＡプロジェクトの一環としてタスクⅨが新たな事業として取り上げられた。

1.2　事業目的

タイトルは Deployment of PV Technologies : Co-operation with Developing Countries（開発途上国との協調による太陽光発電技術の普及）である。

開発途上国に太陽光発電システムを導入する際の技術的・経済的課題について、タスクⅢ－ＤＣチームの成果等、これまでの経験を生かした推奨策を取り纏めると共に、ワークショップを開催し、各援助機関との連携を図ることを目的とする。

1.3　活動内容と期間

活動内容は大きく次の４項目に区分される。

・開発途上国でのＰＶ導入経験に関する情報収集と分析
・開発途上国の中からモデル国を選定し推奨実践ガイド（ＲＰＧｓ）を作成する
・援助機関との連携、協力を深める調査を行う
・開発途上国における太陽光発電システムの技術的及び経済的な面の検討調査・分析・検討
　期間は5ヶ年間とされた。

1.4　専門家会議（海外）について

1.4.1　第１回　専門家会議［1999/10/14～16 ｵﾗﾝﾀﾞ-ﾕﾄﾚﾋﾄ、谷ﾘｰﾀﾞｰ及び 事務局(原田) 出席］

新タスクの発足に伴う、キックオフ会議であり、ＯＡから５年間の基本計画（案）の説明と意見交換を行い、次の結論を導き出した。

・参加国として次の１１ヶ国の確認が行われた。今後ＯＡを中心に増やす方向にて進めることも確認された。
　オーストラリア、カナダ、デンマーク、フィンランド、フランス、
　イタリア、日本、オランダ、スイス、英国、米国

・３つの Subtaskを編成し作業を進めることとし、リーダーを選任した。

－Subtask 10：Deployment Infrastructure （開発基盤）リーダー国：オランダ

－Subtask 20：Support & Co-operation（援助と協力） リーダー国：スイス

－Subtask 30：Technical & Economic Aspects

（発展途上国におけるPVの技術的・経済的状況）リーダー国：日本（暫定）

・作業計画を進めるにあたって必要とされる総人員の見積もりを行った。

その結果 次の見積もりとなった。

－Subtask 10 110 人･月 (Activity:11-60人･月 12-20人･月 13-30人･月)

－Subtask 20 60 人･月 (Activity:21-45人･月 22-15人･月)

－Subtask 30 40 人･月 (Activity:31-18人･月 32-12人･月 33-10人･月)

合 計 210 人･月

・各リーダーを中心に５年間のワークプラン骨子を作成することを確認した。

・今後の予定

2000年 2月初旬 モロッコ(マラケシュ)

2000年 10月初旬 インドネシア(ジャカルタ)

1．4．2 第２回 専門家会議［2000/2/8～9 USA ﾜｼﾝﾄﾝDC、吉野ｻﾌﾞﾘｰﾀﾞｰ及び事務局(原田)出席］

・Subtask10/20の作業を効率的に進めるという観点から，事前に両 Subtask が連携して作成したワークプラン（案）の提案がなされた。

目的： 開発途上国における太陽光発電の効果的かつ効率的な普及に寄与する

方法： ＰＶプログラムに関する情報の収集

効果的かつ効率的な普及を促進するためワークショップを開催

推奨実施ガイド（ＲＰＧs ）と事例研究をつきあわせ精査する

成果： 関係機関並びにタスク参加国にとって実用的なＲＰＧs の作成

一連のワークショップを通じて、開発途上国の導入意識、理解を深める

・Subtask30 は日本から暫定リーダー辞退の申入れを行った。

その申入れに伴い、リーダーの希望を募ったが、希望はなく保留となり、ＯＡ（運営推進者）を中心にオーストラリア、ドイツ、米国、日本にて検討する事となった。

・開発途上国における世界銀行の活動状況報告及びタスクⅨと世界銀行の連携のあり方についての意見交換が行なわれた。

・今後の予定

2000年 10月28～29日 モロッコ(マラケシュ)

2001年 ２～３月 インドネシア(ジャカルタ)

１．５　作業部会（国内）について

１．５．１　第１回　作業部会（平成11/10/5）

・ＮＥＤＯからの委託に伴う、事業内容の説明並びに推進計画の検討を行った。

　ＩＥＡ　ＰＶＰＳ並びにタスクⅨの位置付け等の概要説明

　テーマ「ＩＥＡ　太陽光発電プログラム　タスクⅨに関する情報収集」

・事業推進体制の検討と整備を行い、リーダー：谷　隆之 氏(日本エネルギー経済研究所)及びサブリーダー：吉野量夫 氏(吉野コンサルタント事務所)を選任した。

・第１回　専門家会議への対応策についての検討を行った。

１．５．２　第２回　作業部会（平成11/11/12）

・第１回　専門家会議の報告

・Subtask 30のリーダーとして日本が条件付き（暫定）ではあるが推挙された事を受けてワークプラン（案）の検討を行った。
基本線はＯＡの提案をベースとして肉付け、調整を行った。

１．５．３　第３回　国内作業部会（平成12/1/19）

・第２回　海外専門家会議への対応策の検討

・Subtask 30ワークプラン（案）の見直し

・ＯＡから配布された“Target Country Matrix”に基づく検討
特に日本サイドから提供出来る見込みの、開発途上国へのＰＶ導入に関する技術データ並びに当該政府機関との接触衝可能性を中心にTarget Country の選定を行った。

・ＮＥＤＯ“平成１１年度　第１回　ＩＥＡ／ＰＶ対策部会”の報告

１．６　平成１１年度　作業部会メンバー

リーダー	：谷　隆之	［（財）日本エネルギー経済研究所］
サブリーダー	：吉野　量夫	［吉野コンサルタント事務所］
メンバー	：鳥喰　貞次	［シャープ㈱］
	桜井　勝	［昭和シェル石油㈱］
	本多　潤一	［京セラ㈱］
事務局担当	：原田　恒久	［太陽光発電懇話会］

IEA PVPS Task IX
Deployment of Photovoltaic Technologies: Co-operation with Developing Countries

STATUS REPORT
March 2000

Report prepared by J.R. Bates and B. McNelis
Operating Agent
(IT Power, The Warren, Bramshill Road, Eversley,
Hampshire RG27 0PR, UK)

Participating Countries

Australia	Italy
Canada	Japan
Denmark	Netherlands
Finland	Switzerland
France	UK
Germany	USA
UNDP	World Bank

SECTION I - ISSUES FOR THE EXECUTIVE COMMITTEE

1. Work Plan

The Task is proceeding to schedule and inputs from the ExCo are not anticipated at this stage.

2. Annex to the Implementing Agreement

The Annex to the PVPS Implementing Agreement has been completed and authorised by the IEA Legal Department in Paris. A copy has been circulated to ExCo members.

3. Relationship with the World Bank

At the last ExCo meeting in Oslo, the ExCo requested a document explaining the function of the World Bank and the Task IX relationship with this organisation. A briefing has been prepared and distributed to ExCo members. Since the last ExCo, the World Bank has established a Consultative Group on PV. Membership is restricted and includes leaders of the PV industry (at CEO level) and multilateral and bilateral donors. The World Bank is responsible for renewable energy in 14 countries totalling 1.5 billion, with $150M in grants from the Global Environment Facility (GEF) projects. The Operating Agent recommends that the ExCo endorse the continued institutional relationship building already underway within Task IX, including active membership of the Consultative Group.

4. Relationship with IEA/REWP

The REWP is developing strategies relating to market deployment, and have shown particular interest in PVPS Task IX. The Operating Agent has been invited to attend the next Working Party Meeting (Madrid 12-14 April). A verbal report will be presented in Quebec.

5. International Conference

At the ExCo meeting in Oslo, the suggestion was made that PV deployment in developing countries would be an important topic for an international conference and that Task IX might initiate such an event once concrete results become available. At the PVPS Executive Conference in Venice in November 1999, Hans Jørgen Koch (IEA, Director Energy Efficiency, Technology and R&D) in his speech suggested another Executive Conference to be held in Japan in 2001. The Operating Agent advises to the ExCo to recommend PV in Developing Countries as the subject, and to consider a developing country as the venue, with the date being 2002.

6. Participation by additional countries

Since the last ExCo meeting, Germany has confirmed its participation. This is welcomed by the Operating Agent.

The 2nd Experts Meeting included an observer from Spain (Emiliano Perezagua, Isofoton). Isofoton is interested to participate in the Task but is not familiar with the procedures for requesting the Spanish signatory to the Implementing Agreement (Iberdrola) to approve participation in Task IX. Guidance is sought.

Clarification of the annual manpower input to Task IX by France is also requested.

7. Website

Task IX has established its website with 2 "interim" addresses:

1 www.ieatask9.org

2 www.task9.pvps.iea.org

The address < www.task9.pvps.iea.org> is identical in format to that proposed by Task III. This format has the advantage that the domain name is <iea.org> so there is no difficulty in reserving domain names for the other tasks (Task III has experienced this problem already). People accessing the site <www.task9.pvps.iea.org> are automatically routed from the IEA server to the existing website address, i.e., <www.ieatask9.org> meaning that further name changes would be unnecessary for all the Tasks.

Task IX will also be pleased to change the address to be in line with a standard form of address and to be integrated with the PVPS main website.

8. Joint publications with external organisations

Task IX was approached by the ASTAE Unit of the World Bank to peer review and endorse a series of PV Quality Manuals with a view to joint publication. Task IX was not able to accept this request due to the short timescale involved and uncertainty about procedures within the PVPS Programme for the publication of documents which are approved by Task IX but not authored by the Task. Clarification on this issue is requested.

1. Task Objectives and Programme

The primary objective of the Task is to further increase the overall rate of successful deployment of PV systems in developing countries. This will be achieved by:

1. development of Recommended Practice Guides based on existing information;
2. promoting improved techno-economic performance of PV in developing countries;
3. identification of areas where further technical research is necessary;
4. exchange of information with, and between, target groups;
5. workshops for, and information exchange with, donor agencies.

The Task IX Workplan was agreed by the ExCo at the meeting in May 1999. The Task has been divided into 3 subtasks:

- Subtask 10: Deployment Infrastructure;
- Subtask 20: Support and Co-operation;
- Subtask 30: Technical and Economic Aspects of PV Systems in Developing Countries.

The programme for Task IX is given in Table 1 below.

Table 1: Task IX Global workplan

TASK	Task Duration																							
	1999				2000				2001				2002				2003				2004			
Task Meetings			■		■		■		■		■		■		■		■		■		■		■	
International Conference: PV in Developing Countries														■										
Subtask 10 Deployment Infrastructure																								
Information Compilation and Analysis			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■						
Preparation of RPGs								■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
Dissemination of RPGs												■	■	■	■	■	■	■	■	■	■	■		
Subtask 20: Support and Co-operation																								
Support to multilateral and bilateral donors and development banks			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
Co-operation with REWP and IEA/OECD			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
Subtask 30: Technical and Economic Aspects of PV in Developing Countries																								
Stand-alone PV Systems							■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
Village Grid and Hybrid Systems							■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
Grid-connected PV Systems							■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

2. Appointment of National Experts

In the period between May 1999 and October 1999, the participating countries were involved in the selection of their respective national experts. Thirteen countries are currently participating in the task. The experts and their affiliations are detailed in Table 2.

Table 2 : National Experts and their Affiliations

COUNTRY	Name	Affiliation	e-mail
Australia	Gordon Thompson	CASE	gthompson@case.gov.au
Australia	Geoff Stapleton	GSES	gses@bigpond.com
Canada	Gerry Collins	CIDA	gerry_collins@acdi-cida.gc.ca
Denmark	Peter Ahm	PA Energy A/S	ahm@paenergy.dk
Denmark	Jean Paul Laude	DANIDA	jealau@um.dk
Finland	Heikki Tikkanen	Fortum AES	heikki.tikkanen@fortum.com
Finland	Heikki Neuvonen	Fortum AES	heikki.neuvonen@fortum.com
France	Jean Loius Bal	ADEME	Jean-Louis.Bal@ademe.fr
France	Hubert Bonneviot	IED	h.bonneviot@ied-sa.fr
Germany	Rolf Posorski	GTZ	rolf.posorski@gtz.de
Germany	Klaus Preiser	Fraunhofer Institute	preiser@ise.fhg.de
Italy	Carlo Zuccaro	ENEL	zuccaro@pal.enel.it
Japan	Takayuki Tani	Institute of Energy Economics	tani@tky.ieej.or.jp
Japan	Eiichi Waki	NEDO	wakieii@nedo.go.jp
Netherlands	Winfried Rijssenbeek	ETC	w.rijssenbeek@etcnl.nl
Switzerland	Alex Arter	ENTEC	alex.arter@entec.ch
UK	Bernard McNelis	IT Power	bmcn@itpower.co.uk
UK	Jonathan Bates	IT Power	jrb@itpower.co.uk
USA	Mark Fitzgerald	ISP	markfitz@pvpower.com

In addition, there are representatives of international agencies engaged in Task IX. These are listed in Table 3.

Table 3: International organisations Experts assigned to Task IX

UNDP	Suresh Hurry	EEAP	
World Bank	Enno Heinjdermans	ASTAE	

3. Experts Meetings

3.1 1st Experts Meeting, The Netherlands

The 1st Experts Meeting was held in Utrecht, The Netherlands on 14th-16th October 1999. The meeting concentrated on refining the workplan for the Task and establishing its modus operandi. An outline of the objectives of the Task and its context within the PVPS Implementing Agreement was presented to the experts. A list of participants is given in Annex 2.

Subtask Leaders were identified for each of the three subtasks.

Subtask 10 led by The Netherlands
Subtask 20 led by Switzerland
Subtask 30 led provisionally by Japan.

The participating countries also agreed their annual manpower commitment to the Task. These are detailed in Table 4 below. A more recent version of this Table is provided in Annex 1.

Table 4: Annual manpower commitment to Task IX by the participating countries[1].

Subtask	***Participating Countries***											
	AUS	CAN	CHE	DEN	FIN	FRA[2]	GBR[3]	ITA	JPN	NLD	USA	Total
Deployment infrastructure	1	1	2		1		2.5	3.5	1	2.5	2.5	17
Support and co-operation	1	2	4 (+3)	4			3		1	0.5	0.5	16
Techno-economic aspects	1						1	2	2			6
Total annual effort	**3**	**3**	**6**	**4**	**1**		**6.5**	**5.5**	**4**	**3**	**3**	**39**

Participants in the 1st meeting are listed in Annex 2.

3.2 2nd Experts Meeting, The USA

The 2nd Experts Meeting was held in Washington DC, USA on 8th-9th February 2000 and was hosted by the ASTAE Unit at the World Bank. The 2nd Experts Meeting concentrated on refining the detailed workplans for Subtasks 10 and 20 and on how to proceed with Subtask 30. Presentations were also given to World Bank and IFC staff on Task IX. Participants are listed in Annex 3.

German participation in Task IX was confirmed at the meeting and Spain also attended as an observer. The meeting was also attended by representatives of the World Bank, UNDP, IEA REWP, the PVPS Executive Committee, the US Department of Energy, PVGAP and the IFC.

Presentations by invited speakers were given to the meeting on:

World Bank SHS Projects: Experiences and Lessons Learned 1993-2000	Erik Martinot
Market Status for Greenhouse Gas Credits	Robert Lee

A technical tour was arranged to the BP Solarex manufacturing facility at Frederick, Maryland.

4. Subtask 10 – Deployment Infrastructure

The overall objective of Subtask 10 is to contribute to overcoming the critical barriers to widespread PV deployment. The central task will involve the preparation of recommended practice guidelines for the deployment requirements of PV.

The Subtask has three activities:

Activity 11: Information Compilation and Analysis
Activity 12: Recommended Practice Guide Preparation
Activity 13: Dissemination and Promotion of Recommended Practice Guides

4.1 Activity 11: Information Compilation and Analysis

This activity will investigate the various strategies for infrastructure development and deployment

[1] At the second experts meeting, Germany confirmed its participation to a level of 3 person-months per year.
[2] At the Task IX Prepartory Workshop, Eversley, UK, October 1998, an indicative commitment of between 6 and 12 person-months per was given.
[3] Exclusive of Operating Agent function.

to ensure widespread and successful implementation of PV. Key issues relating to PV deployment strategies and initiatives will be investigated and collated to provide input to Activity 12.

In order to carry out the surveys, information will be gathered from existing sources and networks (e.g. PRESSEA, the EU White Paper, existing PV suppliers networks, results gathered in the light of IEA PVPS Task III, etc.) and, if necessary, in-country missions may be undertaken. The surveys will collect data on existing schemes and initiatives for each identified subject area. Each survey will be reviewed by the Task experts and then used as input to the corresponding Recommended Practice Guide.

The process of identifying a number of target countries has been initiated. Possible selection criteria include: geographical spread; large potential market; existing market; sustainable market; previous experience; Task III DC Survey Report.

A provisional list of Target Countries was drawn up at the 1st Experts Meeting. Following the meeting a questionnaire was sent to the experts in order to assist with the identification process.

Target countries have been provisionally identified as: Argentina, Brazil, China, Dominican Republic, Ghana, Honduras, Kiribas, Indonesia, India, Morocco, Philippines, South Africa, Vietnam, Zimbabwe.

Following the final identification of the target countries, the following tasks have been defined:

1. *Selection of the countries on basis of defined criteria.*
2. *Priority ranking of selected countries.*
3. *Database set-up for info use.*
4. *Secondary information collection and analysis.*
5. *Starting the country communications.*
6. *Preparation of checklist on required country information.*
7. *Setting out time frame for in-country PV experts to collect information if necessary.*
8. *Information collation and analysis.*
9. *First understanding and lessons learned.*

4.2 Activity 12: Recommended Practice Guide Preparation

Activities 12 and 13 are not scheduled to start until the end of 2000 and the end of 2001 respectively.

However, a framework for the development of the guidelines has been developed and will involve the following actions:

1. Preparation of an experts panel from Task IX and possibly with representation from target groups.
2. Analysis of the country documents to identify relevant lessons learned.
3. First Draft of the guidelines document.
4. Workshop on the draft guidelines with the experts panel to improve it with their comment (preparation).
5. Finalising the guidelines document with the comments and improvements of the expert panel.

Guides relating to the following areas will be collated:

- government policy and RE planning
- financing mechanisms
- institutional development

- training programmes
- operation and maintenance of systems
- certification and accreditation
- systems planning
- infrastructure frameworks
- awareness raising.

Figure 1 represents the relation and information exchange between the different parties

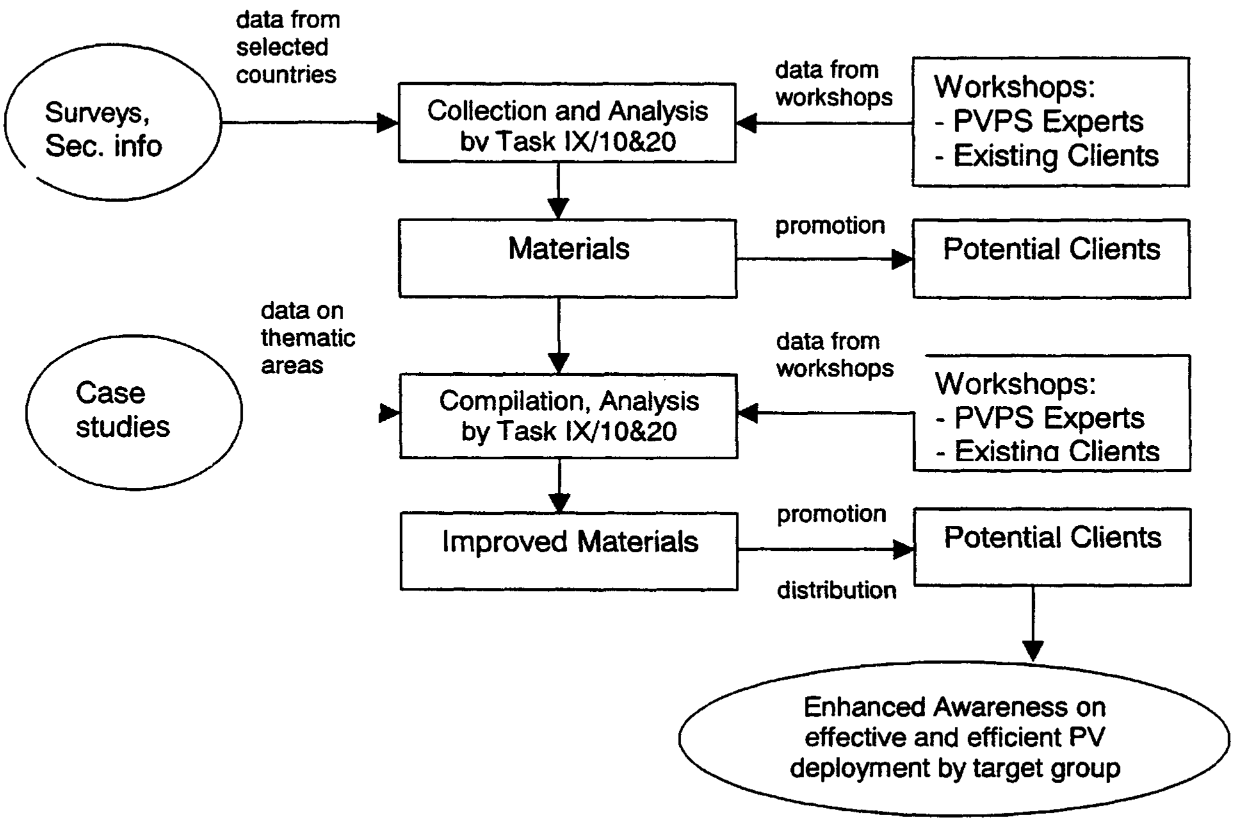


Figure 1 Information exchange strategy:

4.3 Activity 13: Dissemination of Recommended Practice Guides

Activity 13 is not due to start until the end of 2001. However it has been decided that the RPGs will be probably be published over the internet as this is both cost effective and easier than hard-copy publication. It will also facilitate easy and regular updating of the Guides.

5. Subtask 20 – Support and Co-operation

The objective of Subtask 20: is to stimulate awareness and interest amongst the target sectors on the technical and economic potential, social implications, opportunities and best practice of PV systems and to establish a dialogue with multilateral and bilateral agencies and development banks. The objectives will be met through two main areas of activity:

The Subtask has two Activities:

Activity 21: Support to Multilateral and Bilateral Donors and Development Banks
Activity 22: Co-operation with IEA's Renewable Energy Working Party (REWP) and IEA / OECD

The programme of work for each Activity will take the form of:

- Educational seminars and workshops for donor agency, bank and client country staff
- Information and dissemination services including publications
- Review of publications
- Co-operation with the IEA / REWP, IEA / non-member country committee and OECD Secretariats

5.1 Activity 21: Support to Multilateral and Bilateral Donors and Development Banks

Workshops and Seminars

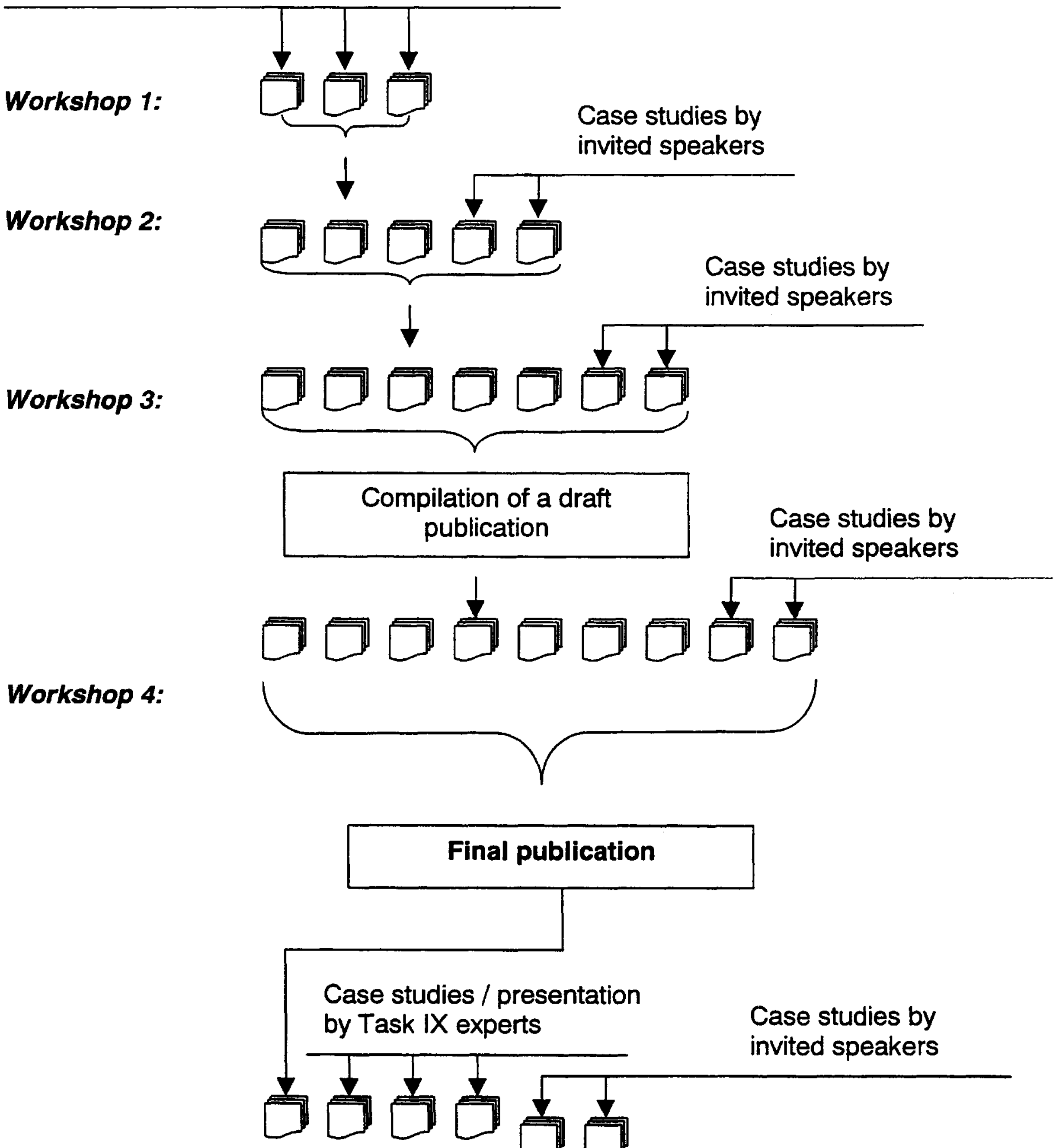
Four workshops are planned over the next four years. The following agencies have been identified as host institutions:

- World Bank Group, Washington
- United Nations Development Programme (UNDP), New York
- Asian Development Bank (ADB), Manila
- Interamerican Development Bank (IDB), in-country-office in a Latin American State
- African Development Bank (AFDB), Abidjan
- European Commission (EC), Brussels

The sequence of the workshops will to be determined according to the availability of staff and any coinciding events at the above locations. The total number of participants should not exceed 50 per workshop otherwise in order to maximise interaction between speakers and participants.

The proposed approach is to structure the planned workshops in such a way that invited speakers with relevant practical experience can bring in their views at the workshop and thus assist the Task IX team in enlarging the know-how and experience in PV technology deployment. Figure 2 illustrates this approach

Case studies / presentation by Task IX experts



The above approach ensures that:

- The cases of a maximum number of projects and programmes are collated and presented without exceeding subtask 20 budgets, and
- The information presented is not a desk work of a few experts but represents the views and experience of the stakeholders at large.

The Qual-PV Manuals

The ASTAE Unit has asked the PVPS Programme and Task IX in particular to review a series of QA manuals and associated training programmes. The ASTAE Unit has funded the development of QA documentation on:

- Quality Management in Photovoltaics: Manufacturers Quality Control Training Manual – (developed by PVGAP)

- Manual for design and modification of solar home system components – (developed by ECN)
- Training Manual for Quality Improvement of Photovoltaic Testing Laboratories in Developing Countries – (developed by FSEC)
- PV Installation and Maintenance Practitioner Certification Infrastructure: Development Procedures – (developed by ISP)

The ASTAE Unit requested that Task IX undertake a peer review of the documents and the training programmes and explore the possibility of replicating the training programmes in countries not covered by ASTAE. The possibility of joint World Bank/PVPS publication was also discussed.

The consensus within Task IX was that there was certainly a need for a quality standard of some kind for World Bank and other programmes and that these manuals went a long way towards addressing this. There was also some discussion as to what the procedures would be in order for the PVPS programme to approve the manuals – this would have to be clarified by the Executive Committee of PVPS.

At the time of the 1st Experts Meeting only the Manufacturers Quality Control Training Manual had been received, and general comments were made on the manual. It was agreed that the replication of training courses was beyond Task IX's remit. The general consensus was that the manual prepared by ECN would be more appropriately reviewed by experts from Task III.

Following the 2nd Experts Meeting and further discussions with the ASTAE Unit, Task IX is to undertake a further review of the manuals prepared by ISP (PV Installation and Maintenance Practitioner Certification Infrastructure: Development Procedures) and FSEC (Training Manual for Quality Improvement of Photovoltaic Testing Laboratories in Developing Countries). These reviews will be undertaken with a view to further developing the manuals by Task IX.

5.2 Activity 22: Co-operation with IEA's Renewable Energy Working Party (REWP) and IEA / OECD

The Renewable Energy Working Party (REWP) oversees the Implementing Agreements on bioenergy, geothermal energy, hydrogen, hydropower, wind turbines, solar heating and cooling, solar thermodynamic power (SolarPACES) as well as PV. The REWP also advises the IEA Committee on Energy Research and Technology (CERT) and other IEA bodies on strategy. A Support Unit has recently been established at IEA Headquarters in Paris, and has appointed Rick Sellers as Administrator. The REWP is paying particular attention to market deployment in developing countries, and therefore has a special interest in PVPS Task IX, as the first IEA task with this objective.

The REWP Chairman (Roberto Vigotti) and Vice Chairman (Alan Hoffman) participated in the 2nd Experts Meeting in Washington.

5.3 Co-operation with Developing Countries

The IEA is developing a policy of co-operation with developing countries. A mechanism by which this can occur within Task IX needs to be identified. The PVPS programme through Task IX is the first Implementing Agreement to address this directly and will therefore needs to be sure of how this can be done effectively. Mechanisms by which this co-operation might be developed were identified as:

- Hold Task meetings in target countries in association with other related events
- Hold workshops in target countries in association with Task meetings
- Target country experts participate in special sessions of Experts meetings
- DC experts to undertake work - assist with surveys etc

6. Subtask 30 - Technical and Economic Aspects of PV Systems in Developing Countries

Following the 1st Experts meeting Japan has confirmed it is unable to lead Subtask 30 although is keen to contribute to the Subtask. In the light of this, a Working Group led by Australia with input from Germany, Japan and the USA has been established to finalise the Workplan for Subtask 30.

7. External Relationships

7.1 Renewable Energy Working Party

The Task III Expert of the Netherlands (Frans Nieuwenhout, ECN) has been nominated as the Task III contact person for Task IX. Winfried Rijssenbeek (NLD) was nominated as the Task IX contact person for Task III. At the 1st Experts Meeting in October 1999, Frans Nieuwenhout, the Task III Expert from the Netherlands gave a presentation to Task IX on the activities of Task III.

Presentations on the status of Task IX have been given to Task III by Jonathan Bates at the Task III Experts meetings in Sweden (September 1999) and Portugal (February 2000).

7.2 Renewable Energy Working Party

Bernard McNelis was nominated as the Task IX contact for the Renewable Energy Working Party. The Operating Agent has been invited to participate in the next REWP meeting in Madrid - 12-14 April 2000. The meeting will include a Round Table on Renewable Energy. Needs Non-Member Countries, and invitations have been sent to Brazil, China, Ecuador, India, Mexico, Morocco, Philippines and Poland. The Task IX Operating Agent will make a presentation on PV market deployment.

7.3 World Bank

The Asia Alternative Energy (ASTAE) Unit

The World Bank has been very supportive of the objectives of Task IX and a positive relationship has been established with the ASTAE Unit, who hosted the 2nd Experts Meeting in February 2000.

The World Bank PV Consultative Committee

Further interaction with the World Bank has been developed through involvement in the World Bank's PV Consultative Committee. The PV Consultative Committee first met on 7th February 2000 and Task IX representatives were invited to take part. The Committee has been set up to facilitate discussion between the PV industry and the World Bank on future PV programmes.

A Working Group is to be set up to further develop the role of this Consultative Committee and its interaction with groups such as Task IX. The Task IX Operating Agent has agreed to serve on this Working Group. The full Consultative Committee will meet next in June/July 2000.

7.4 United Nations Development Programme

The UNDP has been represented at the 1st and 2nd Experts Meeting and provided a very valuable contribution to the meetings. The UNDP has asked Task IX to undertake peer review of a document on financing of renewable energy technologies. This will also act as a test case for developing procedures for undertaking these activities.

7.5 Other Organisations

Discussions have been ongoing with UNEP (United Nations Education Programme). UNEP initially indicated their willingness to participate in the activities of Task IX and nominated an expert, Mark Radka, but he was unable to attend the first two Experts Meetings. UNEP have now announced that they will not join Task IX, but are interested in co-operating with the IEA on renewable energy technologies (ie not PV specific).

Contact has been established with the World Energy Council and Gerry Collins (CAN) has been nominated as the Task IX contact.

The Operating Agent is a member of the PV-GAP Board and facilitates close contact. PV-GAP is currently reviewing its own strategy. The next Board Meeting will be held in Glasgow on 30th April.

7.6 General Promotion

An abstract describing the status of Task IX was submitted to the 16th European Photovoltaic Solar Energy Conference to be held in Glasgow 1-5 May 2000. This was accepted for oral presentation (by J.R Bates).

8. Next planned Task IX Expert Meetings

28-29 September 2000, Marrakech, Morocco

This meeting will be immediately following the GEF workshop on PV to be held in Marrakech 25-27 September.
February/March 2001, Jakarta, Indonesia

Annex 1

PVPS Task IX Workplan
Contribution and effort evaluation in person months
(annual effort of each participating country)

Subtask	***Participating Countries***												
	AUS	CAN	CHE	DEN	DEU	FIN	FRA	GBR[4]	ITA	JPN	NLD	USA	Total
Deployment infrastructure	1	1	2		1.5	1		2.5	3.5	1	2.5	2.5	18.5
Support and co-operation	1	2	4 (+3)	4	1.5			3		1	0.5	0.5	17.5
Techno-economic aspects	1							1	2	2			6
Total annual effort	**3**	**3**	**6**	**4**	**3**	**1**	**TBC**	**6.5**	**5.5**	**4**	**3**	**3**	**42**

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[4] Exclusive of Operating Agent function.

Annex 2

List of Participants at 1st Task IX Experts Meeting, Utrecht, The Netherlands

Country	Representative name		Organisation
Australia	Gordon	THOMPSON	CASE
Australia	Geoff	STAPLETON	GSES
Canada	Gerry	COLLINS	CIDA
Denmark	Peter	AHM	PA Energy A/S
Finland	Heikki	NEUVONEN	Fortum AES
Italy	Carlo	ZUCCARO	ENEL
Japan	Tsunehisa	HARADA	JPEA
Japan	Takayuki	TANI	IEEJ
Netherlands	Winfried	RIJSSENBEEK	ETC
Netherlands	Pim	KIESKAMP	ETC
Switzerland	Alex	ARTER	ENTEC AG
UK	Bernard	MCNELIS	IT Power Ltd
UK	Jonathan	BATES	IT Power Ltd
USA	Mark	FITZGERALD	ISP
	Suresh	HURRY	UNDP

Annex 3

List of Participants at 2nd Task IX Experts Meeting, Washington DC, USA

Country	Representative name		Organisation
Australia	Gordon	THOMPSON	CASE
Australia	Geoff	STAPLETON	GSES
Canada	Gerry	COLLINS	CIDA
Canada	Josef	AYOUB	CANMET-EDRL
Denmark	Peter	AHM	PA Energy A/S
France	Hubert	BONNEVIOT	IED
Germany	Rolf	POSORSKI	GTZ
Germany	Klaus	PREISER	FhG-ISE
Italy	Roberto	VIGOTTI	ENEL
Japan	Tsunehisa	HARADA	JPEA
Japan	Kazuo	YOSHINO	Yoshino Consultant
Japan	Eiichi	WAKI	NEDO
Japan	Yoshiko	YURUGI	NEDO
Netherlands	Winfried	RIJSSENBEEK	ETC
Netherlands	Chris	WESTRA	ECN
Netherlands	Jan	CLOIN[6]	ECN/UNDP
Spain	Emiliano	PEREZAGUA	Isofoton
Switzerland	Alex	ARTER	ENTEC AG
Switzerland	Stefan	NOWAK[5]	NET Ltd for CHE Govt
UK	Bernard	MCNELIS	IT Power Ltd
UK	Jonathan	BATES	IT Power Ltd
USA	Robert	HASSETT	US DOE
USA	Allan	HOFFMAN	US DOE
USA	Mark	FITZGERALD	ISP
USA	Roger	TAYLOR	NREL
	Eric	MARTINOT	World Bank/IEA
	Suresh	HURRY	UNDP
	Enno	HEIJNDERMANNS	ASTAE Unit, World Bank
	Peter	VARADI[6]	PVGAP
	Dana	YOUNGER[6]	IFC
USA	Robert	LEE[6]	AED

[5] 7 February only
[6] 8 February only

IEA PVPS タスク IX

太陽光発電技術の普及：発展途上国との協力

現況報告

2000 年3月

報告書作成: J.R. ベーツ および B. マクネリス （運営委員）
（英国 IT パワー社）

参加国：

オーストラリア	イタリー
カナダ	日本
デンマーク	オランダ
フィンランド	スイス
フランス	英国
ドイツ	米国
国連開発計画（UNDP）	世界銀行

第1章　執行委員会関係

1. 行動計画

タスクはスケジュール通りに動いており、この段階では執行委員会(ExCo)からの情報提供等は期待していない。

2. 実施協定付属書

PVPS 実施協定付属書が完成し、パリの IEA 法務局の承認を得てある。コピーは執行委員会メンバーに配布済み。

3. 世界銀行との関係

前のオスローExCo 会合で、世界銀行の機能およびタスク IX との関係を説明する資料を ExCo が請求している。報告書を作成して ExCo メンバーに配布した。前の ExCo 会合以来、世界銀行は PV に関する諮問グループを設立した。同グループの加入者は PV 業界のリーダー(経営責任者クラス)および多国間・二国間援助機関に限られる。世界銀行は 14 カ国、15 億人のための再生可能エネルギーを担当し、地球環境資金制度(GEF)から＄150M の助成金を提供している。運営委員は ExCo に対して、諮問グループの積極的参加も含めて、タスク IX の中に作られつつある組織関係を引き続き支援するよう勧告している。

4. IEA / REWP との関係

REWP は市場展開に関する戦略を作成しつつあり、PVPS タスク IX に特に関心をもっている。運営委員は次回のワーキングパーティ会合(マドリード、4 月 12〜14 日)に出席するよう招待されている。口頭報告はケベックで発表される予定である。

5. 国際会議

オスローの ExCo 会合では、発展途上国における PV 普及が国際会議の重要課題となり、一旦具体的な結果が得られたら、タスク IX がこの種のイベントを開始すべきであると示唆された。1999 年 11 月ウィーンで開かれた PVPS 実行会議で、ハンス・ヨルゲン・コッホ(IEA、エネルギー効率・技術・研究開発部長)は、報告の中で 2001 年に日本で次回の実行会議を開くことを提案した。運営委員は会議の主題を「発展途上国における PV」とするとともに、開催年を 2002 年に、開催地を発展途上国にするよう ExCo に勧告した。

6. 参加国の追加

前の ExCo 会合以来、ドイツが参加を確約した。運営委員はこのことを歓迎する。

第2回専門家会議にはスペインからエミリアノ・ペレサグア氏（Isofoton社）がオブザーバとして参加した。Isofoton 社はタスク参加に関心を示したが、タスクへの参加承認を得るために、実施協定（Iberdrola）へのスペイン政府の調印を求める手続きが明確でないとのことである。手続き案内を明確にすることが必要である。

フランスからタスク IX に対する年間マンパワー記入の説明も求められている。

7. ウエブサイト

タスク IX は次の 2 つの臨時アドレスを使ってウエブサイトを開設している。

1. www.ieatask9.org
2. www.task9.pvps.iea.org

<www.task9.pvps.iea.org>というアドレスはタスク III が提案しているアドレスと同じ形式である。この形式はドメイン名が<iea.org>になっていて、他のタスクのドメイン名をつけることに何の困難もない。（タスク III はすでにこの問題を経験している。）サイト<www.task9.pvps.iea.org>にアクセスすると、自動的に IEA サーバーを経由して既存のウエブサイト<www.ieatask9.org>にも達する。すなわち、どのタスクもアドレスを変更する必要がないことを意味する。

タスク IX にとっても、アドレスの標準形式に合わせて、PVPS のメインウエブサイトと統合されるように変更することは好ましいことである。

8. 外部機関との共同出版

世界銀行の ASTAE ユニットから、タスク IX に対して、共同出版を目指して一連の PV 品質マニュアルを校閲・支援するようにとの申し入れがあった。時間が十分に得られないこと、およびタスク IX が承認したとはいえ、第 3 者が作成した文書の出版について、PVPS プログラムが OK を出すかわからないということもあって、タスク IX はこの請求に応ずることができなかった。この問題をクリアする必要がある。

第2章　専門家会議関係

1. タスクの目的と計画

タスク IX の主要目的は、発展途上国における PV システム普及の成功率を向上させることである。このために以下の施策が講じられる。

1. 現在の情報を基に「推奨実務ガイド」を作成する。
2. 発展途上国における PV の技術・経済性能の改善を推進する。
3. 技術的研究の継続が必要な分野を確定する。
4. ターゲットグループとの情報交換、およびグループ相互間の情報交換を行う。
5. 支援機関のためのワークショップを開催し、情報交換を行う。

タスク IX の作業計画は 1999 年 5 月の会合で ExCo の承認を受けた。タスクは下記の 3 つのサブタスクに分けられている。

- サブタスク 10:　普及のための基盤構造
- サブタスク 20:　支援と協力
- サブタスク 30:　発展途上国における PV システムの技術的および経済的側面

タスク IX のプログラムを表1に示す。

表 1　タスク IX のグローバル作業計画

タスク	タスク期間																							
	1999				2000				2001				2002				2003				2004			
タスク会合			X		X		X		X		X		X		X		X		X		X		X	
国際会議:発展途上国における PV														X										
サブタスク 10 普及のための基盤構造																								
情報の収集と解析			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
RPG の作成								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
RPG の配布												X	X	X	X	X	X	X	X	X	X	X		
サブタスク 20 支援と協力																								
多国間および二国間支援機関、開発銀行への支援			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
REWP および IEA/OECD との協力			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
サブタスク 30 発展途上国における PV システムの技術的および経済的側面																								
独立型 PV システム							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
村落型系統とハイブリドシステム							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
系統連系 PV システム							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

2. ナショナルエキスパートの任命

1999 年 5 月から 1999 年 10 月までの間に、加盟国はそれぞれのナショナルエキスパートを選任した。現在タスクには 13 カ国が加盟しており、エキスパートの姓名と所属を表 2 に示す。

表 2. ナショナルエキスパートとその所属

国	氏名	所属	e-メールアドレス
オーストラリア	ゴードン・トンプソン	CASE	gthompson@case.gov.au
オーストラリア	ジョフ・ステープルトン	GSES	gses@bigpond.com
カナダ	ゲリー・コリンズ	CIDA	gerry_collins@acdi-cida.gc.ca
デンマーク	ペーテル・アーム	PA Energy A/S	ahm@paenergy.dk
デンマーク	ジャン・ポール・ラウデ	DANIDA	jealau@um.dk
フィンランド	ヘイキ・ティッカネン	Fortum AES	heikki.neuvonen@fortum.com
フィンランド	ヘイキ・ノイヴォーネン	Fortum AES	heikki.neuvonen@fortum.com
フランス	ジャン・ルイ・バル	ADEME	Jean-Louis.Bal@ademe.fr
フランス	ユベール・ボンヌヴィオ	IED	h.bonneviot@ied-sa.fr
ドイツ	ロルフ・ポゾルスキ	GTZ	rolf.posorski@gtz.de
ドイツ	クラウス・プライザー	フランホーファ研究所	preiser@ise.fhg.de
イタリア	カルロ・ズッカロ	ENEL	zuccaro@pal.enel.it
日本	タカユキ・タニ	Institute of Energy Economics	tani@tky.ieej.or.jp
日本	エイイチ・ワキ	NEDO	wakieii@nedo.go.jp
オランダ	ウィンフリート・レイセンベック	ETC	w.rijssenbeek@etcnl.nl
スイス	アレックス・アルター	ENTEC	alex.arter@entec.ch
英国	バーナード・マクネリス	IT Power	bmcn@itpower.co.uk
英国	ジョナサン・ベーツ	IT Power	jrb@itpower.co.uk
米国	マーク・フィッツジェラッド	ISP	markfitz@pvpower.com

このほかにタスク IX に参加している国際機関の代表者がいる。表 3 に示す。

表 3. タスク IX に配属された国際機関のエキスパート

UNDP	スレッシュ・ハリー	EEAP	
世界銀行	エンノ・ハイニダーマンス	ASTAE	

3. 専門家会議

3.1 第1回専門家会議(オランダ)

第1回専門家会議は1999年10月14～16日、オランダ国ユトレヒトで開催された。同会議は、タスクの作業計画の精査および運営方法の確立に集中した。タスクの目的とPVPS実施協定の中での文脈が専門家に提示さえた。

3つのサブタスクのリーダー国が決められた。

サブタスク10　オランダ
サブタスク20　スイス
サブタスク30　日本

参加国はタスクに対する年間マンパワー提供についても合意した。その詳細を表4に示す。表4の新しいバージョンを付録1に示す。

表4. 参加国からタスクへの年間マンパワー提供

サブタスク	参加国											
	AUS	CAN	CHE	DEN	FIN	FRA[2]	GBR[3]	ITA	JPN	NLD	USA	Total
普及のための基盤構造	1	1	2		1		2.5	3.5	1	2.5	2.5	17
支援と協力	1	2	4 (+3)	4			3		1	0.5	0.5	16
技術的・経済的側面	1						1	2	2			6
年間合計	3	3	6	4	1		6.5	5.5	4	3	3	39

第1回会議の参加者は付録2に示す。

3.2 第2回専門家会議(米国)

第2回専門家会議は2000年2月8～9日に米国ワシントンD.C.において、世界銀行ASTAEユニットの主催で開催された。第2回専門家会議の論議は、サブタスク10および20の詳細作業プランの検討と、サブタスク30の進め方に集中した。世界銀行およびIFCスタッフに対して、タスクIXの解説も行われた。参加者リストは付録3に記してある。

この会議でタスクIXへのドイツの参加が確認され、スペインもオブザーバとして参加した。会議には、世界銀行、UNDP、IEA REWP、PVPS実行委員会、米国エネルギー省(DOE)、PVGAPおよびIFCの代表も出席した。

下記の招待講演も行われた。

「世界銀行 SHS プロジェクト：1993～2000 年に得られた経験と教訓」　エリク・マルティノー
「温室効果ガスクレジットの市場現況」　ロバート・リー

メリーランド州フレデリック市の BP ソラレックス製造設備の工場見学も実施した。

4. サブタスク 10 － 普及のための基盤構造

サブタスク 10 の全般的目的は、PV の広範囲な普及に対する重大な障碍克服に貢献することである。中核課題は PV 普及条件に対する推奨実務ガイドラインを作成することである。

サブタスク 10 には次の 3 つのアクティビティが含まれる。

アクティビティ 11： 情報の収集と解析
アクティビティ 12： 推奨実務ガイドの作成
アクティビティ 13： 推奨実務ガイドの配布と推進

4.1 アクティビティ 11： 情報の収集と解析

このアクティビティでは、PV の広範囲かつ成功裏の実現を確実にするため、基盤構造の開発・展開について、各種の戦略を調査する。PV の普及戦略および構想に関する重点課題を調査・照合して、アクティビティ 12 に対し情報を提供する。

この調査を行うために、既存の情報源やネットワーク（たとえば、PRESSEA、EU 白書、PV サプライヤのネットワーク、IEA PYPS タスク III で集められた成果など）から情報を収集し、必要があれば国内調査を実施する。この調査では、それぞれの確立された分野について既存のスキームや構想に関するデータを収集する。各調査結果はタスク専門家の評価を受け、対応する推奨実務ガイドに対する情報として用いられる。

ターゲット国を決めるプロセスが開始された。選定基準としては、地理的な広がり、大きな市場ポテンシャル、既存の市場、持続可能な市場、以前の経験、タスク III の PV 調査報告などがあげられる。

第1回専門家会議でターゲット国の暫定リストが作成された。この会議の後で、専門家にアンケートを送り、選定の参考にした。

現在ターゲット国に指定されているのは、アルゼンチン、ブラジル、中国、ドミニカ共和国、ガーナ、ホンジュラス、キリバス、インドネシア、インド、モロッコ、フィリピン、南アフリカ、ベトナム、ジンバブエの 14 ヶ国である。

ターゲット国の最終選定に続いて、下記の作業が選定された。

1. *決められた基準に従って国を選ぶ。*
2. *選ばれた国に優先順位を与える。*
3. *情報活用のためにデータベースを構築する。*
4. *二次的情報の収集と解析。*
5. *対象国との交渉開始。*
6. *必要な国情報のチェックリスト作成。*
7. *国内のPV 専門家が情報収集するためのスケジュール設定。*
8. *情報の照合と解析。*
9. *最初の理解と得られた教訓。*

4.2 アクティビティ 12: 推奨実務ガイドの作成

アクティビティ 12 およびアクティビティ 13 は、それぞれ 2000 年末および 2001 年末に開始されるようにスケジュールが決められている。

しかし、ガイドライン作成の予定表が決められ、その中には次のような行動が含まれている。

1. タスク IX の専門家パネルを作り、できればターゲットグループの代表者も含める。
2. 各国の文書資料を解析して関連教訓を引き出す。
3. ガイドライン文書の第一草稿。
4. 専門家パネルとガイドライン案に関するワークショップを開き、彼らのコメントを考慮して改訂する。(準備中)
5. 専門家パネルの意見や改訂案を取り入れて、最終稿を作成する。

下記の分野に関するガイドを照合する。

- 政府の政策と再生可能エネルギー企画。
- 資金調達メカニズム。
- 制度の開発。
- 研修プログラム。
- システムの運用と保守。
- 証明書と信用状。
- システム企画。
- 基盤構造フレームワーク。
- 意識の高揚。

図1は各当事者の間の関係と情報交換を示す。

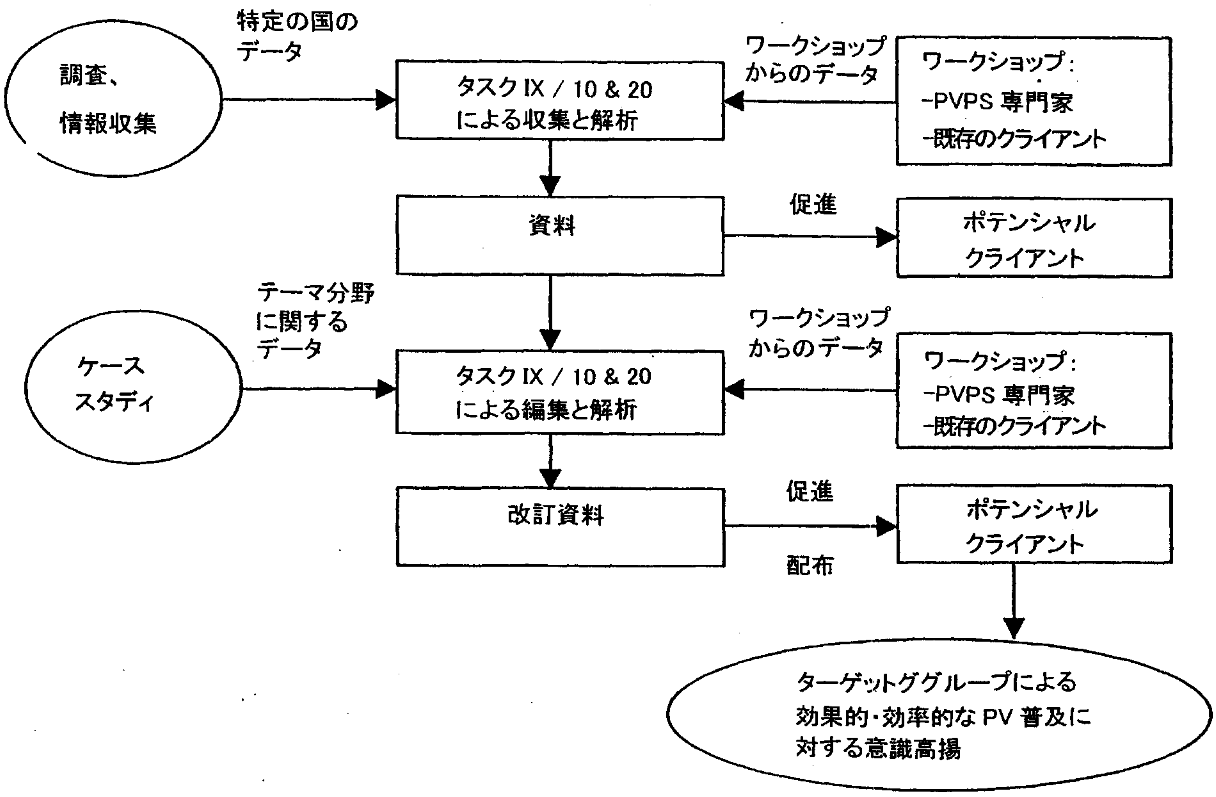


図 1. 情報交換の戦略

4.3 アクティビティ 13： 推奨実務ガイドの配布と推進

アクティビティ 13 は 2001 年末までは開始されないことになっている。しかし、推奨実務ガイドはインターネットを通じて発表されることに決まっている。この方が紙による出版よりもコスト効果が優れているからである。またこれによりガイドの更新が容易になり、定期的な更新も可能になる。

5. サブタスク 20 － 支援と協力

サブタスク 20 の目的は、ターゲットセクターの間に PV システムの技術・経済ポテンシャル、社会的意義、機会および最良実務に対する意識と関心を刺激し、多国間および二国間支援機関や開発銀行との対話を確立することである。目的の達成には 2 つの主要アクティビティが実行される。

サブタスク 20 のアクティビティは：

アクティビティ 21： 多国間および二国間支援機関や開発銀行への支援
アクティビティ 22： IEA の再生可能エネルギー作業部会（REWP）および IEA / OECD との協力

各アクティビティの作業プログラムは下記の形を取る。

- 支援機関、銀行、クライアント国のスタッフに対する教育セミナーおよびワークショップ。
- 刊行を含む情報・普及サービス。
- 刊行物の検討。
- IEA / REWP、IEA/非加盟国委員会および OECD 事務局との協力。

5.1 アクティビティ 21： 多国間および二国間支援機関や開発銀行への支援

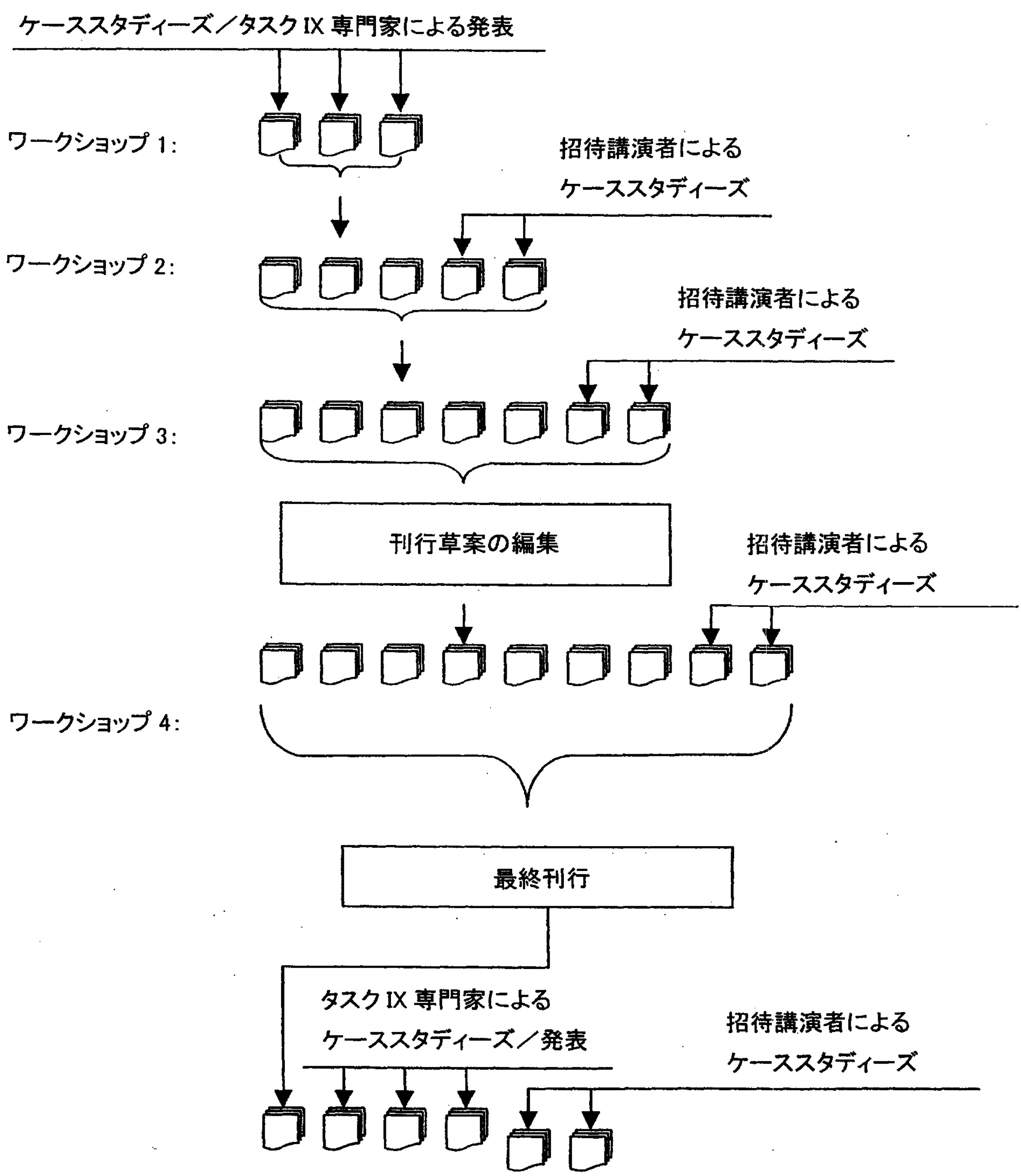
ワークショップとセミナー

これから 4 年間に 4 回のワークショップが企画されている。主催組織として下記の機関が決められている。

- 世界銀行グループ（ワシントン）
- 国連開発計画（UNDP、ニューヨーク）
- アジア開発銀行（ADB、マニラ）
- 国際開発銀行（IDB）、ラテンアメリカ国の国内オフィス
- アフリカ開発銀行（AFDB、アビジャン）
- ヨーロッパ委員会（EC、ブリュッセル）

ワークショップの開催順序については、上記予定地のスタッフの都合や同時進行行事の有無などにより決まる。スピーカーと参加者との間に十分な対話が得られるように、1 回のワークショップの参加者は 50 名までとする。

提案したアプローチでは、関連した実務経験をもつ招待講演者が、ワークショップでその見解を披露し、タスク IX のチームが PV 技術普及のノウハウや経験を拡張するのを支援するように、ワークショップが組織される。このアプローチを図 2 に示す。



上記のアプローチにより下記の事柄が保証される。

- サブタスク 20 の予算を超えることなく、最大数のプロジェクトやプログラムのケーススタディーズを照合・発表する。
- 発表される情報は少数の専門家によるデスクワークではなく、利害関係者全体の見解や経験を代表するものである。

Qual-PV マニュアル

ASTAE ユニットは PVPS プログラムおよびとくにタスク IX に、一連の QA マニュアルや関連研修プログラムを見直すよう求めている。ASTAE ユニットは下記に関する QA 文書の作成に資金を提供している。

- 太陽光発電技術における品質管理:製造業者の品質管理マニュアル(PVGAP が作成)
- ソーラーホームシステム部品の設計および変更のマニュアル(ECN が作成)
- 発展途上国における太陽光発電試験機関の品質改善研修マニュアル(FSEC が作成)
- PV の設置・保守施行業者証明基盤構造:開発手順(ISP が作成)

ASTAE ユニットはタスク IX に文書および研修プログラムの査読、ASTAE がカバーしていない国の研修プログラムを複製する可能性を探るよう要請した。世界銀行と PVPS との共同出版の可能性も討議された。

タスク IX 内部の合意によれば、世界銀行やそのほかのプログラムにとって、ある種の品質基準を設けることが必要であり、これらのマニュアルがこの目標に向かっての大きな前進となることは確かである。PVPS プログラムがマニュアルを承認するためには、どんな手順が必要かという点にも論議がある。この問題は PVPS の ExCo が解決すべきである。

第 1 回専門家委員会では、製造業者品質管理研修マニュアルが提出され、マニュアルについて一般的なコメントが述べられた。研修コースを複製することはタスク IX の業務外であるということに合意された。ECN が作成したマニュアルの査読は、タスク III で行うのが適当であるという点で、意見が一致している。

第 2 回専門家委員会および ASTAE ユニットとの継続論議に引き続き、タスク IX は ISP が作成したマニュアル(PV の設置・保守施行業者証明基盤構造:開発手順)および FSEC が作成したマニュアル(発展途上国における太陽光発電試験機関の品質改善研修マニュアル)の査読を続けることになった。これらの作業はタスク IX によるマニュアルを発展させるという見地から実施される。

5.2 アクティビティ 22: IEA の再生可能エネルギー作業部会(REWP)および IEA/OECD との協力

再生可能エネルギー作業パーティ(REWP)は、バイオエネルギー、地熱エネルギー、水素、水力発電、風力発電、太陽熱利用冷暖房、太陽熱力学発電(ソーラーPACES)および PV に関する実施協定を監督している。REWP は IEA のエネルギー研究・技術委員会(CERTI)およびその他の IEA 戦略関連機関に勧告を行っている。最近になって、パリの IEA 本部に支援ユニットが設置され、リック・セラーズが責任者に任命された。REWP は発展途上国における市場展開に特別な関心をもち、この問題に関する IEA 最初のタスクである PVPS タスク IX に強い注目を払っている。

REWP の座長ロベルト・ヴィゴッティと副座長アラン・ホフマンは、ワシントンの第 2 回専門家会議に出席した。

5.3 発展途上国との協力

IEA は発展途上国との協力政策を展開している。タスク IX の範疇内でこれを実現できる仕組みを確認しなければならない。タスク IX を介した PVPS プログラムは、直接これに携わる最初の実施協定であり、効果的な実施法を確立する必要がある。この協力関係を発展させる仕組みとしては次の手段があげられる。

- ターゲット国において他の関連行事と併せてタスク会合を開く。
- ターゲット国においてタスク会合と併せてワークショップを開く。
- ターゲット国の専門家に専門家会議の特別セッションに出席してもらう。
- 発展途上国の専門家が作業に参画し、調査の支援を行う等。

6. サブタスク 30 － 発展途上国における PV システムの技術的および経済的側面

第 1 回専門家会議の後で、日本はサブタスクに寄与する意向は十分にあるが、サブタスク 30 を主催することはできないと表明した。そこで、オーストラリアをリーダーとして、ドイツ・日本・米国の参加を求めて、作業グループを作りサブタスク 30 の作業プランを決定することになった。

7. 外部との関係

7.1 再生可能エネルギー作業パーティ

オランダのタスク III 専門家フランス・ニューウェンホウト(ECN)が、タスク III の対タスク IX コンタクトパーソンに任命された。またウィンフリート・レイセンベーク(NLD)がタスク IX の対タスク III コンタクトパーソンに任命された。1999 年 10 月の第 1 回専門家会議で、オランダのタスク III 専門家フランス・ニューウェンホウトはタスク III のアクティビティについてタスク IX に報告した。

タスク III に対するタスク IX の現状報告は、スウェーデン(1999 年 9 月)およびポルトガル(2000 年 2 月)のタスク III 専門家会議で、ジョナサン・ベーツが行った。

7.2 再生可能エネルギー作業パーティ

タスク IX の対再生可能エネルギー作業パーティコンタクトパーソンには、バーナード・マクネリスが任命された。運営委員は 2000 年 4 月 12～14 日にマドリードで開かれる次回の REWP 会合に参加するよう招聘された。この会合には再生可能エネルギー円卓会議も併催され、ブラジル・中国・エクアドル・インド・メキシコ・モロッコ・フィリピンおよびポーランドが招待された。タスク IX の運営委員は PV 市場の展開について報告した。

7.3 世界銀行

アジア代替エネルギー(ASTAE)ユニット

世界銀行はタスク IX の目的に極めて協力的で、ASTAE ユニットとは積極的な協力関係が結ばれ、同ユニットは 2000 年の第 2 回専門家会議を主催した。

世界銀行 PV 諮問委員会

さらに世界銀行 PV 諮問委員会に参加することにより、世界銀行との関係がさらに進められた。PV 諮問委員会の第 1 回会合は 2000 年 2 月 7 日に開催され、タスク IX の代表も参加するよう招待された。この委員会は将来の PV プログラムについて PV 産業と世界銀行との間の討議を進めるために設置された。

この諮問委員会およびそれとタスク IX のようなグループとの対話を進めるために作業グループが設立された。タスク IX の運営委員は諮問委員会に参加することに合意した。諮問委員会の次回会合は 2000 年 6 月ないし 7 月に予定されている。

7.4 国連開発計画(UNDP)

UNDP は第 1 回および第 2 回の専門家会議に出席し、両会議の成功に極めて大きな貢献をした。UNDP はタスク IX に再生可能エネルギー技術の財政支援に関する文書を査読するよう要請した。このことは、この種のアクティビティを実施するための手順を決めるためのテストケースになるだろう。

7.5 その他の組織

国連教育計画(UNEP)との討議が進行中である。UNEP は当初タスク IX のアクティビティーズに参加する意向を示し、専門家マーク・ラドカを推薦した。しかしラドカは第 1 回および第 2 回の専門家会議には出席できなかった。UNEP はタスク IX には参加しないが、再生可能エネルギー技術に関して IEA と協力することにはやぶさかではないと表明している(すなわち PV には限定しないという意味である)。

世界エネルギー協議会との関係も成立し、対タスク IX コンタクトパーソンにゲリー・コリンズ(CAN)が任命された。

運営委員は PV-GAP 委員会の委員であり、連絡を密にする上で役に立っている。PV-GAP は現在自身の戦略を再検討している。次回の委員会は 2000 年 4 月 30 日にグラスゴーで開催される予定である。

7.6 一般促進

タスク IX の現状を記述するアブストラクトは、2000 年 5 月 1～5 日に開催される第 18 回ヨーロッパ

太陽光発電ソーラーエネルギー会議に提出され、口頭発表として受理された(J. R. ベーツが発表する予定)。

8. タスクIX専門家会議次回予定

モロッコ国マラケシュ市 2000年9月28～29日。

この会合は9月25～27日のPVに関するGEFワークショップに直ぐ引き続いて開催される。
インドネシア国ジャカルタ市 2001年2/3月。

付録 1

PVPS タスク IX の作業計画

人力提供および努力の評価（人月）

（各参加国の年間提供努力）

サブタスク	***参加国***												
	オーストラリア	カナダ	チェコ	デンマーク	ドイツ	フィンランド	フランス	英国	イタリア	日本	オランダ	米国	合計
普及の基盤構造	1	1	2		1.5	1		2.5	3.5	1	2.5	2.5	18.5
支援と協力	1	2	4 (+3)	4	1.5			3		1	0.5	0.5	17.5
技術・経済側面	1							1	2	2			6
年間努力の合計	**3**	**3**	**6**	**4**	**3**	**1**	TBC	**6.5**	**5.5**	**4**	**3**	**3**	**42**

付録 2

第 1 回タスク IX 専門家会議参加者リスト(オランダ国ユトレヒト市)

国名	代表者名	所属
オーストラリア	ゴードン・トンプソン	CASE
オーストラリア	ジョフ・ステープルトン	GSES
カナダ	ゲリー・コリンズ	CIDA
デンマーク	ペーテル・アーム	PA エネルギーA/S
フィンランド	ヘイキ・ノイヴォーネン	フォータム AES
イタリア	カルロ・ズッカロ	ENEL
日本	ツネヒサ・ハラダ	JPEA
日本	タカユキ・タニ	IEEJ
オランダ	ウィンフリート・レイセンベック	ETC
オランダ	ピム・キースカンプ	ETC
スイス	アレックス・アルター	ENTEC AG
英国	バーナード・マクネリス	IT パワー社
英国	ジョナサン・ベーツ	IT パワー社
米国	マーク・フィッツジェラッド	ISP
	スレッシュ・ハリー	UNDP

付録 3

第 2 回タスク IX 専門家会議参加者リスト(米国ワシントン市)

国	氏名	所属
オーストラリア	ゴードン・トンプソン	CASE
オーストラリア	ジョフ・ステープルトン	GSES
カナダ	ゲリー・コリンズ	CIDA
カナダ	ジョセフ・アユーブ	CANMET-EDRL
デンマーク	ペーテル・アーム	PA エネルギーA/S
フランス	ユベール・ボンヌヴィオ	IED
ドイツ	ロルフ・ポゾルスキ	GTZ
ドイツ	クラウス・プライザー	FhG-ISE
イタリア	ロバート・ヴィゴッティ	ENEL
日本	ツネヒサ・ハラダ	JPEA
日本	カズオ・ヨシノ	ヨシノコンサルタンツ
日本	エイイチ・ワキ	NEDO
日本	ヨシオ・ユルギ	NEDO
オランダ	ウィンフリート・レイセンベック	ETC
オランダ	クリス・ウェストラ	ECN
オランダ	ヤン・クロイン[6]	ECN/UNDP
スペイン	エミリアノ・ペレサグア	イソフォトン
スイス	アレックス・アルター	ENTEC AG
スイス	シュテファン・ノワック[5]	チェコ政府を代表して NET Ltd.
英国	バーナード・マクネリス	IT パワー社
英国	ジョナサン・ベーツ	IT パワー社
米国	ロバート・ハッセット	US DOE
米国	アラン・ホフマン	US DOE
米国	マーク・フィッツジェラツド	ISP
米国	ロジャー・テイラー	NREL
	エリク・マルチノー	世界銀行/IEA
	スレッシュ・ハリー	UNDP
	エンノ・ヘインダーマンス	世界銀行 ASTAE ユニット
	ペテル・ヴァラディ[6]	PVGAP
	ダナ・ヤンガー[6]	IFC
米国	ロバート・リー[6]	AED

[5] 2 月 7 日のみ　　[6] 2 月 8 日のみ

３． 専門家会議

３．１　第１回　専門家会議

３．１．１　委員出張報告

・出張報告書　１）　Status Report Presentation to Ex. Co.
・資 料　２）　ＰＶ in Japanese ＯＤＡ
３）　Ｔａｓｋ IX
Deployment of PV Technologies:
Co-operation with Developing Countries ＷＯＲＫＰＬＡＮ

３．１．２　議事録

１）　ＩＥＡ ＰＶＰＳ
Ｔａｓｋ IX
Development of PV Technologies:
Co-operation with Developing Countries
1st Experts Meeting ＭＩＮＵＴＥＳ
２）　同　上　(翻訳版)

３．２　第２回　専門家会議

３．２．１　委員出張報告

・出張報告書
・資 料　１）　Presentation Paper by Jonathan Bates
２）　SUBTASK 10 & 20 ＷＯＲＫＰＬＡＮ
３）　同　上　(翻訳版)
４）　World Bank Solar Home Systems Projects:
Experience & Lesson Learned (1993-2000)
５）　同　上　(翻訳版)

３．２．２　議事録

ＩＥＡ ＰＶＰＳ
Ｔａｓｋ IX
Deployment of PV Technologies:
Co-operation with Developing Countries
2nd Experts Meeting ＭＩＮＵＴＥＳ (Ｄｒａｆｔ)

International Energy Agency Photovoltaic Power Systems Programme
Task IX
Deployment of Photovoltaic Technologies: Co-operation with Developing Countries

キックオフミーティング報告

日時：1999年10月14日～16日

場所：オランダ国ユトレヒト市 Jaarbeur Conference Center

参加者：

UK	It Power Ltd.	Bernard McNelis
UK	It Power Ltd	Jonathan Bates
Australia	CASE	Gordon Thompson
Australia	Global Sustainable Energy Solution Pty	Geoff Stapleton
Canada	CIDA	Gerry Collins
USA	Institute for Sustainable Power, Inc.	Mark Fitzgerald
Japan	JPEA 太陽光発電懇話会	原田 恒久
Japan	IEEJ (財)日本エネルギー経済研究所	谷 隆之
Netherlands	ETC	Winfried Rijssenbeek
Netherlands	ETC	Pim Kieskamp
Denmark	PA Energy A/S	Peter Ahm
Italy	ENEL	Carlo Zuccaro
Switzerland	Entec	Alex Arter
Finland.	Fortum Power and Heat Oy	Heikki Neuvonen
UNDP	Energy and Atmosphere Programme	Suresh Hurry

議事内容：第1日(10月14日(木))

1. Welcome Speech by host： Mr. Wim. Van Nes of Netherands Agency for Energy and
   Environment (Novem)
2. Brief Introductions： 各自簡単な自己紹介
3. Background to, and development of, Task IX：B McNelis
   Task-IXを設定するに至った経緯をMcNelisが簡単に説明、UKにおけるスポンサーはDTI,DFID、Shell Solar、BPSolarex、Labcraftであった。
4. Presentation of country experiences and activities:各国の開発途上国に対するPV、REの開発協力の状況を説明

1) Australia:Indonesia の SHS 36,000、PNG にも積極的にアプローチ、Rural Poverty Alleviation Program
2) Canada：Canadian International Development Agency の紹介、PV にはあまり積極的でない
3) Denmark：DANCED(Danish Cooperation for Environment & Development)

Program の紹介、Nepal に SHS 30, 000～40, 000, Malawi に GEF Project と共同で 10, 000 の計画がある

4) Finland：East Africa をターゲットカントリーとしている

5) Italy：政府としては最近特に大きなプロジェクトを行なっていない。E-7 のメンバーとしてインドネシアのハイブリッドシステムに関与。Algeria で PV の村落電化を行なったが利用者には満足されなかった。

6) Japan：JICA,NEDO の PV を利用した開発途上国におけるプロジェクトの紹介、JICA が今春作成した再生可能エネルギー開発プロジェクトの紹介ビデオは第 2 日に紹介した。

7) Netherland：政府が積極的に PV の途上国利用を後押ししている。Solar Investment Fund の創生、Novem, SENTER, DGIS などの組織が関与している。PPP-JI にも RE を取り入れる

8) Switzerland：SDC(Swiss Development Corporation)、SECO(State Secretariat for Economic Affairs)などが AIJ のパイロットプログラムを計画中。AMTRAC が改組した、ASEAN Centre for Energy(Jakarta)をサポートしている

9) U.K.：政府は開発途上国に対する再生可能エネルギーの開発協力に積極的でない。(It Power)　国内では NFFO(Non Fossil Fuel Obligation)などで支援している。

5. Subtask 1 – Deployment Infrastructure

1) Identification of subtask leader：Netherlands がリーダーの意思表示を行ない、欠席しているが USA もその意志があったとのことで、本日中に電話で打ち合せを行ない決定する事とした。（希望どうりオランダ ETC が SubTask10 のリーダーに決定）

2) Detailed workplan and organization of subtask：Task の内容が Workplan により説明があった。主目的はいくつかの対象国を選定し、その国に PV を導入するためのガイドライン(プラン)を作成する事にある。対象国はいくつか候補国を挙げて絞り込む事とした。マン・マンスの予定(5 年間で 110)が示されたが、後程他のサブタスクも併せて調整する事とした。

6. Subtask 2 – Support and Co-operation

1) Identification of subtask leader：Swiss がリーダーに意思表示を行ない、U.K.も事前に意思は示していたが、希望どうり Swiss がリーダーとなった

2) Detailed workplan and organization of subtask：Workplan の説明、開発途上国における Workshop の開催がメインタスクになる。マン・マンスについては ST10 に同じ(5 年間で 60 を予定)

議事内容：第 2 日(10 月 15 日(金))

7. Subtask 3 – Techno-economic aspects

1) Identification of subtask leader：希望国として意思表示する国が無く、McNelis か

らNEDOの今野氏がST30のリーダーに日本がなる用意があると言っていたとのコメントがあり、SwissのAlexからもUSAは日本がリーダーをやるべきと推薦しているとのコメントがあったので、引き受けざるをえなくなった。記録上はProvisionalとして記載されている。

2) Detailed workplan and organization of subtask : Workplanの説明があったがPVPS Task－IIIやTask-Vとの協力が必要となる部分が多い。期間は他のサブタスクと同じ5年間とし、予定マン・マンスは40程度

8. Future Subtasks

Task-IXでCDMやAIJを開発途上国にPVを取り入れるための手段として活用するためのガイドラインを作成してはどうかの提案であったが、Finlandからまだ時期尚早であり、現在のTaskを軌道に乗せてから検討しようとの意見が出され見送られた。

9. Co-operation with Developing Countries and Experts

開発途上国との共同作業を実現する方法について検討、途上国で開催される再生可能エネルギー関連の会議やWorkshopを利用する事や、Task-IXのミーティングを途上国で開催し近隣の途上国の専門家や関連部門の参加を推進する事で行なうこととなった。まず次回のミーティングはUNDP/GEFがモロッコのMarrakechで行なうWorkshopに隣接して開催する。さらにその次はJakartaのACE(ASEAN Centre for Energy)似て行なう予定となった。

10. Co-operation with Task III : by Mr. Francis Nieuenhout (ECN)

Task-IIIはStand-AloneシステムとIsland Applicationシステムの件とうを行なう事となっており、1999から2003のWorkplanとしてST-1がQuality Assurance、ST-2がTechnical Issues(Hybrid system、Storage and Load-management)となっている。

コンタクトルートはECNとECT(ともにオランダ)の間で行なう事が可能で有る。

QAのマニュアルはWBのASTAEが行なっており、

QA for ManufacturerがPV-GAP、Design of electronic BOS components がECN、QA for Testing LaboratoryがFSC、そしてQA for Training ProgrammesがISPの担当で準備されつつある。

11. Co-operation with Task I : Mr. Peter Ahm (CIDA)

Task-Iの内容説明でどのようなデーター、情報を集めているかの説明があり また、その情報へのアクセスの方法と、Task-IXについて情報伝達の方法について打ち合わせ、Task-IXも独自のホームページ(Website)を持ちそこへ各自アクセスする事により情報の共有化を行なう。

12. Review of World Bank QA documents and publication, training programmes and replication

次のDiscussion of PVGAP manual – preparation of commentsと同時に議論され、

先進国の技術レベルを途上国に持ち込む事は早急には難しいし、途上国には品質は劣っても価格が安ければそれを要求する市場がある。として Task-IX としては積極的にこれらの標準や、マニュアルを開発途上国に持ち込む事に関わらない姿勢をとる事になった。実際にはこのマニュアルを基にインドでパイロットトレーニングを実施した、USA の Mr. Mark Fitzgerald の話を聞いてからの方がよかったと思われるが、彼の話が第 3 日に予定されており、しかも遅れて到着したためにマニュアルの内容の善し悪しや、試験的に実施したトレーニング結果の反映はされていない。

議事内容：第 3 日(10 月 16 日(土))

13. Review of World Bank Pilot Training Programmes in India が Mark の到着が遅れたためキャンセルとなった

14. Future meetings schedule

1) 3,4 Feb. 2000　Marrakech Morocco

2) 2,3 Oct. 2000　Jakarta　Indonesia

15. Presentation to ExCo

1) Sub Task Leader Country

2) ST-10 : Netherlands、 ST-20 : Switzerland、 ST-30 : Japan(Provisional)

3) Estimated Man/month (per year) declared by presented countries
ST-10 : 14.5、 ST-20 : 11.5、 ST-30 : 6　Total ; 32.0

4) Target Countries (Candidates)
Argentine、Bolivia、Brazil、Chili、Guatemala、Honduras、Indonesia、India、Kenya、Mexico、Morocco、Philippines、Sri-Lanca、South Africa、Syria、Thailand、Viet-Nam

5) List of Action

Work plan	13/November
Comment to ST Leader	30/November
Final Work-plan	31/December

以上

Photovoltaic Power Systems Programme

Task IX

DEPLOYMENT OF PHOTOVOLTAIC TECHNOLOGIES: CO-OPERATION WITH DEVELOPING COUNTRIES

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Status Report presentation by

Bernard McNelis

to

Executive Committee, Oslo, October 1999

The Operating Agent acknowledges financial support from:

dti

DFID

Solar

Lab Craft

BP SOLAREX

Solar Energy from BP Amoco

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Traditional PV Co-operation

Developing Country	**+ Science Ministry**	**+ Donor**	**= joint research, demonstrations, studies. <u>NO</u> SUSTAINABLE MARKET BUILDING**
Developing Country	**+ Donor**		**= demonstrations, lotsa studies. <u>NO</u> SUSTAINABLE MARKET BUILDING**
Developing Country	**+ Donor**	**+ PV Manufacturer**	**= more hardware, less studies. <u>NO</u> SUSTAINABLE MARKET BUILDING**
Developing Country	**+ Donor**	**+ Consultant**	**= even more studies. <u>NO</u> SUSTAINABLE MARKET BUILDING**

Results of traditional PV Co-operation

- Studies, more studies and even more studies
- Demonstrations, often of unproven systems (ie, “flemonstrations”)
- Demonstrations without market building
- Lots of person-years of management, study, research, record PhD/MWp
- Few MWp of PV

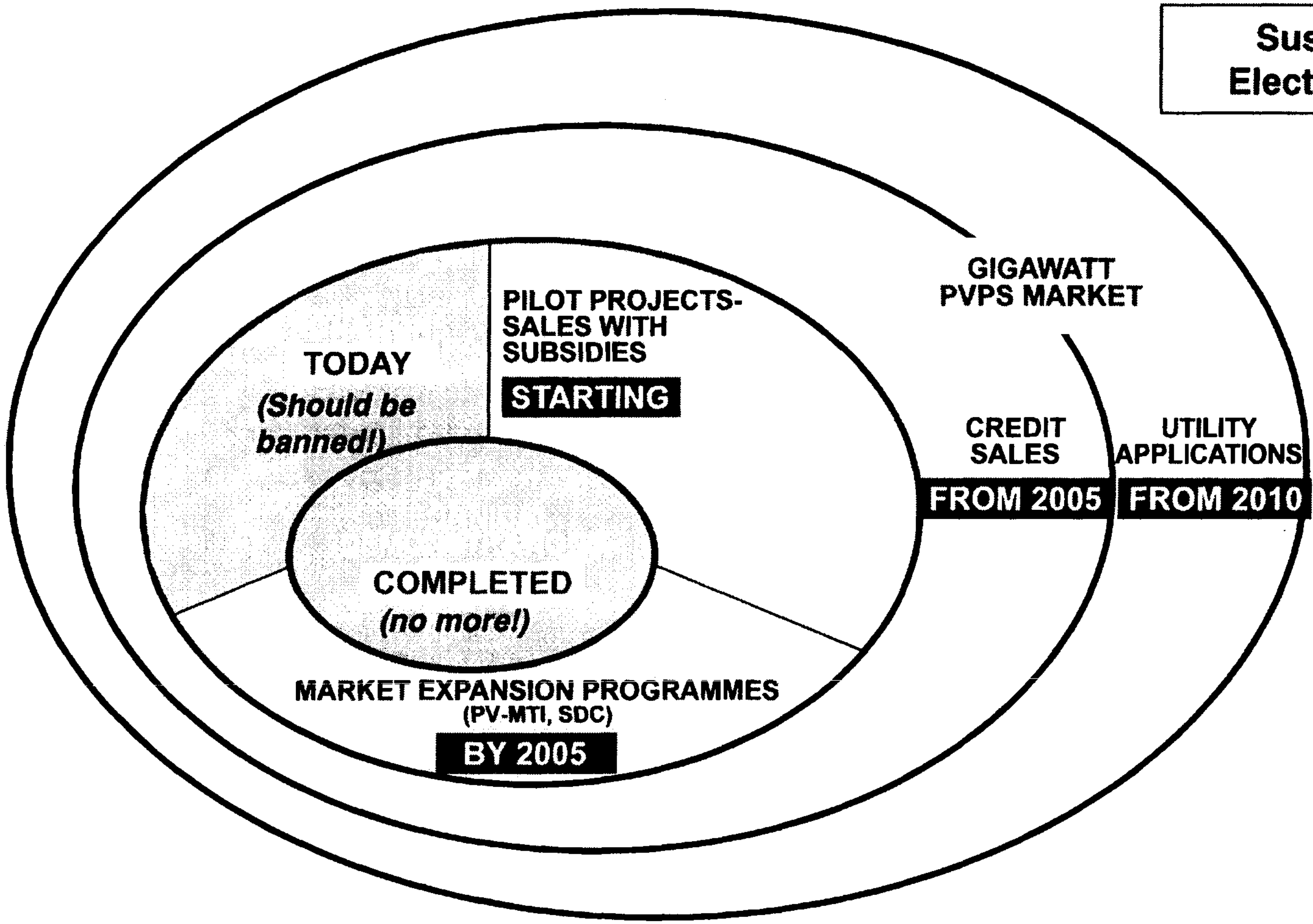
Picture: A large group of distinguished people met in Lausanne in May 1999 to approve PVPS Task IX

OBJECTIVE

To increase the overall rate of successful deployment of PV systems in developing countries, through increased co-operation and information exchange between bilateral and multilateral donors and the IEA PVPS Programme.

PV MARKET DEPLOYMENT STRATEGY

Sustainable Markets in Electricity-Deficient Areas



OECD DAC

IEA

PVPS Country Bilateral Programmes and Donors

Other PVPS Tasks

REWP and other IEA Implementing Agreements

PVPS Country National Programmes

IEA PVPS Task IX

World Bank/GEF Projects

Other Multi-lateral Projects

Improved Deployment Infrastructure

Task IX: SubTasks

- **SubTask 10:** Deployment Infrastructure
- **SubTask 20:** Support and Co-operation
- **SubTask 30:** Technical and Economic Aspects of PV in Developing Countries

Task IX Experts

- Australia: Gordon Thompson, CASE;
  Geoff Stapleton, GSES (Observer)
- Canada: Gerry Collins, CIDA
- Denmark: Peter Ahm, PA Consulting
- Finland: Heikki Tikkanen, Fortum AES;
  Heikki Neuvonen, Fortum AES (alternate)
- France: Jean-Louis Bal, ADEME
- Italy: Carlo Zuccaro, ENEL
- Japan: Takayuki Tani, IEEJ; Tsunehisa Harada, JPEA
- Netherlands: Winfried Rijssenbeek, Pim Keiskamp, ETC
- Switzerland: Alex Arter, ENTEC
- UK: Bernard McNelis, Jonathan Bates, IT Power
- USA: Mark Fitzgerald

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Bilateral Donors Represented

■ Canada	CIDA
■ CHE	SECO, SDC
■ Denmark	DANIDA
■ UK	DFID

Multi-lateral Donor Organisations

participating in Task IX

■ World Bank	Enno Heijndermans
■ UNDP	Suresh Hurry
■ UNEP	Mark Radka

Task IX Experts - Core Competencies

- PV technology
- Utility PV
- Developing Countries - project design, implementation, evaluation (including PV, wind, hydro, biomass, "non-energy" sectors)
- Development Assistance - bilateral and multilateral donor programmes
- Economic appraisal and analysis - socioeconomic surveys
- PV business - manufacture, commercial marketing, sales, service

Countries not yet participating

- Austria
- EU - suggestion made that DGI/DGVIII/SCR expert might join
- Germany - GTZ has expressed interest
- Israel
- Korea
- Mexico - could make significant contribution, no response to communications
- Norway
- Portugal
- Spain
- Sweden

Kick-off meeting. Utrecht, 14-16 October

Participants

Australia	- Gordon Thompson	Netherlands	- Winfried Rijssenbeek
	- Geoff Stapleton		- Wim van Nes (NOVEM)
Canada	- Gerry Collins		- Pim Keiskamp
Denmark	- Peter Ahm		- Franz Nieuwenhout (Task III)
Finland	- Heikki Neuvonen	UK	- Bernard McNelis
Italy	- Carlo Zuccaro		- Jonathan Bates
Japan	- Tsunehisa Harada	UNDP	- Suresh Hurry
	- Takayuki Tani	USA	- Mark Fitzgerald

Utrecht Meeting - External Relations

- 14 Oct - Presentation to Netherlands industry:
  - Shell Solar
  - ECN
  - SDC
  - Stroomwerk Energy BV
  - Triodos Bank
  - Free Energy Europe
  - Logic Green Energy

- 15 Oct - Dinner Talk by Elliot Berman (Founder of Solar Power Corporation, "The man who brought solar cells down to Earth" - John Perlin)

Picture: Task IX Experts with Elliot and Ann Berman, Utrecht Station

SubTask Leadership

SubTask 10: Deployment Infrastructure

Leader: Netherlands

SubTask 20: Support and Co-operation

Leader: Switzerland

SubTask 30: Technical and Economic Aspects

Leader: Japan is considering

Personpower Commitments (pm)

Subtask	Participating Countries AUS	CAN	CHE	DEN	FIN	FRA	GBR	ITA	JPN	NLD	USA	Total
Deployment infrastructure	1	1	2		1		2.5	3.5	1	2.5	2.5	17.0
Support and Co-operation	1	2	4 (+3)	4			3		1	0.5	0.5	16.0
Techno-economic aspects	1						1	2	2			6
Total annual effort	**3**	**3**	**6**	**4**	**1**	**6.12**	**6.5**	**5.5**	**4**	**3**	**3**	**45**

Provisional Target Countries

- Argentina
- Bolivia
- Brazil
- China
- Guatemala
- Honduras
- Indonesia
- India
- Kenya
- Mexico - IEA member
- Morocco
- Philippines
- Sri Lanka
- South Africa
- Syria
- Thailand
- Vietnam
- Island countries?

Contacts and Liaisons

+ Task I - DEN
+ Task III - NLD
+ Task VIII - NLD
+ ASEAN Centre for Energy (ACE) - CHE
+ World Energy Council - CAN
+ REWP - GBR

Achievements to date

- 11 Countries already participate, highly experienced experts, representation from 4 bilateral donors
- Additionally, 3 multi-lateral donors participating
- SubTask Leaders appointed for 10 - Netherlands, and 20 - Switzerland
- Japan encouraged and is considering leading SubTask 30
- Detailed SubTask workplans in preparation
- WebSite operational: www.ieatask9.org - provisional content and address
- World Bank and PV-GAP Manuals reviewed
- Strategy to involve developing countries and experts

PV-GAP/World Bank QA Manuals

+ World Bank wants to be a bank, not technology standards and training institute!!
+ WB sees IEA-PVPS as well qualified and highly respected 'home' for this work
+ Task IX Experts so far comment informally
+ 'Official' IEA PVPS approvals not presently feasible
+ Replication of Training Courses beyond Task IX remit

First comments on QA Manuals

+ Concern at relevance of ISO 9000 to DCs - especially small manufacturers of BOS components
+ Manuals assume detailed knowledge of quality management - which will often be lacking in DCs
+ Implementation of manuals may create further barriers to PV deployment

First comments on QA Manuals

+ ISO 9000 guarantees consistency not quality
+ The set of manuals do not consider project planning or system design - both of which are crucial for successful PV deployment
+ There will always be a market for lower specification and cost products!
+ Conflict with National Standards
+ Primarily a Task III issue (??)
+ Some kind of quality standard is needed for WB programmes - supplier guarantees?

Future Meetings

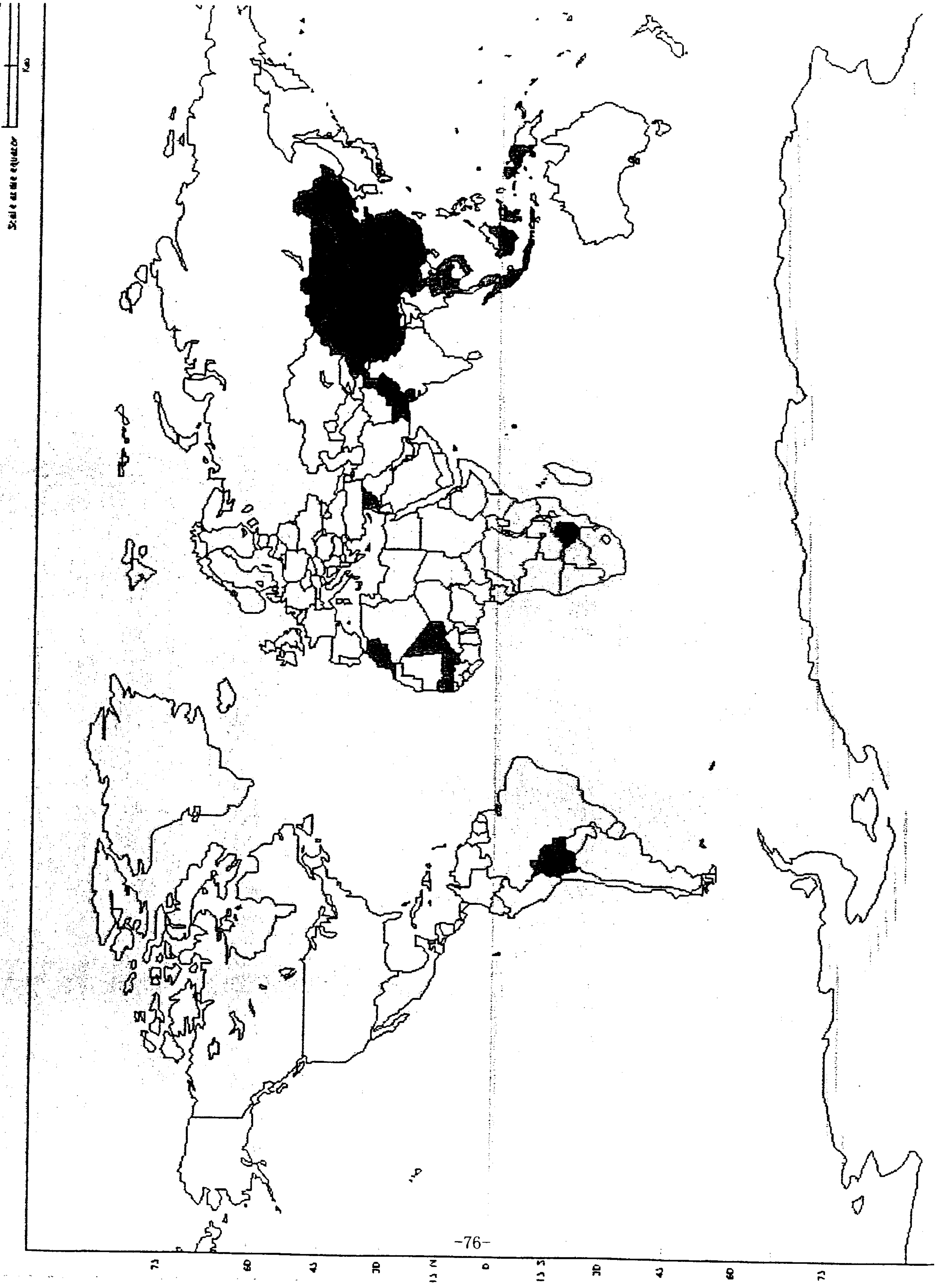
- 3rd-4th February 2000 - Marrakech
- 2nd-3rd October 2000 - Jakarta
- Spring 2001 - Paris? (with IEA, REWP, OECD-DAC??)
- Joint meeting with Task III?

Issues for the ExCo

1. Task IX has made a good, albeit very recent, start
2. World Bank-PV GAP relationship requires further review by Task III and IX, and strategy should be decided by the ExCo
3. Encourage other countries to join
4. Signature of Annex??
5. Provide inputs on non-IEA countries to ISR??

PV in Japanese ODA

- PV in Japanese ODA begins in earnest recently.
- They have been implemented so far in JICA project of the **grant aid, technical cooperation** and the **collaboration study** of NEDO.
- There is no **loan project** item of OECF yet.


Scale at the equator
Km
75
60
45
30
15 N
0
15 S
30
45
60
75

JICA Grant aid projects

- **Islamic Republic of Pakistan** :

  Study of the farm village energy development plan (1984-1987)

  Two villages 57kW、38kW

- **Kingdom of Thailand**:

  The study of the electrification of the remote area (1985-1986)

  Three villages 30kW、60kW、60kW

- **Republic of Senegal**:

  The study of village water supply (1993-1995)

  PV desalination and water supply system

JICA Technical cooperation project(1)

- **Republic of Indonesia** :

  The study of the rural electrification by the hybrid system utilize the photovoltaic System (1988-1993)

  72 kW of PV-10 kW of diesels, 48 kW of PV-7 kW of small hydropower generation

- **Republic of Kiribati** :

  The study of the rural electrification utilizing of the PV system (1990-1993)

  120W x 55 households, 600W x 1 public hall

- **Republic of Mali** :

  The study of PV water pump up project in Nara district (1992-1994)

JICA Technical cooperation project(2)

- **Syrian Arab Republic :**

  The study of the integrated rural electrification utilizing PV system (1996-2000)

  35kWAC x 1(village)、200WDC x 13(houses), 300W DC x 27(houses), 500WAC x 17(systems), 4kW(pump up), 10kW (pump up and desalination)

- **Kingdom of Morocco :**

  The study of rural electrification master plan in Hauz district (1996-1997)

  The preparation of RE master plan for 100 villages

- **Republic of Zimbabwe :**

  The study of the promotion of the PV rural electrification (1996-1998)

  25W(50W) x100(house)、83W x 10(system, school and clinics)

JICA Technical cooperation project(3)

- Lao's People's Democratic Republic of :

The study of the PV rural electrification (1998—2000)

100W x 250 (house) 6kW x 1,0.9kW x 1 (system) for BCS

- Mongolian People's Republic :

The study of the PV rural electrification (1998—2000)

3.4kWPV--2.5kW Wind Turbine x 3 (villages)

- Republic of Bolivia

The study of the rural electrification by renewable energies (1999—2001)

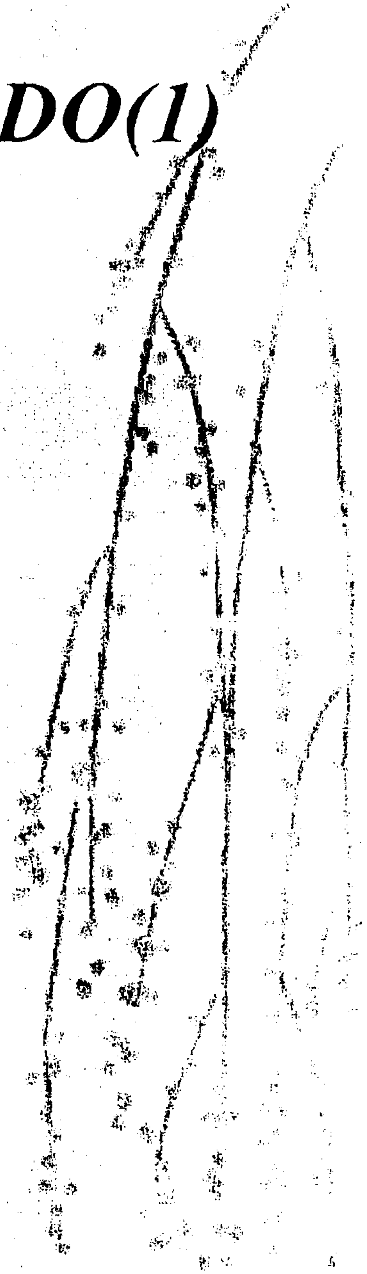
60W x 300 (house)

- Republic of Senegal is coming on the line

The study of the PV rural electrification plan (1999—2001)

Collaboration with NEDO(1)

- **Kingdom of Thailand :**
  The system of the pump up water by PV (--1988)
  6.3kW (pump)
- **Kingdom of Thailand :**
  Study of the PV battery charging system (1992-1997)
  4kW x 1(village), 40kW x 1 (village)
- **Malaysia :**
  Study under tropical condition (1992-1997)
  10kW x 1 (system), 100kW x 1 (system)
- **Kingdom of Nepal :**
  Study under high altitude condition (1992-1997)
  40kW Water pump up system
- **Mongolian People's Republic :**
  Study of the portable PV system for nomad families (1992-1997)
  200W x 100 (houses)



Collaboration with NEDO(2)

- **People's Republic of China :**

  The cooperation study about the utilization technique of PV at schools in the remote area (1997-1998)

  4kW x 4 (schools)

- **Socialist Republic of Vietnam :**

  The proof study of the hybrid system with PV and microhydro generation (1997-2000)

  100kW x 1 (system)

- **People's Republic of China :**

  The cooperation study about the practical use of the PV system of the area of different condition (1998-2001)

  1998: 6kW x 4 (schools)

  1999: 150W x 100 (houses), 8kW x 1 (school), 10kW x 2 (village centers)

International Energy Agency

Photovoltaic Power Systems Programme

TASK IX

DEPLOYMENT OF PHOTOVOLTAIC TECHNOLOGIES:

CO-OPERATION WITH DEVELOPING COUNTRIES

WORKPLAN

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APPENDIX 1 TASK IX FRAMEWORK

FOREWORD

The International Energy Agency (IEA), founded in 1974, is an automonous body within the framework of the Organisation for Economic Co-operation and Development (OECD) which carries out a comprehensive programme of energy co-operation among its twenty four member countries. The European Commission also participates in the work of the Agency.

The IEA Photovoltaic Power Systems Implementing Agreement is one of the collaborative R & D agreements established within the IEA, and since 1993, its participants have been conducting a variety of joint projects in the applications of photovoltaic conversion of solar energy into electricity.

The overall programme is headed by an Executive Committee composed of one representative from each participating country, while the management of individual research projects (Tasks) is the responsibility of Operating Agents. Currently seven tasks have been established.

The twenty one members of PVPS are: Australia (AUS), Austria (AUT), Canada (CAN), Denmark (DNK), European Commission, Finland (FIN), France (FRA), Germany (DEU), Israel (ISR), Italy (ITA), Japan (JPN), Korea (KOR), Mexico (MEX), The Netherlands (NLD), Norway, (NOR), Portugal (PRT), Spain (ESP), Sweden (SWE), Switzerland (CHE), The United Kingdom (GBR) and the United States of America (USA).

This document is intended for the use of IEA Photovoltaic Power System Programme ExCo and experts. It has been prepared by:

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and

Leendert Verhoef

Verhoef Solar Energy Consultancy (NLD)

with the assistance of experts from Australia, Canada, Denmark, France, Germany, Italy, Japan, The Netherlands, Sweden, Switzerland, The United Kingdom, the United States of America, and the IEA Secretariat.

This document was approved at the meeting of the PVPS Executive Committee in Lausanne in May 1999.

SCOPE AND OBJECTIVE

This report sets out an initial programme for a new Annex, Task IX, to the IEA PVPS Programme. The suggested title of the Task is *Deployment of Photovoltaic Technologies: Co-operation with Developing Countries.* The key objective of the Task is to further increase the overall rate of successful deployment of photovoltaic systems in developing countries through increased co-operation and exchange of information between the IEA PVPS Programme and developing countries, development banks, multilateral and bilateral aid agencies and other targeted groups.

The Task activities do not concern any aspects of product promotion, commercialisation or marketing activities which remain the responsibility of the private PV industry.

The Task has been divided into 3 subtasks: Deployment Infrastructure; Support and Co-operation; and Technical and Economic Aspects of PV Systems in Developing Countries.

1. MOTIVE

The IEA, through its Renewable Energy Working Party (REWP), has announced a policy of co-operation with developing countries, by increased participation in existing Implementing Agreements and possibly new Technology Co-operation Agreements. The overall mission of the PVPS Implementing Agreement is to encourage international collaboration efforts through which photovoltaic energy becomes a significant option in the near future. In developing countries, PV is often the only viable option for remote electrification, and therefore PVPS has been exploring the possibilities for, and scope of, co-operation with developing countries and international financial institutions. As a result of this work PVPS is now ready to prepare a new Task to the Agreement: this new Task would be complementary to Task III which is already addressing the technical and implementation issues of stand-alone PV systems.

2. OBJECTIVE

The objective of Task IX is to further increase the overall rate of successful deployment of PV systems in developing countries. This will be achieved by:

1. identification of existing information and experience
2. exchange of information between PVPS participants
3. exchange of information with and between target groups
4. workshops for and information exchange with donor agencies
5. development of Recommended Practice Guides based on existing information
6. improved techno-economic performance of PV in developing countries
7. identification of areas where further technical research is necessary.

3. APPROACH

IEA PVPS Task IX will draw its information from a resource pool of international technical and non-technical experts, other IEA-PVPS Tasks, REWP and existing programmes and networks. Information will flow between the Task IX Team and the main target sectors:

- government and semi-government agencies
- multilateral and bilateral donor agencies
- development banks
- local and multinational banks
- local and multinational industry
- local and multinational utilities
- R&D institutions
- non-governmental organisations (NGOs)
- training organisations
- foundations
- professional bodies
- consumer associations

In addition to those organisations identified above, PV experts in selected non-IEA member developing countries will be accessed through co-operation with existing networks and frameworks.

Task IX will draw upon other similar existing programmes and networks and build upon these to provide an effective and efficient programme that will address the needs and potential of developing countries, multilateral and bilateral donor agencies and development banks.

It is proposed to organise the collaborative work into three main Subtasks, each of which will be led by a Task IX member:

Subtask 10: Deployment Infrastructure

To contribute to overcoming the critical barriers to widespread PV deployment and implementation through the development, dissemination and application of a series of Recommended Practice Guides (RPGs) to promote the necessary infrastructure requirements in developing countries.

Subtask 20: Support and Co-operation

To stimulate awareness and interest amongst the target sectors on the technical and economic potential, opportunities and recommended practice of PV systems. This will enable decision-makers to obtain the expertise and knowledge that is required for appropriate PV system deployment.

Subtask 30: Technical and Economic Aspects of PV in Developing Countries

To investigate the techno-economic aspects and potential of PV systems, and the roles of utilities in developing countries. This Subtask will identify areas requiring further research and, in order to avoid duplication, feed this into the relevant PVPS Task.

In addition to these subtasks, Task IX will keep informed of progress on the negotiations related to clean development mechanisms (CDM) and activities implemented jointly (AIJ) and the implications for the three subtasks.

4. ACTIVITIES

Activities within these Subtasks will be carried out on a task-sharing basis, as in other tasks of the PVPS Implementing Agreement, and in co-ordination with activities in selected developing countries and in open communication with those countries.

All results and know-how will be disseminated within all Subtasks. Distribution of information within the Task will be the responsibility of the Subtasks. On a Task level, the distribution of general materials (such as minutes of meetings) and IEA-documents shall be the responsibility of the Operating Agent.

4.1 Subtask 10: Deployment Infrastructure

Subtask Leader: To be appointed

Objective: To contribute to overcoming the critical barriers to widespread PV deployment.

Method: To collate existing information and, if necessary, conduct surveys of specific issues in identified countries. The results of these surveys will be collated into a coherent series of Recommended Practice Guides that will then be disseminated and promoted in selected countries.

Output: Comprehensive set of practical Recommended Practice Guides targeted at development banks, multi-lateral and bilateral agencies, developing country experts and IEA PVPS member countries.

Duration: 5 years

Budget: To be established

The overall objective of Subtask 10 is to contribute to overcoming the critical barriers to widespread PV deployment. The central tasks will involve the preparation of recommended practice guidelines for the deployment requirements of PV. The approach by which this will be implemented will be to collate existing information and conduct additional surveys where necessary, in a number of target countries identified by the Task IX experts. The results will be collated in to a series of Country Reports that will form a key input to the Recommended Practice Guides (RPGs). The RPGs will use case studies from the Country Reports to highlight successes and failures.

The Recommended Practice Guides will be targeted for use by in-country planners, agencies setting up PV programmes, industry experts etc. as well as feeding into initiatives such as PVGAP.

Specifically the Subtask will entail the activities detailed in Table 1.

Table 1: Activities for Subtask 10

Activity 11	Information Compilation and Analysis
Activity 12	Recommended Practice Guide Preparation
Activity 13	Dissemination and Promotion of Recommended Practice Guides

Activity 11: Information Compilation and Analysis

This activity will investigate the various strategies for infrastructure development and deployment to ensure widespread and successful implementation of PV. Key issues relating to PV deployment strategies and initiatives will be investigated and collated to provide input to Activity 12.

In order to carry out the surveys, information will be gathered from existing sources and, if necessary, in-country missions may be undertaken. The surveys will collect data on existing schemes and initiatives for each identified subject area. Each survey will be reviewed by the Task experts and then used as input to the corresponding Recommended Practice Guide.

The information gathered from these surveys will be collated into a Country Report document. This document will provide a view of the state of the PV market and infrastructure in each of the target countries. These country reports will provide an important source of information for Activity 12.

Activity 12: Recommended Practice Guides

The objective of Activity 12 is to prepare a series of clearly understandable recommended practice deployment and implementation guides. Guides relating to the following areas will be collated:

- financing mechanisms
- institutional development
- training programmes
- operation and maintenance
- certification and accreditation
- systems planning
- infrastructure frameworks
- awareness raising

For each of the subject areas identified, a listing, review and analysis of case studies will be undertaken so that the lessons learned can be drawn from the successes and failures for each aspect of PV deployment. The information will be made readily available and accessible. Following the review and analysis process, a Recommended Practice Guide will be drawn up for each of the identified subject areas. It is intended that each document will be a 'free-standing' publication in its own right, although taken as a set, the guides will form a comprehensive and practical Recommended Practice Guide for all aspects of PV deployment.

It is intended that the guides will be published one at a time rather than as a complete set of documentation in order to reinforce the stand-alone nature of each document.

The Country Reports from Activity 11 will be published in conjunction with the Recommended Practice Guides.

Activity 13: Dissemination and Promotion of Recommended Practice Guides

The Recommended Practice Guides will provide a comprehensive series of documents that will be disseminated via the networks established and identified in Subtask 20. The dissemination of the Recommended Practice Guides is crucially important to ensure that they are implemented and utilised by the organisations at which they have been targeted.

A key goal of this dissemination exercise is to ensure that the guides are implemented on a practical level in real implementation programmes. In order to achieve this goal, relevant agencies will be encouraged to adopt the Recommended Practice Guides as an integral part of their rural electrification programmes. A part of this process will involve a series of workshops and seminars, targeted at relevant institutions in specified countries, as well as manufacturers, utilities, training organisations etc.

4.2 Subtask 20: Support and Co-operation

Subtask Leader: To be appointed.

Objective: To stimulate the awareness and interest amongst the targeted sectors on the technical and economic potential, social implications, opportunities and best practice of PV systems and to establish a dialogue with multilateral and bilateral agencies and development banks.

Method: Activities will include workshops, missions in selected developing countries and publications. Task IX will draw upon existing networks and frameworks for disseminating promotional material and information. This Subtask will include two main activities.

Output: Improved communication between PVPS, developing countries, development banks and agencies.

Duration: This Subtask will run for the full duration of the Task.

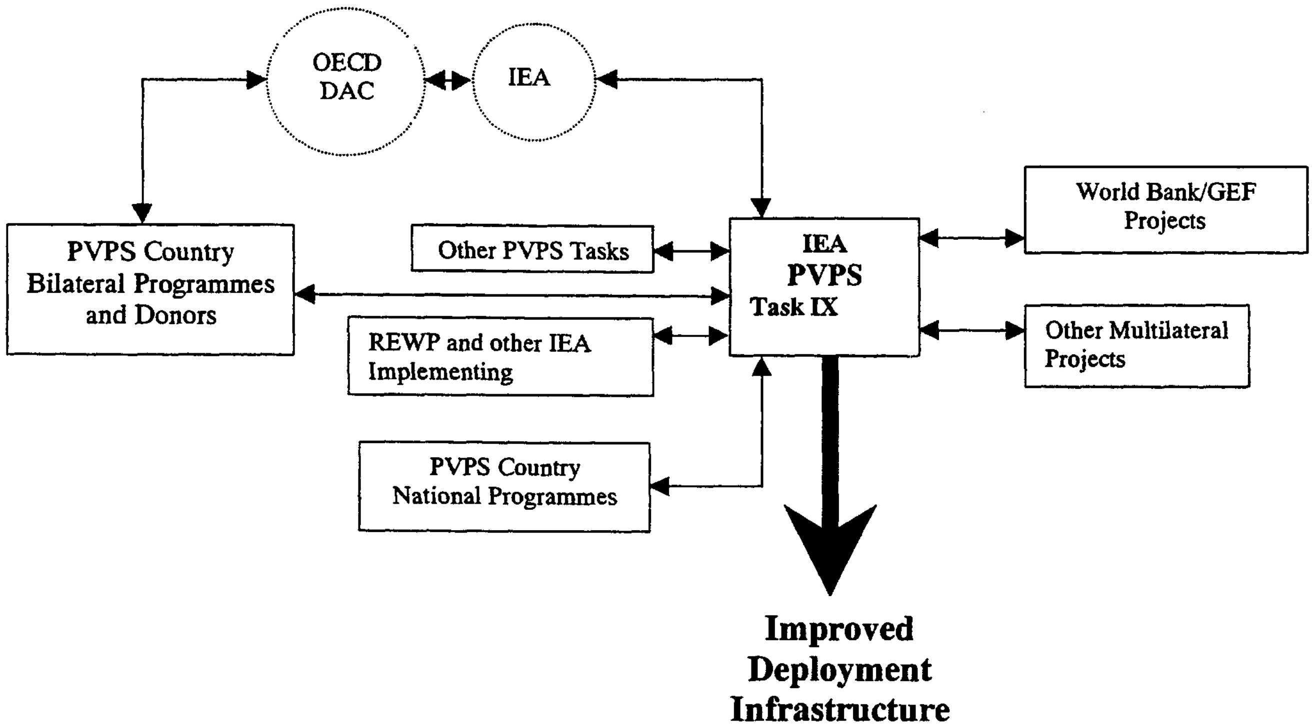
Budget: To be established.

Specifically the Subtask will entail the activities detailed in Table 2.

Table 2: Activities for Subtask 20

Activity 21	Support to Multilateral and Bilateral Donors and Development Banks
Activity 22	Co-operation with REWP and IEA/OECD

The schematic below illustrates the dynamics of the interactions between the two activities.



Activity 21: Support to Multilateral and Bilateral Donors and Development Banks

The objective of Activity 21 is to ensure dialogue between IEA PVPS members and donors, highlight major donor PV projects and opportunities for use of PV (e.g. in rural development) and provide neutral short-term technical advice and support to multilateral and bilateral donor agencies and development banks. The transfer of knowledge from activities undertaken within the IEA to donor agencies and their client countries will be enhanced. The overall objective of this activity is to increase the role played by multilateral and bilateral donors and development banks in PV deployment.

Collaboration with multilateral and bilateral donor agencies and development banks will follow a uniform and comprehensive programme of action. The IEA PVPS Task IX Team will provide the following:

1. Educational Workshops and Seminars: includes conducting and/or participating in PV or related workshops targeting bank and agency staff and client countries. Training workshops on PV for developing countries will also be offered. PVPS workshops will

raise the level of awareness of staff and overcome information and perceived technical and economic barriers to enhanced PV content in donor agency activities.

2. Information and dissemination services, including publications (e.g., PV POWER and theme notes), and workshops in selected developing countries.

3. Development of Terms of Reference for special studies to address technical issues that may require analysis and review.

4. Participating countries should establish a contact between the ExCo delegate (his/her institution) and the national Aid Ministry.

Activity 22: Co-operation with REWP and IEA/OECD

The objective of Activity 22 is to promote PV systems to target groups in developing countries through already existing IEA/OECD committees and working groups. This will be achieved by working closely with the IEA/REWP, IEA/Non-Member Country Committee and the IEA and OECD Secretariats. Task IX will establish a close linkage with other OECD processes and working groups including the Development Assistance Centre and the Environment Centre. Other networks such as the Society for International Development will also be utilised for the dissemination of information. Task IX will use these existing networks to promote PV deployment.

Efforts will be undertaken to enhance the transfer of knowledge to other countries, in particular developing countries, interested in applying PV power systems.

4.3 Subtask 30: Technical and Economic Aspects of PV in Developing Countries

Subtask Leader: To be appointed

Objective: To evaluate the techno-economic aspects of PV in developing countries.

Method: To compile information on specific issues in selected developing countries and to identify areas requiring further research for feeding into other PVPS Tasks.

Output: Identification of areas requiring further technical research and input into other PVPS Tasks.

Duration: 3 years

Budget: To be established

Through the surveys carried out in Activity 11 and the preparation of the Recommended Practice Guides in Activity 12, it is likely that areas for further research with respect to the deployment of PV systems in developing countries will be identified. The objective of this Subtask therefore is to feed this information to the other PVPS tasks in order that the relevant issues can be addressed. A key area of this Subtask will be to investigate the role that could be played by electricity utilities (both local and multinational) in PV deployment.

Specifically the Subtask will entail the activities detailed in Table 3.

Table 3: Activities for Subtask 30

Activity 31	Stand-alone PV systems
Activity 32	Village grid and hybrid systems
Activity 33	Grid-connected PV systems

Activity 31: Stand-alone PV Systems

Activity 31 will focus on the techno-economic aspects of stand-alone PV systems. Information on the performance and reliability of stand-alone PV systems will be collected and reasons for successes and/or failures identified. Information regarding areas where further research is required will be passed to Task III.

Activity 32: Village-grid and Hybrid Systems

This activity will focus on the use and development of village-grid and hybrid PV systems. Information will be compiled and analysed on systems installed in target countries and information regarding further research requirements fed into Task III. It is intended that activity will concentrate on PV-diesel hybrids although studies of other hybrid systems will be made.

Activity 33: Grid Connected PV Systems

The objective of this activity is to examine the future technical and economic viability of grid-connected PV in developing countries.

The potential for, and applications of, grid connected PV will be influenced by the extent and quality of electricity generation and distribution networks. This activity will compile information in countries with different levels of grid penetration in rural areas and examine the prospects for PV implementation both from a technical and an economic perspective. The economics of grid connected PV in a series of target countries will be studied and the potential for PV for both embedded generation and grid support applications will be evaluated. The role of the electricity utilities will be a key parameter in Activity 33.

5. EXPECTED OUTPUTS

The main outcome from the Task is expected to be increased worldwide co-operation and co-ordination between developing countries, PV specialists, multilateral and bilateral donor agencies, development banks and other target groups.

The direct outputs will include:

- Collation and analysis of existing publications on PV in developing countries;
- Recommended Practice Guides for successful introduction and expansion of PV systems drawing from past experiences and lessons learned from technology co-operation projects and programmes. These will be disseminated by appropriate means in selected developing countries;
- Staff workshops for multilateral and bilateral agencies;
- Workshops in non-IEA countries, co-ordinated with bilateral and/or multilateral agencies and/or NGOs;
- Active participation of target groups in selected developing countries;
- Dialogue and contact point with staff of multilateral and bilateral agencies;
- Identification of technical issues relating to PV in developing countries.

The results of the Task will be available to the Participants and associated experts in developing countries. Public reports on the key results of the Task will be available for all individuals, companies and institutes involved with PV systems. These are summarised in the Table 4.

Table 4: Activity to Output Matrix

ACTIVITY	OUTPUT
Activity 11: Information Compilation and Analysis	Collation and analysis of existing publications on PV in developing countries.
Activity 12: Recommended Practice Guide Preparation **Activity 13:** Dissemination and Promotion of RPGs	Recommended Practice Guides for successful introduction of PV systems: and their dissemination by appropriate means in selected developing countries.
Activity 21: Support to Multilateral and Bilateral Donors and Development Banks	Staff workshops for multilateral and bilateral agencies. Dialogue and contact point with staff of multilateral and bilateral agencies
Activity 22: Co-operation with REWP and IEA/OECD	Active participation of target groups in selected developing countries. Workshops in non-IEA countries, co-ordinated with bilateral and/or multilateral agencies and/or NGOs.
Activity 31: Stand-alone PV Systems **Activity 32:** Village Grid and Hybrid Systems **Activity 33:** Grid-connected PV Systems	Identification of technical issues relating to PV in developing countries. Input to Task III

6. RELATIONSHIP BETWEEN TASK IX AND OTHER PVPS TASKS

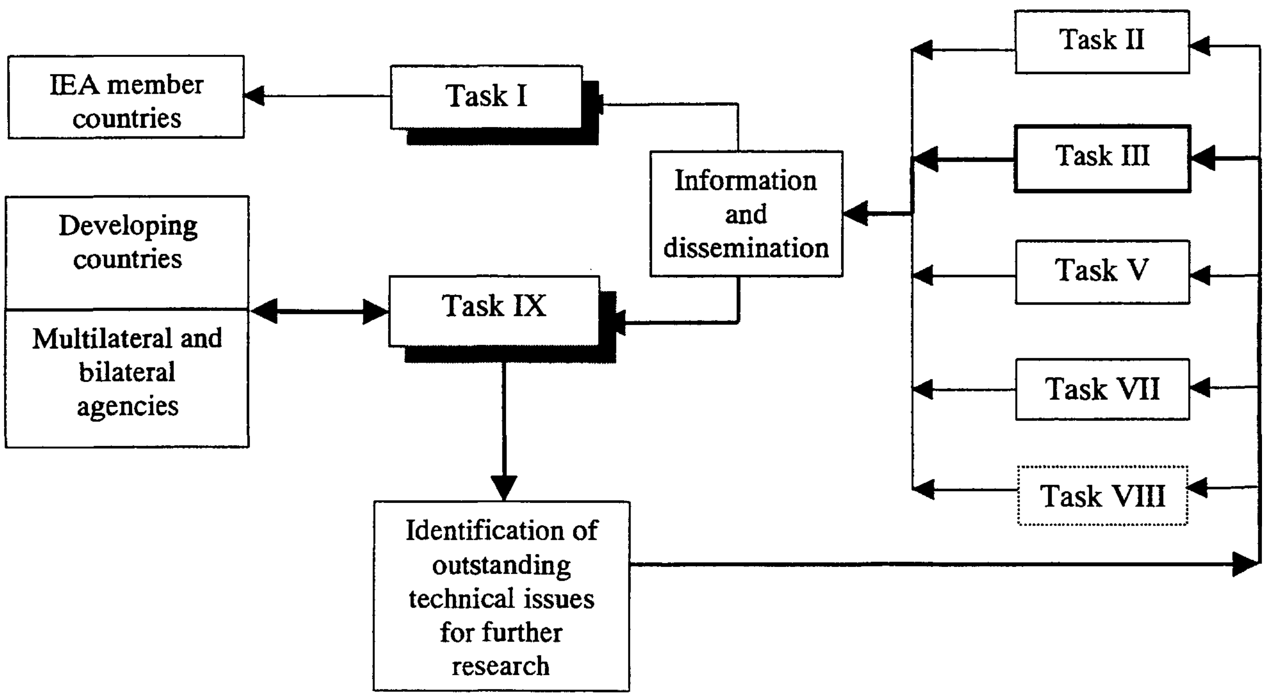
Task IX will undertake its own programme of work through the production and dissemination of the Recommended Practice Guides, the in-country surveys and the techno-economic studies of PV systems.

However, part of the role of Task IX can be viewed as 'cross-cutting' the other PVPS Tasks. This 'cross-cutting' element is essentially in two areas of Task IX:

1. identifying technical areas of research that need to be addressed from a developing country perspective ;
2. and by disseminating the results from the other Tasks to multi-lateral and bilateral agencies, NGOs, banks and to experts in developing countries.

The interaction of Task IX with the other Tasks are shown schematically in the diagram below. The relationship between Task III and Task IX is of particular importance. Task III will address relatively advanced technical issues, whereas Task IX will address information exchange and co-operation with international organisations in developed and developing countries, dealing with non-technical barriers in order to avoid duplication. Some of the Activities in Task IX will be undertaken in close co-operation with Task III, in particular the preparation of the Recommended Practice Guides relating to training, certification and accreditation. Subtask 30 will also be undertaken in co-operation with Task III. A number of publications may be published jointly with Task III.

A schematic representation of the interactions between Task IX and the other Tasks is given below.



The new Task will build on the ongoing work being undertaken in Task III, and will transfer the experience of Task III to the relevant agencies and developing countries. This will become more important as Task III starts a new phase more focused on technical issues and extended to large hybrid systems. Task IX will enhance the transfer of knowledge to and between developing countries, interested in applying PV power systems for autonomous applications. It is proposed that the meetings of Task III and Task IX be scheduled to coincide annually to ensure good collaboration between the Tasks.

7. ORGANISATIONAL ISSUES & KEY DATES

The following Task preparation scheme and key dates are proposed:

i. Approval of Annex and global Work Plan by PVPS ExCo, acknowledgement of Annex and global Work Plan (May 1999);

ii. Formal kick-off meeting for the Task, detailing of the global Work Plan, organisational issues, etc (Autumn 1999);

Candidates for the Subtask Leaders will be nominated during the kick-off meeting.

8. BUDGET & RESOURCES

Potential areas of country involvement for the three subtasks are given in Table 4. The expressions of interest represented in this table do not represent any commitment by the member country.

Table 5: Potential areas of country involvement

Subtask	Potentially interested countries
Subtask 10: Deployment Infrastructure	AUS, CHE, DEU, FRA, GBR, ITA, JPN, NLD, USA.
Subtask 20: Support and Co-operation	AUS, CHE, DEN, FRA, DEU, GBR, JPN, NLD.
Subtask 30: Technical and Economic Aspects of PV in Developing Countries	AUS, FRA, DEU, GBR, ITA, JPN, NLD.

A provisional costing of Task IX is summarised in Tables 5 and 6.

Table 6: Preliminary estimate of labour requirement for Task IX

Subtask	Activity	Person months
10	Activity 11: Information compilation and analysis	60
	Activity 12: RPGs (7)	20
	Activity 13: Dissemination and Promotion of RPGs	30
	Sub-total	*110*
20	Activity 21: Support to Donors and Banks	
	1. Publications	5
	2. Responses	5
	3. Workshops	20
	4. Studies	15
	Activity 22: Co-operation with REWP and IEA/OECD	15
	Sub-total	*60*
30	Activity 31: Stand Alone PV Systems	18
	Activity 32: Village Grid and Hybrid Systems	12
	Activity 33: Grid-connected PV Systems	10
	Sub-total	*40*
TOTAL		**210**

Assuming 12 countries agree to participate in the Task, the labour input as estimated above is approximately 3.5 person months per country per year.

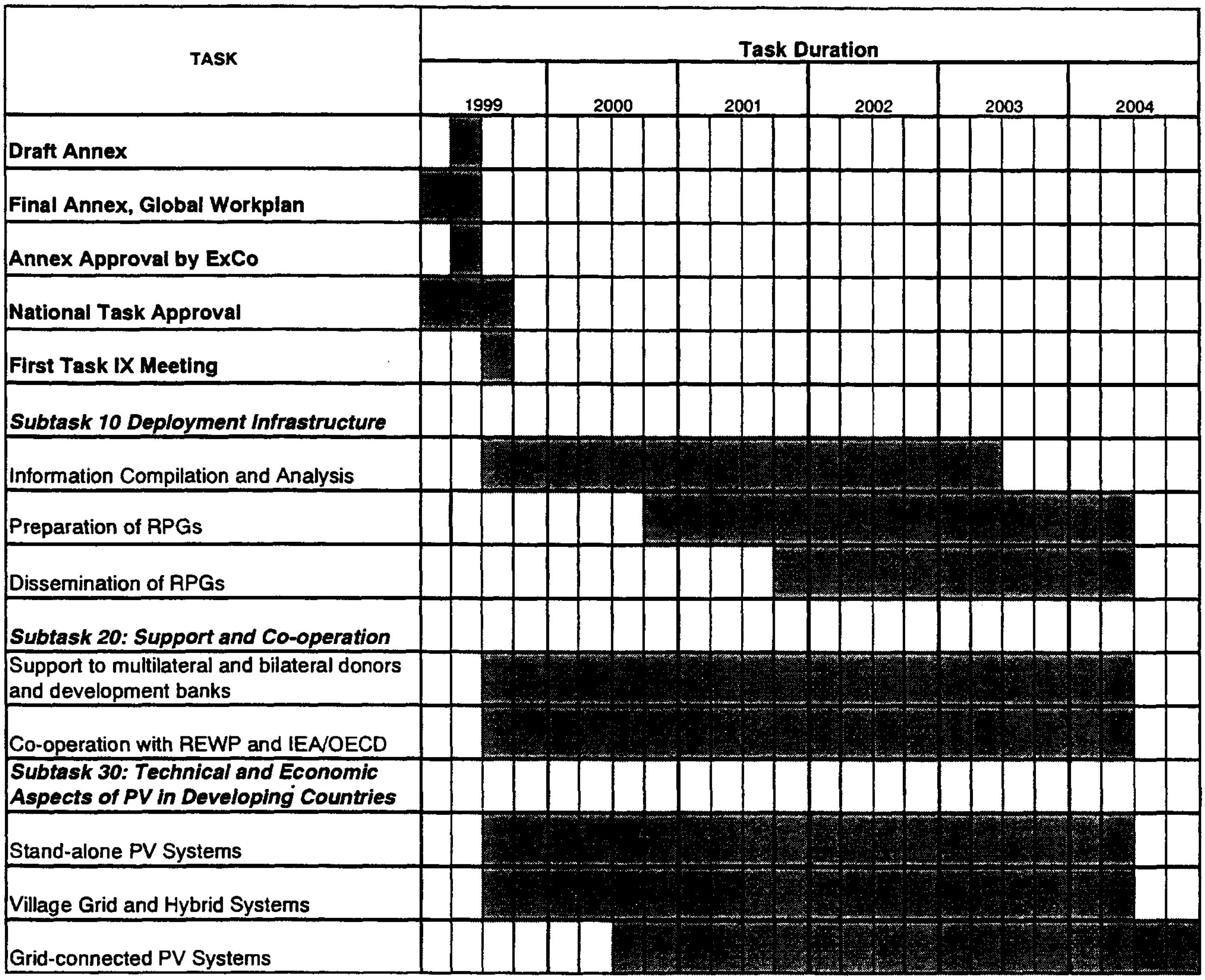
Table 7: Summary of overall estimated costs for Task IX.

Item	Cost/Labour requirement
Labour requirement of Task IX	210 person months
Estimated costs of arranging 4 workshops	120 000 USD
Estimated costs of Task meetings (10 countries participating, 2 per year over 5 years)	150 000 USD
Estimated costs of designing/printing RPGs (7 of, 1000 copies)	100 000 USD
Total Estimated Cost of Task IX	**210 p-m + 370 000 USD**

9. TIME SCHEDULE

Based on the Task preparation scheme, a provisional time schedule has been defined and is shown in Table 8. During the Task, specific work items will be planned in further detail.

Table 8: Provisional schedule for Task IX.



APPENDIX 1 TASK IX FRAMEWORK

Through Task IX, the PVPS will be the first IEA Implementing Agreement with direct co-operation between member and non-member developing countries. Task IX will lead the way for co-operation on all renewable energy technologies as part of the IEA's strategy for implementation of Clean Development Mechanisms (CDM) and Activities Implemented Jointly (AIJ) of the Kyoto Protocol.

The Task will provide the framework for PV co-operation with Developing Countries, enabling the PVPS programme to use its expertise and status to bring together multilateral and bilateral agencies, government and semi-government agencies, NGOs, the PV industry and other target groups required for widespread PV market deployment. PV experts in selected non-IEA member developing countries will be accessed through co-operation with existing networks and frameworks. Task IX will draw upon other similar existing programmes and networks and build upon these to provide an effective and efficient programme that will address the needs and potential of developing countries, multilateral and bilateral donor agencies and development banks.

Task IX can be viewed as a facilitator in the creation of a sustainable PV market through encouraging its target organisations (multi-lateral and bilateral agencies, development banks etc) to adopt PV as a serious candidate for rural electrification strategies as a part of development assistance programmes.

Task IX will provide guidance to the these agencies on the most effective way to implement PV rural electrification programmes, ensuring that they are sustainable, effective and replicable and that they lead to the creation of effective and self supporting infrastructures after multilateral and/or bilateral agency funds have been used. The involvement of the donor agencies in Task IX is of particular importance and their active participation is anticipated.

It is important that the Task IX remains independent of direct commercial interests in its interactions with the multilateral and bilateral agencies and other target organisations and that the advice and guidance offered is independent and impartial.

International Energy Agency
Photovoltaic Power Systems Programme

Task IX

Deployment of Photovoltaic Technologies: Co-operation with Developing Countries

1st Experts Meeting
MINUTES

Utrecht, The Netherlands

14th-16th October 1999

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ANNEX 1 11

1. Agenda

The agenda was agreed as issued – see Annex 1.

2. Introduction of participants

Each of the participants was asked to give a brief introduction outlining their core areas of expertise. This is summarised in the table.

Country	Representative name	Organisation	Expertise
Australia	Gordon THOMPSON	CASE	Renewable energy applications in developing countries
Australia	Geoff STAPLETON	GSES	Utility experience. Consultant on renewable energy in developing countries. Involved in training.
Canada	Gerry COLLINS	CIDA	Senior advisor in energy branch.
Denmark	Peter AHM	PA Energy A/S	Specialist in PV and wind applications in developing countries, Danish representative on Task I.
Finland	Heikki NEUVONEN	Fortum AES	Responsible for PV marketing in developing countries
Italy	Carlo ZUCCARO	ENEL	Electrical engineer involved in PV/wind. Also worked on grid-connected PV
Japan	Tsunehisa HARADA	JPEA	Representative of Japanese PV industry Association
Japan	Takayuki TANI	IEEJ	PV consultant for JICA, Involved in PV for rural electrification
Netherlands	Winfried RIJSSENBEEK	ETC	Agricultural engineering background, worked in renewable energy on wind and biogas in Caribbean & Peru.
Netherlands	Pim KIESKAMP	ETC	Expertise in climate change also on small scale energy systems & environmental impacts in developing countries.
Switzerland	Alex ARTER	ENTEC AG	Involved in design of RE programmes for GTZ for 10 years. Rural development & hydro experience.
UK	Bernard MCNELIS	IT Power Ltd	PV expert with extensive developing countries experience
UK	Jonathan BATES	IT Power Ltd	Expertise in both technical and economic apects of stand-alone and grid connected PV.
USA	Mark FITZGERALD	ISP	[Present Saturday only]
	Suresh HURRY	UNDP	Experience in UN focussed on renewable energy and energy efficiency, and rural electrification.

Also invited were:

Country	Representative name		Organisation	Commnets
France	Jean-Louis	BAL	ADEME	Without notice
Denmark	Jean-Paul	LAUDE	DANIDA	Apologies
	Enno	HEIJNDERMANNS	World Bank, ASTAE	Apologies
	Mark	RADKA	UNEP	Apologies
E.U.	Paul	DOYLE	CEC DGXVII	Apologies

3. Background to Task IX

Bernard McNelis gave an outline of the development of Task IX from the formation of the DC Team as a part of Task III. The DC Team was made a Special Inter-Task project by the PVPS Executive Committee in November 1995.

The participants were informed of the activities of the DC Team which included:

- organisation of a seminar on PV as part of the world Bank's Energy Week in April 1998 which was attended by over 70 people;
- presentation of the possible new Task [Task IX] to the *'Village Power 98 Conference: Scaling up Electricity Access for Sustainable Rural Development'*. The conference was co-sponsored by the World Bank and the US National Renewable Energy Laboratory and took place between 6^{th} and 8^{th} October 1998.

A brief outline of the strategic objectives of Task 9 was prevented. The primary objective of the Task is to further increase the overall rate of successful deployment of PV systems in developing countries. This will be achieved by:

1. development of Recommended Practice Guides based on existing information;
2. promoting improved techno-economic performance of PV in developing countries;
3. identification of areas where further technical research is necessary;
4. exchange of information with, and between, target groups;
5. workshops for, and information exchange with, donor agencies.

4. Country Experiences

Each participant gave a short overview of their national aid agencies and prioirities.

5. Presentation of Task IX workplan

Jonathan Bates presented the detailed Workplan as approved at he ExCo meeting in Geneva in May 1999. The Workplan was drawn up by IT Power of the United Kingdom and Verhoef Solar Energy Consultancy of The Netherlands.

The main target sectors of Task IX have been identified as the following groups:

- local and multinational industry
- local and multinational banks
- local and multinational utilities
- government and semi-government agencies
- multilateral and bilateral donor agencies
- development banks
- non-governmental organisations (NGOs)
- R&D institutions
- training organisations
- foundations
- professional bodies
- consumer associations

In order to reach the objectives, three Subtasks have been defined.

Subtask 10: Deployment Infrastructure

This will contribute to overcoming the critical barriers to widespread PV deployment and implementation through the development, dissemination and application of a series of Recommended Practice Guides (RPGs) to promote the necessary infrastructure requirements in developing countries. These RPGs will be both technical and non-technical covering issues such as quality and certification, operation and maintenance, training and accreditation, and financing mechanisms (both subsidised and non-subsidised). Three activities with Subtask 10 were proposed:

Activity 11	Information Compilation and Analysis
Activity 12	Recommended Practice Guide Preparation
Activity 13	Dissemination and Promotion of Recommended Practice Guides

Subtask 20: Support and Co-operation

This will stimulate awareness and interest amongst multilateral and bilateral agencies, NGOs, development banks, on the technical and economic potential, opportunities and recommended practice of PV systems. This will enable decision-makers to obtain the expertise and knowledge that is required to prepare PV programmes and appropriate PV system deployment. Two activities with Subtask 20 were proposed:

Activity 21	Support to Multilateral and Bilateral Donors and Development Banks
Activity 22	Co-operation with REWP and IEA/OECD

Subtask 30: Technical and Economic Aspects of PV in Developing Countries

To investigate the techno-economic aspects and potential of PV systems, and the roles of utilities in developing countries. This Subtask will identify areas of specific concern to developing country applications requiring further research and feed this into other parts of the IEA PV programme. Three activities with Subtask 30 were proposed:

Activity 31	Stand-alone PV systems
Activity 32	Village grid and hybrid systems
Activity 33	Grid-connected PV systems

The direct outputs from the programme will include:

- collation and analysis of existing publications on PV in developing countries;
- Recommended Practice Guides for successful introduction and expansion of PV systems drawing from past experiences and lessons learned from technology co-operation projects and programmes. These will be disseminated by appropriate means in selected developing countries;
- staff workshops for multilateral and bilateral agencies;
- workshops in non-IEA countries, co-ordinated with bilateral and/or multilateral agencies and/or NGOs;
- active participation of target groups in selected developing countries;
- dialogue and contact point with staff of multilateral and bilateral agencies;
- identification of technical issues relating to PV in developing countries.

The results will be available to the Participants and associated experts in developing countries. Public reports on the key results will be available for all individuals, companies and institutes involved with PV systems.

6. Estimated Manpower Requirement for Completion of Workplan

The estimated manpower requirement for completion of the global workplan is given in the table.

	Activity	**Person months**
Subtask 10	Activity 11: Information compilation and analysis	60
	Activity 12: RPGs (7)	20
	Activity 13: Dissemination and Promotion of RPGs	30
Sub-total		*110*
Subtask 20	Activity 21: Support to Donors and Banks	15
	Activity 22: Co-operation with REWP and IEA/OECD	15
Sub-total		*60*
Subtask 30	Activity 31: Stand Alone PV Systems	18
	Activity 32: Village Grid and Hybrid Systems	12
	Activity 33: Grid-connected PV Systems	10
Subtotal		*40*
Total		***220***
Annual total		***44***

7. Identification of Subtask Leaders.

Following the Workplan presentation, a discussion on the identification of the 3 Subtask Leaders was initiated. The Netherlands and the USA both expressed interest in leading Subtask 10 and Switzerland the UK expressed interest in leading Subtask 20.

It was agreed that:

Subtask 10 would be led by The Netherlands
Subtask 20 would be led by Switzerland
Subtask 30 would be led provisionally by Japan.

The Subtask leaders agreed to expand on the global workplan and to provide a detailed workplan for each Subtask. This would be circulated to all participants prior to the next meeting.

8. Co-operation with Developing Countries

The IEA has recently announced a policy of co-operation with developing countries. a mechanism by which this can occur within Task IX needs to be identified. Possibilities include:

- Participation in Implementing Agreements
- Technology Co-operation Agreements

The PVPS programme through Task IX is the first Implementing Agreement to address this directly and will therefore needs to be sure of how this can be done effectively. Mechanisms by which this co-operation can be developed were identified as:

- Hold Task meetings in target countries
- Hold workshops in target countries
- Target country experts participate in meetings
- DC experts to undertake work - assist with surveys etc

A number of countries will be identified as target countries for Task IX. Possible selection criteria include: geographical spread; large potential market; existing market; sustainable market; previous experience; Task III DC Survey Report.

A provisional list of Target Countries was drawn up: India, China, Philippines, South Africa, Argentina, Brazil, Indonesia, Morocco, Kenya, Sri Lanka, Mexico (IEA member), Honduras, Guatemala, Vietnam, Thailand, Syria, SDC countries, Island states.

It was agreed that a matrix would be drawn up listing countries against various criteria and this would be circulated to experts for completion.

9. Co-operation with Task I

Peter Ahm gave a presentation outlining the work of Task I. The production of the 6 monthly nesletter was highlighted along with the International survey Reports.

10. Co-operation with Task III

The Task III contact person for Task IX, Frans Nieuwenhout of ECN, presented an overview of the Task III Workplan and how Task III and Task IX could work together to avoid any duplication of effort.

Key areas of co-operation were agreed as in the preparation of Recommended Practice Guidelines (RPG) under Task IX Subtask 10 and Task III Subtask 1 and between Task IX Subtask 30 and Task III Subtask 2.

Winfried Rijssenbeek agreed to act as the contact point for Task III.

Frans Nieuwenhout also gave an overview of one of the World Bank Quality Assurance Training Courses just completed in Jaipur, India.

11. Co-operation with the World Bank QUAP-PV project

ASTAE Unit at the World Bank has funded the development of QA documentation on:

- Quality Management in Photovoltaics: Manufacturers Quality Control Training Manual – (developed by PVGAP)
- Manual for design and modification of solar home system components – (developed by ECN)
- Training Manual for Quality Improvement of Photovoltaic Testing Laboratories in Developing Countries – (developed by FSEC)
- PV Installation and Maintenance Practitioner Certification Infrastructure: Development Procedures – (developed by ISP)

A series of pilot training programmes were ongoing at the time of the meeting in Jaipur, India. A representative of IT Power India was attending the course on behalf of Task IX.

The ASTAE Unit has asked the PVPS Programme and Task IX in particular to review the QA manuals and training programmes. The possibility of Task IX to replicating the training programmes in countries not covered by ASTAE was also raised. The World Bank would be prepared to publish the manuals as a joint publication with the Task IX if a serious review of the documentation were to be undertaken.

The consensus was that there was certainly a need for a quality standard of some kind for World Bank and other programmes and that these manuals went a long way towards addressing this. There was also some discussion as to what the procedures would be in order for the PVPS programme to approve the manuals – this would have to be clarified by the Executive Committee of PVPS.

At the time of the meeting only the Manufacturers Quality Control Training Manual had been received, although some of the comments below are likely to be relevant to the other manuals.

The comments made are summarised below:

1. the manuals assume detailed knowledge of quality management which will often be lacking in developing countries;
2. concern was expressed at the relevance of ISO 9000 to developing countries - especially small manufacturers of BOS components - could supplier guarantees play a role here? Furthermore, ISO 9000 does not necessarily provide a guarantee of quality but of consistency;
3. implementation of the manuals may create further barriers to PV deployment;
4. the manuals do not consider project planning or system design - both of which are crucial for successful PV deployment;
5. there will always be a market for lower specification and lower cost products;
6. there could be conflicts with National Standards in some countries.

It was also agreed that the replication of training courses was beyond Task IX's remit.

Frans Nieuwenhout from ECN also a gave a short presentation on the *Quality Assurance for Improved Design of BOS Components* manual. The general consensus was that this manual would be more appropriately reviewed by experts from Task III.

12. Contacts and Liasons

The following Experts were appointed to act as contact points:

IEA PVPS Task III	Winfried Rijssenbeek, ETC, The Netherlands
World Energy Council	Gerry Collins ,CIDA, Canada
Renewable Energy Working Party	Bernard McNelis, IT Power, GBR

13. Manpower Commitment of Participating Countries

Experts were asked for their estimated annual manpower commitment to the three subtasks. These are summarised in the table.

Subtask	***Participating Countries***											
	AUS	CAN	CHE	DEN	FIN	FRA[1]	GBR[2]	ITA	JPN	NLD	USA	Total
Deployment infrastructure	1	1	2		1		2.5	3.5	1	2.5	2.5	17
Support and co-operation	1	2	4 (+3)	4			3		1	0.5	0.5	16
Techno-economic aspects	1						1	2	2			6
Total annual effort	**3**	**3**	**6**	**4**	**1**	**6-12**	**6.5**	**5.5**	**4**	**3**	**3**	**45**

14. Proposals for 2nd and 3rd Expert Meetings

In order to enable Task IX to interact with experts from developng countries it is intended that the experts meeting will be held in devleoping countries as far as possible. Possible dates and locations for the 2nd and 3rd Experts Meetings are :

31st January to 2nd February 2000 – Marrakech, Morocco
2nd – 3rd October 2000 – Jakarta, Indonesia

[1] Based on indication given at Task IX Prepartory Workshop, Eversley, UK, October 1998.
[2] Exclusive of Operating Agent function.

15. List of Actions

Action	By	Date
Develop detailed Work-plan for 3 subtasks and circulate to all experts for comments	NLD, CHE, JPN	13/11
Comments to Subtask Leaders	All	30/11
Final Workplan	NLD, CHE, JPN	31/12
Investigate REWP schedules	GBR	31/10
Establish contact with World Energy Council and distribute contact details/notes of meetings	CAN	31/10
Liase with K Presnell on PV-D hybrid	AUS	31/10
Distribute Task 3 Survey Report	GBR	✓
Distribute information on Italian bilateral programmes	ITA	31/11
Meetings Marrakech, Jakarta, Paris?	GBR	
Target country matrix	GBR	31/10
Distribute ISR to T9 experts	GBR	31/10
Summarise discussion on Quality manuals and circulate for comment – then send to ASTAE	GBR	31/10
2nd meeting 31/1/00 to 3/2/00 – Marrakech TBC	GBR/UNDP	
3rd Meeting Jakarta – 2-3 October 2000	GBR	
Investigate ACE hosting meeting in Jakarta with EC support	CHE	15/11
IEA info to ACE	GBR	31/10
Prepare Task IX flyer draft then circulate	GBR	31/10
Circulate PV in DC markets paper	GBR	✓
Arrange meeting for w-plan development w/c 8.11	GBR, NLD, CHE	22/10
Finalise website (address <<ieatask9.org>>)	USA	

ANNEX 1

International Energy Agency
Photovoltaic Power Systems Programme
Task IX

Deployment of Photovoltaic Technologies: Co-operation with Developing Countries

Agenda – Thursday 14 October	Discussion Leader	Time
Welcome by host	W. Van Nes	10.00
Brief Introductions	All	10.15
Background to, and development of, Task IX	B McNelis	10.30
Presentation of country experiences and activities (15 mins per expert)	All	11.30
Lunch		*13.00 – 14.00*
Presentation of country experiences and activities (continued)	All	14.00
Subtask 1 – Deployment Infrastructure Identification of subtask leader Detailed workplan and organisation of subtask	W Rijssenbeek	15.30
Subtask 2 – Support and Co-operation Identification of subtask leader Detailed workplan and organisation of subtask	J Bates B McNelis	16.30
Finalisation of Subtasks 1 and 2	All	17.30
Close		18.00
Dinner – hosted by NOVEM		*19.30*

Agenda - Friday 15 October	Discussion Leader	Time
Subtask 3 – Techno-economic aspects Identification of subtask leader Detailed workplan and organisation of subtask	J Bates	09.30
Future Subtasks	All	11.30
Co-operation with Developing Countries and Experts	J Bates	12.00
Lunch		*13.00 – 14.00*
Co-operation with Task III	F Nieuwenhout	14.00
Review of World Bank Pilot Training Programmes in India	F Nieuwenhout	14.15
Co-operation with Task I	P Ahm	14.30
Review of World Bank QA documents and publication, training programmes and replication	J Bates	15.30
Discussion of PVGAP manual – preparation of comments	All	16.30
Close		18.00
Dinner – speech by Eliott Berman, ('the man who brought solar cells down to earth' – John Perlin)	TBD	19.30 (TBC)

Agenda - Saturday 16 October	Discussion Leader	Time
Task IX Communication Strategy – website, publications	M Fitzgerald	11.00
Future meetings schedule	All	11.30
Presentation to ExCo	B McNelis	12.00
Any Other Business	All	12.30
Close		13.00

IEA（国際エネルギー機関）

PVPS（太陽光発電システム計画）

Task Ⅸ

太陽光発電技術の開発:

発展途上国協力

第1回専門家会議議事録

オランダ ユトレヒト

1999 年 10 月 14-16 日

1. 協議事項

協議事項は、提出されたように同意された。－付属書類 1.を参照。

2. 参加者の紹介

各参加者は、彼らの専門技術の核となる分野を概略する簡単な紹介を求められた。これを表に要約する。

国	代表者氏名	組織	専門技術
ｵｰｽﾄﾗﾘｱ	Gordon THOMPSON	CASE	発展途上国での再生可能ｴﾈﾙｷﾞｰ応用
ｵｰｽﾄﾘｱ	Geoff STAPLETON	GSES	電力事業経験者。発展途上国での再生可能ｴﾈﾙｷﾞｰｺﾝｻﾙﾀﾝﾄ。訓練に関わる
ｶﾅﾀﾞ	Gerry COLLINS	CIDA	ｴﾈﾙｷﾞｰ部門の上席ｱﾄﾞﾊﾞｲｻﾞｰ
ﾃﾞﾝﾏｰｸ	Peter AHM	PA Energy A/S	発展途上国での太陽光発電と風力応用の専門家。Task I のﾃﾞﾝﾏｰｸ代表
ﾌｨﾝﾗﾝﾄﾞ	Heikki NEUVONEN	Forlum AES	発展途上国での太陽光発電市場の責任者
ｲﾀﾘｱ	Cario ZUCCARO	ENEL	太陽光発電/風力に関わる電力専門家。系統連系太陽光発電にも従事
日本	原田 恒久	JPEA	日本太陽光発電懇話会代表
日本	谷 隆之	IEEJ	JICA の太陽光発電ｺﾝｻﾙﾀﾝﾄ。周辺地域電化用太陽光発電に参加
ｵﾗﾝﾀﾞ	Winfried RIJSSENBEEK	ETC	農業工学を経歴。ｶﾘﾌﾞ海域とﾍﾟﾙｰの風力及びﾊﾞｲｵｶﾞｽに関する再生可能ｴﾈﾙｷﾞｰに従事
ｵﾗﾝﾀﾞ	Pim KIESKAMP	ETC	小規模ｴﾈﾙｷﾞｰｼｽﾃﾑに関する気候変化及び発展途上国における環境影響の専門。
ｽｲｽ	Alex ARTER	ENTEC AG	10 年間 GTZ のための RE 計画の設計に従事。周辺地域開発と水力発電を経験
英国	Bernard MCNELIS	IT Power Ltd	広範な発展途上国経験を有する専門家
英国	Jonathan BATES	IT Power Ltd	独立分散及び系統連携太陽光発電に関する技術的及び経済的双方の専門
米国	Mark FITZGERALD	ISP	(土曜日のみ出席)
	Suresh HURRY	UNDP	再生可能ｴﾈﾙｷﾞｰ、ｴﾈﾙｷﾞｰ効率、地方電化に関する英国での経験

他の招待者:

国	代表者氏名		機関	注釈
フランス	Jean-Louis	BAL	ADEME	連絡無し
デンマーク	Jean-Paul	LAUDE	DANIDA	欠席の陳謝
	Enno	HEIJNDERMANNS	Worid Bank,ASTAE	欠席の陳謝
	Mark	RADKA	UNEP	欠席の陳謝
E.U.	Paul	DOYLE	CEC DGXⅦ	欠席の陳謝

3. Task Ⅸの背景

Betnard McNells は、Task Ⅲの一部であるDC チームの編成から Task Ⅸの進展の概略を説明した。DC チームは、1995 年 11 月に PVPS 執行委員会から Task 内プロジェクトとして編成された。

参加者は、次のことを含む DC チームの活動を通知された。

- 70 名以上が参加した 1998 年 4 月の世界銀行エネルギー週間の一部としてのセミナーの組織;
- 「村落電化 98 会議:持続可能な周辺地域開発のための電化方策の拡大」に対する可能な限りの新たな Task(Task Ⅸ)の発表。会議は、世界銀行と米国国家再生可能エネルギー研究所で共催され、1998 年 10 月 6~8 日に開催された。

Task 9 の戦略的目標の簡単な概要が提出された。Task の基本的な目標は、発展途上国での成功した太陽光発電システムが全体的な割合で更に増加することである。これは、以下のことで成し遂げられるだろう。

1. 現存する情報に関する推奨実施手引きの開発;
2. 発展途上国における太陽光発電の改良された技術-経済的性能の促進;
3. 更なる技術的調査が必要な地域の明確化;
4. 目標グループからのそして共同での情報の交換;
5. 提供機関のための研究会と情報交換。

4. 各国の経験

各参加者は、それぞれの国家機関と優先事項の簡単な概要を説明した。

5. Task Ⅸの作業計画の提出

Jonathan Bates は、1999 年 5 月のジュネーブでの ExCo(執行委員会)会合で是認された詳細な作業計画を提出した。作業計画は、英国の IT Power と Verhoef 太陽エネルギーコンサルタントにより作成された。

Task Ⅸの主たる目標分野は、次のグループに定義される:

- 一国及び多籍間産業
- 一国及び多国間銀行
- 一国及び多国間電力事業者
- 政府及び準政府機関
- 多国間及び二国間提供機関
- 開発銀行
- 非政府機関(NGOs)
- 研究開発機関
- 研修機関
- 基金
- 専門団体
- 消費者組合

目標の研究のために、三つの Subtask が置かれた。

Subtask 10:開発基盤

これは、発展途上国における必要な基盤の要求条件を促進するための推奨実施手引き(RPGs)シリーズの開発、普及及び適用による広範な太陽光発電の開発と実行に対する危機的な障害を克服することに寄与することにある。これらの RPGs は、品質と証明、運転と保守、研修と認定、そして(補助及び非補助双方の)融資方式などの論点を対象とする技術的及び非技術的なものである。Subtask 10 には三つの activity が提案された。

Activity 11　情報の編集と分析
Activity 12　推奨実施手引きの準備
Activity 13　推奨実施手引きの普及と促進

Subtask 20:支援と協力

これは、太陽光発電システムに関する技術的及び経済的潜在性、機会及び推奨実施を、多国間及び二国間機関、NGOs、開発銀行に認識と興味を刺激するものとなる。これは、意志決定者が、太陽光発電計画を準備し太陽光発電システムの開発を承認するために必要な専門技術と知識を得ることを可能とするだろう。

Activity 21　多国間及び二国間提供団体及び開発銀行の支援
Activity 22　REWP と IEA/OECD との協力

Subtask 30:発展途上国における太陽光発電の技術的及び経済的状況

太陽光発電システムの技術-経済的状況と潜在性、そして発展途上国での電力事業者の役割を調査すること。この Subtask は、更なる研究を必要とする発展途上国に対する特別な関心の領域を明確にし、そして IEA PV 計画の他の部分へこれを供給することとなる。Subtask 30 の三つの activity は、次のように提案された。

Activity 21　独立分散型太陽光発電システム
Activity 32　村落電力系統及びハイブリッド型システム
Activity 33　電力系統連系型太陽光発電システム

計画からの直接的な成果は、次のようになるだろう。

- 発展途上国における太陽光発電に関する現存する出版物の照合と分析；
- 技術協力プロジェクトと計画から学んだ経験と教訓から導き出される太陽光発電システムの成功した導入と拡張のための推奨実施手引き。これらは、選ばれた発展途上国における適切な手段により普及されるだろう。；
- 多国間及び二国間機関のためのスタッフ研究会；
- 二国間或いは多国間機関若しくは NGOs と協力による、非 IEA 加盟国での研究会；
- 選ばれた発展途上国における目標グループの活動的な参加；
- 多国間及び二国間機関のスタッフによる対話と接触点；
- 発展途上国における太陽光発電に関係する技術的論点の明確化。

この結果は、参加者と発展途上国の関連する専門家に利用されるだろう。重要な結果の公の報告は、太陽光発電システムに関係する個人、企業及び研究所に利用可能となるだろう

6. 作業計画完了のために必要な総人員の見積もり

全作業計画完了のために必要と見積もられた総人員は、表に示す。

	活動	人/月
Subtask 10	Activity 11：情報編集と分析	60
	Activity 12：RPGs(7)	20
	Activity 13：RPGs の普及と促進	30
小計		*110*
Subtask 20	Activity 21：提供団体と銀行への支援	15
	Activity 22：REWP と IEA/OECD との協力	15
小計		*60*
Subtask 30	Activity 31：独立分散型太陽光発電ｼｽﾃﾑ	18
	Activity 32：村落電力系統及びﾊｲﾌﾞﾘｯﾄﾞｼｽﾃﾑ	12
	Activity 33：電力系統連系型太陽光発電ｼｽﾃﾑ	10
小計		*40*
合計		***220***
年間合計		***44***

7. Subtask リーダーの決定

事業計画の提出に従い、3 名の Subtask リーダーの決定の議論が開始された。オランダと米国双方が Subtask 10 の指導に興味を表明し、スイスと英国が Subtask 20 の指導に興味を表明した。

以下のように同意された。

Subtask10 は、オランダが指導する。
Subtask20 は、スイスが指導する。
Subtask30 は、日本が仮に指導する。

Subtaskリーダーは、全作業計画の拡張と各Subtaskのための詳細な作業計画の作成を同意した。これは、次の会合前に全参加者に配布されることとなった。

8. 発展途上国との協力

IEA は、最近、発展途上国との協力の方針を表明した。Task IXにおいて、このことが生じることを可能とする方式を明確にする必要がある。それは次のとおり:

- 実施協定に参加
- 技術協力機関

Task IXによる PVPS 計画計画は、これを直接的に呼びかけるための最初の実施協定であり、このために、これが如何に効果的になされるべきかを明確にする必要がある。この協力が開発されるべき方式は次のとおり:

- 目標国での Task 会合の開催
- 目標国での研究会の開催
- 会合への目標国専門家の参加
- 作業を引き受ける DC 専門家－調査等を助力

いくつかの国が、Task IXの目標国として決定されるだろう。可能な選択基準は次を含む。地理学的広がり;大きな潜在的市場;維持可能な市場;以前の経験:TaskIIIDC 外観調査。

目標国の暫定的なリストは次のとおり。インド、中国、フィリッピン、南アフリカ、アルゼンチン、ブラジル、インドネシア、モロッコ、ケニア、スリランカ、メキシコ(IEA 参加国)、ホンジュラス、グアテマラ、ベトナム、タイ、SDC 国、諸島国。

様々な基準に対するリスト国としてマトリックスを書き上げ、完成のためにこれを専門家に配布することが、同意された。

9. Task Iとの協力

Peter Ahm は、Task IXの作業の概要を説明した。六ヶ月単位のニュースレターの成果は、国際調査報告の中で目立つものとなった。

10. Task Ⅲとの協力

Task Ⅸに対するTask Ⅲの接触要員である、Ecn の Frans Nleuwenhout は、Task Ⅲの作業計画の概要と、如何にTask ⅨとTask Ⅲが作業の重複を避けて、共に作業を行うかを説明した。

協力の重要分野は、Task Ⅸ Subtask 10とTask Ⅲ Subtask 1とTask Ⅸ Subtask 30とTask Ⅲ Subtask 2間の推奨実施手引きの準備として、同意された。

Winfried Rijssnbeek は、Task Ⅲと接触することを同意した。

Frans Nieuwenhout は、インドのジャイプルでまさに完了したばかりの世界銀行品質保証研修コースの一つについての概要を説明した。

11. 世界銀行 QUAD-PV プロジェクトとの協力

世界銀行の ASTAE Unit は、次の QA 文書にある対象の開発に資金を提供した。

- 太陽光発電の品質管理:製造業者品質制御研修マニュアルー(PVGAP が作成)
- 家庭用太陽光発電システム部材の設計と修正のためのマニュアルー(ECN が作成)
- 発展途上国における太陽光発電試験研究機関の質的向上のための研究マニュアルー(FSEC が作成)
- 太陽光発電設置及び保守技術者証明基幹施設:開発手順ー(ISP が作成)

先導的研修計画のシリーズが、インドのジャイプルでの会合と同時に進行中であった。IT Power インドの代表は、Task Ⅸのために、そのコースに出席した。

ASTAE Unit は、とりわけ QA マニュアルと研修プログラムの再検討を、PVPS 計画とTask Ⅸに求めた。ASTAE で対象とされなかった国での研修プログラムの再実行に対するTask Ⅸの可能性もまた、取り上げられた。もし文書の真剣な再検討が着手されたなら、世界銀行は、Task Ⅸとの共同出版としてのマニュアルの発行を準備するだろう。

世界銀行と他の計画に対しある種の品質標準の必要性は確かに存在し、これらのマニュアルはこれを呼び出すために役に立つ事のコンセンサスが得られた。PVPS プログラムにとって、マニュアルを認めるために如何なる手順が存在し得るかもまた議論されたーこれは、PVPS の執行委員会で明らかにされるべきである。

会合時に、製造業者品質制御研修マニュアルのみが受領されたが、以下の幾つかのコメントが他のマニュアルに関連しそうである。

コメントは、次のように要約される。

1. マニュアルは、発展途上国で度々不足しそうである品質管理の詳細な知識を対象としている;

2. 発展途上国に対するISO 9000の関連に関心が寄せられたーとりわけ、周辺機器部材の小規模製造業者に対してー供給業者の保証はここでは有効か。更に、ISO 9000 は、必然的に品質保証ではなく、一貫性を提供する;
3. マニュアルの実行は、太陽光発電開発への更なる障害を産み出すこととなる;
4. マニュアルは、プロジェクト計画或いはシステム設計を考慮していないー両者とも成功する太陽光発電開発には重要である;
5. 常に、低い仕様と低コストの製品が市場にある;
6. ある国においては、国家標準との争いがあり得る。

研修コースの複製は、Task IXの限界を越えていることも同意された

ECN の Frans Nieuwenhout は、*周辺機器部材の改良された設計のための品質保証*マニュアルの簡単な説明を行った。このマニュアルは、Task IIIの専門家により適切に再検討されるべきであることが、全体一致で承認された。

12. 接触と連絡

次の専門家は、接触役を任命された。

IEA PVPS Task III	Winfried Rijssenbeek、ETC、オランダ
世界エネルギー会議	Gerry Collins、CIDA、カナダ
再生可能エネルギー作業会合	Bernard McNells、IT Power、GBR

13. 参加国の作業人員委任

専門家は、三つの subtask に対する年間の作業人員依頼の見積もりを頼まれた。これらは、表にまとめている。

Subtask	参加国										
	AUS	CAN	CHE	DEN	FIN	FRA[1]	GBR[2]	ITA	JPN	NLD	USA	合計
基盤開発	1	1	2		1		2.5	3.5	1	2.5	2.5	17
支援・協力	1	2	4(+3)	4			3		1	0．5	0.5	16
技術経済観点	1						1	2	2			6
全年間量	3	3	6	4	1	6-12	6.5	5.5	4	3	3	4.5

14. 第2回及び第3回専門家会合の提案

発展途上国からの専門家と Task IXが相互に影響し合うために、専門家会合は、可能な限り発展途上国で開かれる予定である。第2回及び第3回専門家会合の可能な時と場所は次のとおり:

2000年1月31日～2月2日	モロッコ、マラケシュ
2000年10月2日～3日	インドネシア、ジャカルタ

IEA PVPS Task IX
Deployment of PV Technologies Co-operation with
Develpoping Countries

第２回 海外専門家会議報告

1. 開催月日：平成１２年２月８日(火) ／９日(水)
(2000)

2. 開催場所：ＵＳＡ Washington ＤＣ
World Bank Main Complex, Conference Room MC 13-130

3. 出席者：

ＮＥＤＯ太陽技術開発室	主査	脇	栄一
同 上		萬木	慶子
吉野コンサルタント事務所	代表	吉野	量夫
太陽光発電懇話会 事務局	次長	原田	恒久

4. 参加者：

2ND Experts Meeting: List of Participants

AUS	Gordon Thompson (CASE)
AUS	Geoff Stapleton (GSES)
CAN	Gerry Collins (CIDA)
CAN	Josef Ayoub (CANMET)
CHE	Alex Arter, (Entec),
CHE	Stefan Nowak (NET AG) – *Tuesday only*
DEN	Peter Ahm (PA Energy)
DEU	Klaus Preiser (Fraunhofer Institute)
DEU	Rolf Posorski (GTZ)
FRA	Hubert Bonneviot (IED)
GBR	Bernard McNelis (IT Power)
GBR	Jonathan Bates (IT Power)
ITA	Roberto Vigotti (ENEL)
JPN	Tunehisa Harada (JPEA)
JPN	Kazuo Yoshino
JPN	Eiichi Waki (NEDO)
JPN	Keiko Yurugi (NEDO)
NLD	Winfried Rijssenbeek (ETC)
USA	Mark Fitzgerald (ISP)
USA	Roger Taylor (NREL)
USA	Robert Hassett (DoE)
UNDP	Suresh Hurry
World Bank	Enno Heijndermanns
World Bank Consultant	Eric Martinot

5. 会議の目的
・キックオフミーティング(第1回 専門家会議-'99/10/14~16)にて確認した作業計画並びに対象とする途上国の選定の審議
・世界銀行を中心として検討されている、開発途上国へのＰＶ導入普及計画との協調についての情報交換

6．議事概要

6 -1：第１日目（２／８）

1)ＯＡ挨拶（Mc Nelis）

順調に会議が進められるよう祈念する事並びに会場提供についての御礼

2)歓迎の挨拶（WB：Heijnderrmanns）

3)自己紹介

席次順に簡単な自己紹介を行った。

4)ＩＥＡ　ＰＶＰＳ　Ｔａｓｋ　IXの目的（Mc Nelis）

新たな参加者を念頭において、Task IXの活動目的について概要説明がされた。

5)要人のスピーチ

ａ：Roberto Vigotti　（前 IEA PVPS 実行委員会議長）

PVPS Task IX新設にあたって、地球規模における太陽光発電の長期的導入計画の立案と実証、評価の推進を期待する、との発言がなされた。

ｂ：Enno Heijnderrmanns　（W.B）

発展途上国へのＰＶ導入拡大アプローチには相当な困難がある。例えば中国、ブラジル等でのトレーニングマニュアルは相当する言語にしておく必要があり、相応するトレーナーの選定も重要である。その国に相応しいRenewable Energy System の選定やファイナンスとその返済方策の組立てにあたって、市場拡大の方策も考えなければならず、相当な努力が必要とされる。Task IXの活動に期待する、との発言がなされた。

6)第１回　専門家会議議事録の確認

ＯＡから確認が行われ、日本から　2. Introduction of participants　谷 氏のOrganisationの訂正(JICA をIEEJ) 及び ExpertiseのSUNE projectは内容不明につき削除を申入れた。その他は異議なく承認された。

7)Ｓubtask 10/20のワークプラン説明

Ｓubtask 10/20はその活動目標から、並列して作業する事がより効果的であるとの見解に立ち準備作業を行なった。事前に送付されたワークプランのポイントにつきスライド又は口頭による説明がなされた。

ａ：Ｓubtask 10(Deployment Infrastructure-普及基盤整備) (NLD-Rijssenbeek)

・目　的：開発途上国へＰＶの効果的／効率的な導入展開に寄与する事。

・対象GP：ＰＶプログラムに関わる関係者、即ち供与／開発官庁、銀行、企業、公益団体、研究／研修機関、財団、消費者団体等。

・方　法：選定された開発途上国を対象に調査を行い、PVプログラムに関する情報収集を行う。有望な開発途上国にへの効果的／効率的なPV普及を促進するため、開発銀行、供与機関、関係官庁のためのワークショップを開催する。
開発途上国の調査に基づき報告書を作成し、Taskに有益な情報を提供する。
同時にケースタディとしてＲＰＧｓ(ﾘｺﾒﾝﾃﾞｯﾄﾞ ﾌﾟﾗｸﾃｨｽ ｶﾞｲﾄﾞ)との精査を行い開発途上国への効果的／能率的なＰＶ導入展開に寄与する。

・Activity:　Act.11(情報の収集と解析)　Act.12(RPG)　Act.13(RPGの普及と推進)

b:　Subtask 20 (Support & Co-operation-支援と協力)　(CHE-Arter)

・目　的：選定された開発途上国のＰＶ導入展開にあたって技術的、経済的潜在性や社会的価値、ＰＶシステムの実用性を提示して、エイジェンシーと開発銀行の相互連携を深めるシステム作りをする。

・Activity:　Act.21(多国間/二国間援助者と開発銀行の支援)　Act.22(IEAのREWPとIEA/OECDとの連携)

以上の説明の後、10/20 の一括討議が行われた。その主な事項は次の通りであった。

・発展途上国の事情、開発目標との整合を計り、サクセスストーリーとする要望。
・現地調査を十分行い、Task Ⅸ－発展途上国－Warld Bankの関係を明確にして、効果的／能率的なＰＶ導入展開に寄与するようにして欲しい。
・Expert/Consult Team メンバーの選定は慎重に、十分検討して欲しい。
・Task Ⅸチームと単独コンサルとの関係に混乱を来さぬように情報は蜜にする。
・全体的な作業予定の固めをする事。
・How to do itが大切（例：ホンジュラス、グァテマラ）
・UNDPとWarld Bankのポジションは異なる事を十分承知しておく事。
　－ＷＢは借款金利の回収にあたっての体制整備を望んでいるようだ－

8) Target Countries の調査結果(J.Bates)

選定にあたって、事前に規定様式にてメンバーに調査した結果が報告された。
Target Countries として選定の多かった国は下記の通り。

・選定者数　7：Morocco　Vietnam
　　　　　　6：SouthAfrica　Indonesia
　　　　　　5：China　India　Philippines
　　　　　　4：Argentina
　　　　　　3：Brazil　Kiribati(Island Countries グループ)

エリア間のバランスやＧＤＰグレード等も念頭に、可能性のある国の総調査をし、上記の結果も参考にして絞り込みをする方向となった。

9) Subtask 30(Technical & Economic Aspects of PV in Developing Countries)のワークプランについて(JPN-HARADA,YOSINO)

1／12付　E-mail (J.Bates) の提案である、"Germany may agree to participate in Task 9 and, if you agree, they might be willing to takeover the leadership of subtask30" についてNEDOとの事前打合わせに基づき、リーダーの変更を申入れた。
説明振りは "暫定リーダーの谷は現在JICAプロジェクトの専門家として、当面2~3ヵ月間セネガルに派遣されており、以降も頻繁にセネガルに行かなければならない見通しである。又事務局(JPEA)の原田は３／末で退職する事となってしまった。
大変申し訳ないがリーダー国としての責務を全う出来ないので交替させて頂きたい"
以上の申し出により、Subtask 30 のリーダーを募ったが挙手者はなく、順次打診が行われた結果、他Subtaskへの組み入れも含め GBR,NLD,CHE,AUS,DEU,USAにて検討する事となった。

10) Summary of WB PV Consultative GP Meeting (McNelis)

前日(2/7) ＷＢにて開催された標記　ＰＶ Consultative GP Meetingの概要が報告された（本会議にはNEDO/JBIC が出席）詳細は当該報告書を参照

11)ＷＢ　Quap-PV Manual について(USA-M.Fitzgerald)

Quap-ＰＶ Projectにて作成したマニュアル（インドでフォローアップしたとの事）の検討もＴask Ⅸ にて行って欲しい、との提案があった。

第１回 Meeting参加者から、Ｔask Ⅸ では開発途上国でのＰＶ関連機器等の製造に関わる品質管理を中心とするマニュアルの検討をする事が第１回 Meetingにて確認されている、との意見が述べられたが、まず内容を見るため関係者に配布する事となった。

（付記）

Quap-PV Project：Mitigating Global Climate Change Through the Development
of a Quality Process Infrastructure for Renewable Energy

6-2: 第２日目（２／９）

1)World　Bank SHS　Projects (WB-E.Martinot)

-Experiences & Lessons Learnd 1993~2000-

コメントを求めるための資料が配布され、資料に基づき概要説明がなされた。

・ＳＨＳにより電力供給のない農村部に照明、ＴＶ等の電力を供給し、導入拡大の課題をピックアップする事であり、次の６つの基本形態が組合わされている。

① 企業及びＮＧＯの供給モデル(ディーラーによる販売とエネルギー供給者による供給)
② 消費者にクレジット供給するメカニズム(ディーラー、消費者金融、開発金融制度)
③ 事前補助と余裕時払いシステム
④ 支援政策の立案と能力
⑤ 法規と標準の制定及び認証・試験・制度の確立
⑥ 消費者の意識調査とマーケッティングプログラムの実行

５つのプロジェクト(バングラ、ドミニカ、インド、スリランカ、ベトナム)にて5,000 基以上のＳＨＳが設置されたが、未だ有望モデルは見出されていない。

将来のプロジェクトはこれらの教訓を生かして成果あるものとすることを期待する。

2)Financing PV from Carbon Credit Mechanisms(Mendis-AED)

専門家から　Carbon Credit の考え方は理論的には構築出来るが、具体化にあたっては開発途上国の開発計画との整合に十分留意した上で進めるべきである、とのコメントが出された。

3)The Quality Training Manuals for the PV (A.Cabraal-ASTAE)

WB-ASTAE(Asia Alternative Energy Program) にて検討された内容につき報告された。

目的：開発途上国におけるＰＶ寄与の有効性を一段と向上させる事。
　　特にインフラ、即ちPV品質(設計、製造、試験、設置、メンテナンス)の向上をねらいとする。

構成：PVインフラの異なった状況別に４つの品質トレーニングマニュアルで構成。
　　①ＳＨＳのＢＯＳ(電気部品)の設計と設計変更。
　　②製造者の品質管理

③ＰＶ試験機関の品質向上

④ＰＶ設置・メンテナンス事業者の資格認証プログラム

7．工場見学（午後）

ＢＰ　Solarex Facility （ワシントン郊外）

8．次回の予定

2nd~3rd Oct. 2000　Jakarta, Indonesia

以上

Photovoltaic Power Systems Programme

Task IX

DEPLOYMENT OF PHOTOVOLTAIC TECHNOLOGIES: CO-OPERATION WITH DEVELOPING COUNTRIES

presentation by

Jonathan Bates

to

Task IX 2nd Experts Meeting, Washington DC, USA, 8-9 February 2000

itPower

Agenda - Tuesday 8th

- Welcome & Introductions
- Role of REWP
- Approval of Minutes of 1st Experts Meeting
- Verification of actions
- Presentation and discussion of detailed workplans for Subtasks 10, 20 and 30
- Results of Target Countries Questionnaire
- Summary of PV Consultative Group Meeting
- Quap-PV Manuals

Agenda - Wednesday 9th

- IEA PVPS Task IX & World Bank
- World Bank SHS Projects: Experiences and Lessons Learned 1993-2000
- Recommended Practice for Training Programmes
- Financing PV from Carbon Credit Mechanisms
- *Visit to BP Solarex Manufacturing Facility*

-130-

Target Countries

- Geographical spread?
- Large potential market?
- Existing market?
- Sustainable market?
- Previous experience?
- Task III DC Survey Report?

Provisional Target Countries

Argentina
Bolivia
Brazil
China
Guatemala
Honduras
Indonesia
India
Kenya

Mexico - IEA member
Morocco
Philippines
Sri Lanka
South Africa
Syria
Thailand
Vietnam
Kiribati
French Polynesia

Provisional Target Countries

Circulate Target Country Matrix

Questionnaire -

- Preferences (yours or your paymaster!)
- PV data - access *and* availability
- Work experience: in-country + desktop
- Likelihood of undertaking missions
- Multi- and bilateral programmes
- Government policy
- Other countries?

Responses

The Good - 9

Australia
Canada
Denmark
France
Finland
Japan
The Netherlands
Switzerland
UK

The Bad - 2

USA
Italy

The Excused - 1

Germany

Other Countries

Botswana, Burkina Faso, Cape Verde, Columbia, Egypt, Ghana, Laos, Malawi, Malaysia, Mongolia, Namibia, Nepal, Pacific Island States, Palestine, Senegal, Yemen, Zimbabwe......

Multi-lateral and bi-lateral programmes

- No knowledge of multi-lateral programmes in Guatemala, Honduras & Syria

- Knowledge of bilateral programmes in all but Mexico

Preferred Countries

Argentina (4)
China (5)
Indonesia (6)
India (5)
Morocco (7)
Philippines (5)
South Africa (6)
Vietnam (7)
Brazil (3)
Kiribati (3)

Preferred Countries

Argentina (4)

- 3 have in-country experience
- 4 desktop experience
- 2 or 3 access to data
- Gov Policy 1- 4 (2.4)

China (5)

- 6 have in-country experience
- 3 desktop experience
- 5 access to data
- Gov Policy 1 - 3 (2.0)

Preferred Countries

Indonesia (6)

- 6 have in-country experience
- 4 desktop experience
- 2 or 3 access to data
- Gov Policy 1 - 2 (1.7)

India (5)

- 5 have in-country experience
- 5 desktop experience
- 4 access to data
- Gov Policy 1 - 3 (1.8)

Preferred Countries

Morocco (7)

- 6 have in-country experience
- 5 desktop experience
- 5 access to data
- Gov Policy 1 - 2 (1.6)

Philippines (5)

- 5 have in-country experience
- 4 desktop experience
- 3 or 4 access to data
- Gov Policy 1 - 3 (2.3)

Preferred Countries

South Africa (6)

- 4 have in-country experience
- 3 desktop experience
- 2 access to data
- Gov Policy 1 - 3 (1.8)

Vietnam (7)

- 6 have in-country experience
- 4 desktop experience
- 2 or 3 access to data
- Gov Policy 2 - 4 (2.8)

Preferred Countries

Brazil (3)

- 4 have in-country experience
- 3 desktop experience
- 1 access to data
- Gov Policy 2 - 3 (2.5)

Kiribati (3)

- 1 has in-country experience
- 1 desktop experience
- 1 or 2 access to data
- Gov Policy 2

International Energy Agency (IEA)

Photovoltaic Power Systems Implementing Agreement (PVPS)

TASK IX

DEPLOYMENT OF PHOTOVOLTAIC TECHNOLOGIES:

CO-OPERATION WITH DEVELOPING COUNTRIES

SUBTASK 10 & 20:

EFFECTIVE AND EFFICIENT PV DEPLOYMENT IN DEVELOPING COUNTRIES

- a joint and parallel to be undertaken activity -

WORKPLAN

Jointly prepared by:

ETC Energy, The Netherlands - Leader Subtask 10
ENTEC, Switzerland - Leader Subtask 20

January 2000

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FOREWORD

As a result of the discussions held during the meeting of IEA PVPS Task IX in Utrecht, The Netherlands on 10 January 2000, it was decided to compile one document containing both the workplan for subtasks 10 and 20 of IEA PVPS Task IX. It was agreed upon that, when implementing these tasks in parallel to each other, one could make use of each others' inputs and resources in a more effective way, at the same time presenting a coherent and comprehensive package to the outer world. Hence, a more efficient implementation of the workplan.

In this parallel effort, the Subtask Leaderships remain in hands of the initially assigned Subtask Leaders. This means, that ETC Energy, for the Netherlands, is Leader of Subtask 10. ENTEC, for Switzerland, is Leader of Subtask 20.

The underlying document is the result of the above initiative, where comments made by Task IX Leader (IT Power, UK) after submitting the separate workplans of the Subtasks 10 and 20, are incorporated.

SUMMARY

Subtask Leaders: For Subtask 10: The Netherlands (ETC Energy)
For Subtask 20: Switzerland (ENTEC)

Objective: To contribute to an effective and efficient PV deployment in developing countries.

Target group: Existing and potential clients involved in PV programmes. These clients include: multi- and bilateral donors and development agencies, banks, industries, utilities, R&D institutions, training organisations, foundations, professional bodies and consumer associations.

Method: Information on existing PV programmes and experiences is collected by making use of secondary information sources, and by means of conducting surveys in selected developing countries. Workshops will be organised for multilateral agencies, development banks and bilateral donors with the twofold aim to generate input for the Subtasks, and to promote effective and efficient PV deployment to potential clients. Surveys conducted in selected countries will result in the compilation of country reports. Case studies will be analysed and collated to a coherent series of Recommended Practice Guides. Promotion of effective and efficient PV deployment will be done through disseminating these materials and publications to the target group.

Output:
- Comprehensive set of practical Recommended Practice Guides targeted at development banks, multi-lateral and bilateral agencies, developing country experts and IEA PVPS member countries.
- Compilation of case study presentation, together with a comparative analysis of case study findings with lessons learned, targeting the existing and potential donors.
- Series of workshops organised serving as input generation for, and promotion of, effective and efficient PV deployment.
- Increased awareness and better understanding of factors influencing successes and failures of PV programmes in developing countries
- Enhanced understanding of PV deployment programmes by multi- and bilateral donors, banks and development agencies currently not involved in PV dissemination programmes

Duration: 5 years.

Budget: To be established.

1. GENERAL INTRODUCTION

There exists a certain overlap in the approach and activities to be carried out in order to reach the objectives of Subtasks 10 and 20:

- The objective of Subtask 10 ("Deployment Infrastructure") is to contribute to overcoming the critical barriers to widespread PV deployment. The approach by which this will be implemented will be to collate existing information and conduct surveys where necessary, in a number of target countries.

- The objective of Subtask 20 ("Support and Co-operation") is to increase PV content in donor agency activities and bank lending. This is done through stimulation of a dialogue with multilateral and bilateral agencies and development banks, informing them on the technical and economic potential, social implications, opportunities and best practice of PV systems.

The target group for these Subtasks is defined as existing and potential clients involved in PV programmes. These clients include: multi- and bilateral donors and development agencies, banks, industries, utilities, R&D institutions, training organisations, foundations, professional bodies and consumer associations.

At the last meeting of IEA PVPS Task IX held in Utrecht, The Netherlands on 10 January 2000, it was decided to combine the efforts of the subtasks into parallel planned activities. This, is envisaged, will increase efficiency of implementation, increase access to information, and better promotes this IEA IX task to the target group.

Basically, there are three areas of interaction between Subtasks 10 and 20:

- Identification of past experience and ongoing programmes on PV deployment and collation and analysis of information. Here, the two sub-tasks should closely work together so as not to duplicate identification work and contacts with programmes thereby annoying their managers and officers. The outcome here would be an agreement on who compiles which information. The division between subtask 10 and subtask 20 could be geographical or on a case-by-case basis.
- Case studies will be an integral part of both subtasks. While Subtask 10 will concentrate more on in-country performance and processes of PV deployment projects, subtask 20 will focus on the project identification aspects and donor expectations as well as the conditions for improved bankability of PV deployment projects. It is suggested that a number of case studies with an interest for both subtasks be carried out as joint undertakings whereby the two expert teams work simultaneously on the same case study albeit with different objectives.
- As subtask 10 is generally focussing on the generation of information and know-how and while subtask 20 is supposed to disseminate and make use of this know-how, there must be an efficient and professional exchange of information between the two subtasks. It is suggested that the two subtask leaders regularly update each other on their work and provide full transparency on what documents they have received (e.g., from in-country missions and surveys, from PV programmes by donors, banks and international NGOs or workshop presentations) and what new contacts they have made.

Furthermore, Subtasks 10 will be co-ordinating with IEA PVPS Task III ("Use of photovoltaic systems in stand-alone and island applications") especially in relation to Task IX/10 activities 12 and 13. It is considered important that all IEA PVPS tasks show a consistent view and outlay to the target groups to be reached.

The above resulted in this combined document, describing the objectives, expected outputs and approaches of the Subtasks 10 and 20. Wherever possible, activities related to information collection and promotion and dissemination of data, are planned as parallel activities so to better exchange information between the Subtasks 10 and 20.
Some of the workshops will be attended/organised jointly where these workshops are meant to:

1. gather relevant data from existing donors, banks and development agencies to be used as input for the materials to be compiled, and
2. to inform the potential donors, banks and development agencies on relevant PV experiences and perspectives, thereby promoting effective and efficient PV deployment.

2. AIMS AND OBJECTIVES

The overall objective of Subtasks 10 and 20 is to contribute to an effective and efficient PV deployment in developing countries.

This is done through collecting secondary information, conducting surveys in selected developing countries, analysing case studies, and organising workshops with multi- and bilateral donors, banks and development agencies. The results of the surveys will be analysed and result in publication of country reports. Case studies will be conducted and analysed, where the data will be collated into a coherent series of Recommended Practice Guides. The organisation of a series of workshops for the target group will be essential since they will be used as information generation events (serving as input for the Subtasks), and as promoting events to get potential donors, banks and development agencies informed and more acquainted with effective and efficient PV deployment. This potential group of clients will, as a results, have increased awareness on, and interest in, the subject.

The expected output is:

- Comprehensive set of practical Recommended Practice Guides targeted at development banks, multi-lateral and bilateral agencies, developing country experts and IEA PVPS member countries.
- Compilation of case study presentation, together with a comparative analysis of case study findings with lessons learned, targeting the existing and potential donors.
- Series of workshops organised serving as input generation for, and promotion of, effective and efficient PV deployment.
- Increased awareness and better understanding by the target group of factors influencing successes and failures of PV programmes in developing countries
- Enhanced understanding of PV deployment programmes by multi- and bilateral donors, banks and development agencies currently not involved in PV dissemination programmes

The following figure represents the relation and information exchange between the different parties:

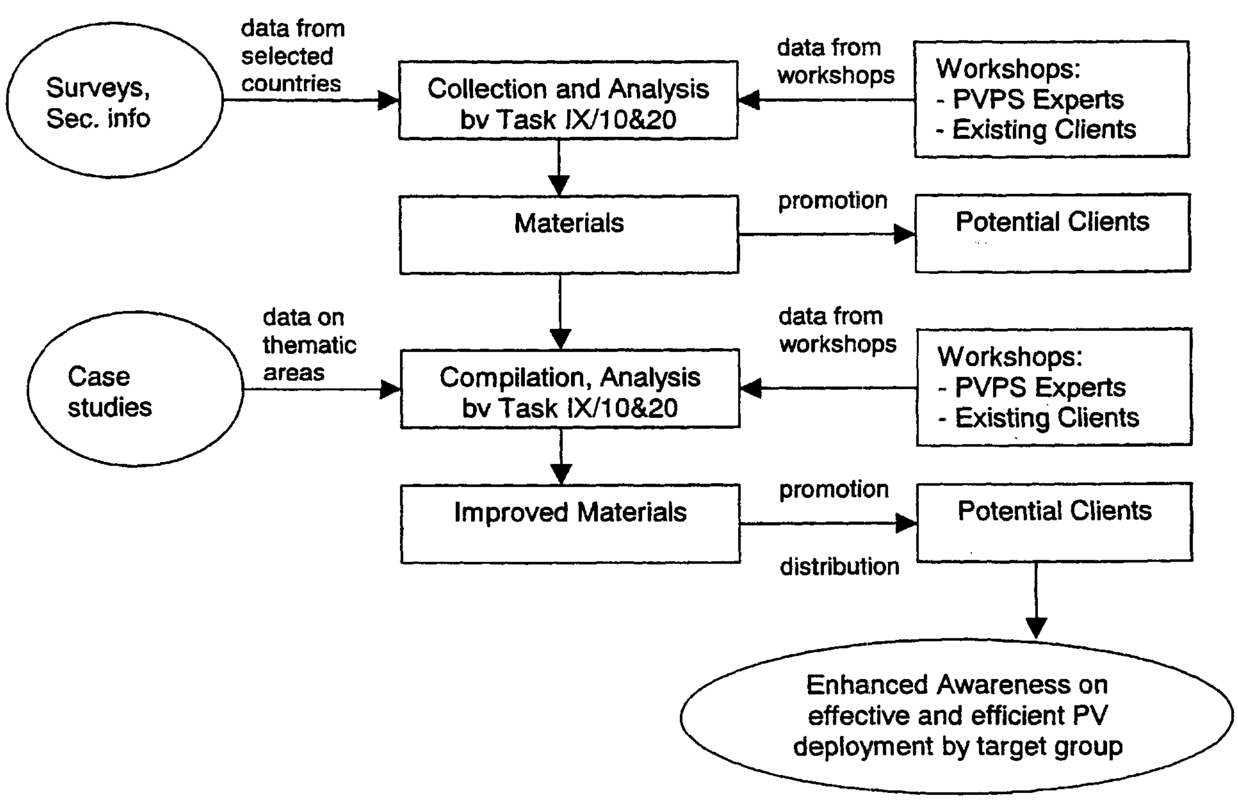


Figure 1: Relation and flow of information between the parties.

3. LOGICAL FRAMEWORK

The logical Framework for carrying out the activities is shown in the following table.

Table 1: Logical Framework Analysis Matrix

Subtask 10	Subtask 20		Approach	Verifiable Indicators
activity 11: information compilation and analysis	**activity 21:** support to multilateral and bilateral donor agency activities and bank lending	**activity 22:** co-operation with IEA's Renewable Energy Working Party (REWP) and IEA/OECD	▪ **Subtask 10:** surveys in selected countries, secondary information collection, preparation of country reports, workshop ▪ **Subtask 20:** workshops, case studies in selected countries, publications, seminars, dialogue, info gathering through workshops and promotion of materials	▪ data base on info-use selected countries ▪ data base on PVPS experts ▪ checklist ▪ country reports ▪ presentation materials ▪ publications
activity 12: preparations of RPGs			▪ **Subtask 10:** Case studies per thematic area through analysis of country reports, workshop ▪ **Subtask 20:** workshops, case studies in selected countries, publications, seminars, continuing dialogue and promotion	▪ further extended data base on PVPS experts ▪ available RPGs ▪ presentation materials ▪ publications
activity 13: dissemination and promotion of RPGs			▪ **Subtask 10:** distributing materials, organising workshop, collating comments and make evaluation ▪ **Subtask 20:** workshops, case studies in selected countries, publications, seminars, continuing dialogue, promotion of PV deployment programmes	▪ further extended data base on PVPS experts ▪ disseminated publications and materials ▪ distributed RPGs at workshops ▪ RPGs made available on website ▪ enhanced awareness of PV deployment programmes by potential banks, donors and development agencies

4. ACTIVITIES, APPROACH AND OUTPUT PER SUBTASK

A: SUBTASK 10: DEPLOYMENT INFRASTRUCTURE

1. Aims and objectives

The overall objective of Subtask 10 is to contribute to overcoming the critical barriers to widespread PV deployment. The central task will involve the preparation of recommended practice guidelines for the deployment requirements of PV. The approach by which this will be implemented will be to collate existing information and conduct additional surveys where necessary, in a number of target countries identified by the Task IX experts. The results will be collated in to a series of Country Reports that will form a key input to the Recommended Practice Guides (RPGs). The RPGs will use case studies from the Country Reports to highlight successes and failures.

2. Approach and target groups

IEA PVPS Task IX and especially subtask 10, will draw its information from a resource pool of international technical and non-technical experts, other IEA-PVPS Tasks, REWP and existing programmes and networks. Information will flow between the Task IX Team and the main target sectors:

- government and semi-government agencies
- multilateral and bilateral donor agencies
- development banks
- local and multinational banks
- local and multinational industry
- local and multinational utilities
- R&D institutions
- non-governmental organisations (NGOs)
- training organisations
- foundations
- professional bodies
- consumer associations

In addition to those organisations identified above, PV experts in selected non-IEA member developing countries will be accessed through co-operation with existing networks and frameworks.

3. Activities

Specifically the Subtask will entail the activities detailed in Table 1.

Table 2: Activities for Subtask 10

Activity	Description
Activity 11	Information Compilation and Analysis
Activity 12	Recommended Practice Guide Preparation
Activity 13	Dissemination and Promotion of Recommended Practice Guides

3.1 Activity 11: Information Compilation and Analysis

This activity will investigate the various strategies for infrastructure development and deployment to ensure widespread and successful implementation of PV. Key issues relating to PV deployment strategies and initiatives will be investigated and collated to provide input to Activity 12.

In order to carry out the surveys, information will be gathered from existing sources and networks (e.g. PRESSEA, the EU White Paper, existing PV suppliers networks, results gathered in the light of IEA PVPS Task III, etc.) and, if necessary, in-country missions may be undertaken. The surveys will collect data on existing schemes and initiatives for each identified subject area. Each survey will be reviewed by the Task experts and then used as input to the corresponding Recommended Practice Guide.

The information gathered from these surveys will be collated into a Country Report document. This document will provide a view of the state of the PV market and infrastructure in each of the target countries. These country reports will provide an important source of information for Activity 12.
More concretely, the following actions have to be undertaken:

1. *Defining criteria for selecting developing countries for PV country reports.*

This selection is likely to include countries with an established commercial PV market as well as so-called 'high-potential' countries; possible target countries may include, for example: Argentina, Bolivia, Brazil, China, Guatemala, Honduras India, Indonesia, Mexico, Morocco, Mozambique, Philippines, South Africa, Syria, Thailand, Vietnam.

2. *Selection of the countries on basis of defined criteria.*

3. *Priority ranking of selected countries.*

4. *Database set-up for info use.*

5. *Secondary information collection and analysis.*

6. *Starting the country communications.*

This includes explanation of aim, objectives and outputs of the subtask and task, as well as elaborating on the required countries input.

7. *Preparation of checklist on required country information.*

This action includes market potential & growth, end-users characteristics, systems & applications installed, government policies, R&D levels, domestic production, intermediaries, etc.

8. *Setting out subcontract and time frame for in-country PV experts to collect information.*
9. *Information collation and analysis.*

10. *First understanding and lessons learned.*

This will be done according to a number of aspects as: government policy and RE planning, financing mechanisms, institutional development (suppliers, producers, dealers, intermediaries, banks etc.), training programmes, operation and maintenance of systems, certification and accreditation systems, systems planning, infrastructure frameworks, PR and awareness raising.

3.2 Activity 12: Recommended Practice Guides

The objective of Activity 12 is to prepare a series of clearly understandable recommended practice deployment and implementation guides. Guides relating to the following areas will be collated:

- government policy and RE planning
- financing mechanisms
- institutional development (suppliers, producers, dealers, intermediaries, banks etc.)
- training programmes
- operation and maintenance of systems
- certification and accreditation
- systems planning
- infrastructure frameworks
- awareness raising.

For each of the subject areas identified, a listing, review and analysis of case studies will be undertaken so that the lessons learned can be drawn from the successes and failures for each aspect of PV deployment. The focus in the analysis is thus on the effectiveness and efficiency (costs per unit) in which these aspects of PV deployment are covered.

The information will be made readily available and accessible. Following the review and analysis process, a Recommended Practice Guide will be drawn up for each of the identified subject areas. It is intended that each document will be a 'free-standing' publication in its own right, although taken as a set, the guides will form a comprehensive and practical Recommended Practice Guide for all aspects of PV deployment.

It is intended that the guides will be published one at a time rather than as a complete set of documentation in order to reinforce the stand-alone nature of each document.

At the end of this activity a comparative analysis might be carried out on what seems to work best. Such meta analysis might be welcomed by a number of countries that still are undetermined on how to move into PV deployment.

The Country Reports from Activity 11 will be published in conjunction with the Recommended Practice Guides.

The (still tentative) guidelines will further include the following:

1. Introduction (for who the guidelines are intended, importance, rationale, readers guide, linkage with other PV IEA tasks, etc.).
2. Market understanding (Market technical potential and resources; segmentation of markets by applications; suppliers & intermediaries; consumers; marketing strategies, etc.).
3. Government Role: policies & instruments (national, local levels; roles in promotion, licenses, quality assurance, pr, support, etc.).
4. Financing: role of banks and investors (project developers, investors, banks, their requirements).
5. Models of best practise for PV deployment (how to best deploys PV under the parameters of a country).
6. Conclusions and follow-up recommendations.

The development of the guidelines involves the following actions:

1. Preparation of an experts panel from both the target groups representation and form the Task IX including selection criteria, ToR of the work, etc.
2. Analysis of the country documents by the Subtask 10 group on the relevant lessons.
3. First Draft of the guidelines document by the subtask 10 group.
4. Workshop on the draft guidelines with the experts panel to improve it with their comment (preparation).
5. Finalising the guidelines document with the comments and improvements of the expert panel.

3.3 Activity 13: Dissemination and Promotion of Recommended Practice Guides

The Recommended Practice Guides will provide a comprehensive series of documents that will be disseminated via the networks established and identified in Subtask 20. The dissemination of the Recommended Practice Guides is crucially important to ensure that they are implemented and utilised by the organisations at which they have been targeted.

A key goal of this dissemination exercise is to ensure that the guides are implemented on a practical level in real implementation programmes. In order to achieve this goal, relevant agencies will be encouraged to adopt the Recommended Practice Guides as an integral part of their rural electrification programmes. A part of this process will involve a series of workshops and seminars, targeted at relevant institutions in specified countries, as well as manufacturers, utilities, training organisations etc.

This activity includes the following concrete actions:

1. Preparation of a distribution list (draft list to be send to the Subtask 10 parties, Task III parties, and others).
2. Preparing the letter of introduction to the readers including the rationale, possible follow-up and linkages with the other subtasks and other IEA Tasks.
3. Making the distribution through website, E-mail and snail mail.
4. Collection of readers comments.
5. Evaluation of readers comments.

4. Expected outputs

The main outcome from the Subtask 10 is expected to be increased world-wide co-operation and co-ordination between developing countries, PV specialists, multilateral and bilateral donor agencies, development banks and other stakeholders.

The direct outputs will include:

- Collation and analysis of existing publications on PV in developing countries.
- Recommended Practice Guides for successful introduction and expansion of PV systems drawing from past experiences and lessons learned from technology co-operation projects and programmes. These will be disseminated by appropriate means in selected developing countries.
- Workshops in non-IEA countries, co-ordinated with bilateral and/or multilateral agencies and/or NGOs to get inputs/comments of the developing countries.
- Active participation of target groups in selected developing countries.
- Dialogue and contact point with staff of multilateral and bilateral agencies to get their input/comment in the documents to be produced.

The results of the Subtask will be available to the participants and associated experts in developing countries. Public reports on the key results of the Subtask 10 will be available for all individuals, companies and institutes involved with PV systems. These are summarised in the Table 2.

Table 3: Activity to Output Matrix

ACTIVITY	OUTPUT
Activity 11: Information Compilation and Analysis	Collation and analysis of existing publications on PV in developing countries.
Activity 12: Recommended Practice Guide Preparation	Recommended Practice Guides for successful introduction of PV systems...
Activity 13: Dissemination and Promotion of RPGs	... and their dissemination by appropriate means in selected developing countries.

5. Time schedule

Table 4: Indicative periods in which sub-activities take place in the five year task duration

Year	**1**		**2**		**3**		**4**		**5**	
Activity 1.1 Information Compilation and analysis	■	■	■	■						
-Criteria for developing countries selection for PV country reports	■									
Selection of the countries on basis of criteria	■									
Priority ranking of selected countries	■									
Database set-up for info use	■									
Secondary information collection and analysis	■	■	■							
Starting the country communications including explanation of aim, objectives and outputs of the subtask and task and required countries input	■	■								
Preparation of checklist on required country information	■									
Setting out subcontract and time frame for in-country PV experts to collect information	■	■								
Information collation and analysis; country reports			■	■						
First understanding and lessons learned				■						

Year	**1**		**2**		**3**		**4**		**5**	
Activity 12: Recommended Practice Guides				■	■	■	■	■		
Preparation of an experts panel from both the target groups representation and form the Task IX including selection criteria, ToR of the work, etc.				■	■	■				
Analysis of the country documents by the Subtask 10 group on the relevant lessons					■	■				
First Draft of the guidelines document by the subtask 10 group						■				
Workshop on the draft guidelines with the experts panel to improve it with their comment (preparation)							■			
Finalising the guidelines document with the comments and improvements of the expert panel								■		

Year	1		2		3		4		5	
Activity 13: Dissemination and Promotion of Recommended Practice Guides										
Preparation of a distribution list (draft list send to the task 10 parties and Task III and others)										
Preparing the letter of introduction to the readers including the rationale, possible follow-up and linkages with the other subtasks and other IEA Tasks										
Making the distribution through website, email and snail mail										
Collection of readers comments										
Evaluation of readers comments										

6. Budget & resources

Potential areas of country involvement for the three subtasks are given in Table 4. The expressions of interest represented in this table do not represent any commitment by the member country. Hereunder an idea on the activities and expected workload is given.

Subtask	Potentially interested countries
Subtask 10: Deployment Infrastructure	AUS, CHE, DEU, FRA, GBR, ITA, JPN, NLD, USA

Subtask	Activity	Person months
10	Activity 11: Information compilation and analysis	60
	Activity 12: RPGs (7)	20
	Activity 13: Dissemination and Promotion of RPGs	30
	Sub-total	**110**

Item	Cost/Labour requirement
Labour requirement of Task IX	110 person months
Estimated costs of arranging 2 workshops[1]	60,000 USD
Estimated costs of designing/printing RPGs[2] (7 of 1000 copies)	100,000 USD

[1] The costs of the workshops will be worked out in detail at a later stage. The costs of the workshops are likely to be shared by the subtasks and participants.

[2] These costs are a first approximate and it is still to be decided which parties will absorb the costs.

B: SUBTASK 20: SUPPORT AND CO-OPERATION

1. Overview

The Objective of Subtask 20: Support and Co-operation is:

To stimulate awareness and interest amongst the target sectors on the technical and economic potential, social implications, opportunities and best practice of PV systems and to establish a dialogue with multilateral and bilateral agencies and development banks.

The Overall Goal is to increase PV content in donor agency activities and bank lending

Subtask 20 is divided into the following two activities:

- **Activity 21:** Support to Multilateral and Bilateral Donors and Development Banks
- **Activity 22:** Co-operation with IEA's Renewable Energy Working Party (REWP) and IEA / OECD

2. Definitions and Interpretation of Task

2.1 Target sectors

As target sectors we understand:

- Multilateral agencies
- Development Banks
- Bilateral Donors, like:
  - Technical Co-operation Agencies of the 21 member countries of IEA / PVPS (GTZ, SDC, SIDA, CIDA, etc.)
  - Financial Assistance Agencies of the 21 member countries of PVPS (KfW, SECO, etc.)
  - International NGOs (Rockefeller Foundation / E&Co., Winrock, Helvetas (CH), etc.)
  - Technical and financial assistance agencies of non-PVPS member countries (e.g. New Zealand, Belgium, etc.)

2.2 Awareness Gaps

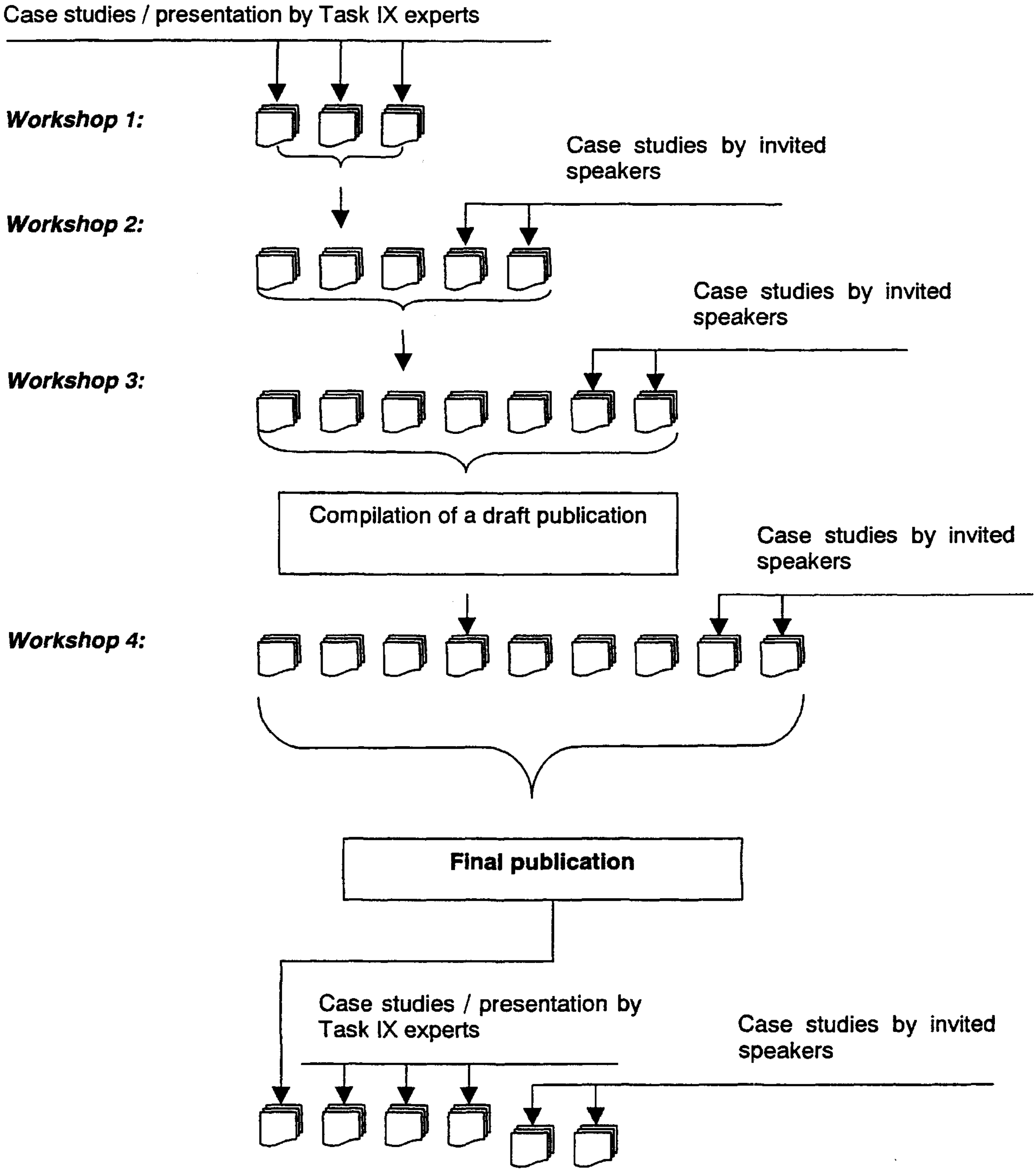
Awareness gaps of the above target institutions may be relatively diverse but seem to be related to the following issues:

- **Lessons Learned not disseminated:** The root causes of the poor performance of some of the past PV-programmes are not generally known at the target institutions; without better knowledge, the blame for failure is often put on the technology (reliability of components) and less on programme approach, subsidy levels, after-sales services. Therefore, other energy technologies are given preference over PV in donor programmes and lending operations. In addition, lessons learned from failed programmes are not widely disseminated by donors because they often reveal not particularly flattering truths of an inadequate donor approach and set-up as the root cause of programme failure.
- **The need of an alternative implementation process:** Programmes for the deployment of PV systems are considerably different in nature than programmes for the dissemination of other renewable energy technologies, especially grid-based power systems for rural electrification. With the PV option (Solar Home Systems), the focus is shifted from technical to organisational issues because each and every household needs its own (though small) generator in the house. In other words, the task has shifted from training and supervising a few in handling complicated issues of a grid, to training and supervising the many (electrical fitters, SHS owners) in simpler tasks. This also brings about new approaches in terms of financing mechanisms. Donor agencies, banks and their in-country project holders do not always know how to tackle this new task (programme set-up and implementation process).
- **Energy as a transversal theme and motor for development:** Energy has not yet been fully recognised as a driving force of social and economic development. Donor agencies and banks have accorded little attention to energy as a transversal theme which can play a role in virtually any development task from poverty alleviation to gender imbalances or food security.

2.3 General Approach

Neither the Subtask 20 Leader nor the other experts associated with Task IX can claim that they have all relevant information on ongoing activities related to the subject or that they have a complete record of past experience with PV system deployment. The proposed approach is to structure the planned workshops in such a way that invited speakers with relevant practical experience can bring in their views at the workshop and thus assist the Task IX team in enlarging the know-how and experience in PV technology deployment. The following graph illustrates this approach:

Workshop preparation phase:



The above approach ensures that:
- The cases of a maximum number of projects and programmes are collated and presented without exceeding subtask 20 budgets, and
- The information presented is not a desk work of a few experts but represents the views and experience of the stakeholders at large.

3. Substantiation of Activities

3.1 Overview

According to the Task IX workplan, the above awareness gaps of the target institutions are to be addressed through:
- Educational seminars and workshops for donor agency, bank and client country staff
- Information and dissemination services including publications
- Co-operation with the IEA / REWP, IEA / non-member country committee and OECD Secretariats

3.2 Workshops (Activity 21)

Workshops would be performed as follows:
1. In collaboration with Sub-task 10: Deployment Infrastructure, establish two to three case studies on PV programmes or possibly other energy sector interventions which illustrate the above awareness gaps and outline the conditions for a successful PV deployment programme.
2. Perform a one-day workshop at a multilateral agency preferably one which is known from previous work (e.g., ASTAE at WB, Washington). A workshop in collaboration with a larger event is also possible (e.g., the World Bank Group's Energy Week 2000 between April 10 to 14, 2000).
3. Since a workshop should by definition be a place for interaction and exchange of views and not a lecture, participants should be given the chance to formally present their experience with PV or other renewable energy dissemination programmes. For this purpose, invite two to three experts (desk officers, managers of PV deployment programmes in India, Indonesia, Philippines, Morocco, etc.) to speak on their particular case.
4. Include these presentations by participants in the form of abstracts, summaries as input material and reference documents for the following workshops.
5. Identify the general difficulties and shortcomings of PV deployment programmes and present and discuss these during the workshops and in the publications.

Timing and Locations of Workshops

There are four workshops planned between the years 2000 and 2004 (approx. 1 per year). The following locations may be considered:
- World Bank Group, Washington
- United Nations Development Programme (UNDP), New York
- Asian Development Bank (ADB), Manila
- Interamerican Development Bank (IDB), in-country-office in a Latin American State
- African Development Bank (AFDB), Abidjan
- European Commission (EC), Brussels

The sequence of the workshops is to be determined according to the availability of staff and any coinciding events at the above locations.

Participants

Total number of participants should not exceed 50 per workshop otherwise effective interaction between speakers and participants is not given. Although the workshops are exclusively held at the headquarters of the four multilateral banks, the staff of bilateral agencies would not be excluded and would have to travel to their nearest or most convenient workshop venue. Assistance to participants (travel, accommodation) would be provided to speakers only (budgets limited to US$ 30,000.- per workshop) and possibly to selected representatives form developing countries. Given the limited number of workshops (4) and participants (4 x 50), the selection of the right agency and bank staff becomes decisive for reaching expected goals. While those already involved in past and on-going PV deployment programmes can easily be identified, it is the staff of non-energy sector divisions who are not easily addressed. It is suggested that a thorough review of country portfolios (in collaboration with the energy divisions of IEA-member countries) would reveal those officers who handle potential PV applications in water pumping, SME, education, communication, health, and other sectors. The same approach would be used for staff of approximately 10 international NGOs.

Case Studies

The case studies are intended to focus on the following issues:

- What mechanism led to the formulation of an energy sector intervention using PV systems (project / programme identification) in a developing country?
- What programme approach was used?
- What were the roles of the different stakeholders, especially the role of the donor agency / bank?
- What project / programme implementation set-up was used and what are the lessons learned?
- What are the frame conditions in a developing country, which make a PV deployment programme potentially viable?
- What are the minimum requirements of the target group of PV systems in order to succeed with a PV deployment programme?
- What socio-economic impacts can be expected from PV deployment programmes?

Technical issues such as R&D, standardisation and testing, hybrid systems, etc. should only be treated if they are relevant for the programme approach and set-up.

A complete case study requires an expert input of about 2.5 person months. The Sub-task 20 budget for studies offers 15 person months, thus a total number of up to 6 case studies could be carried out. It is suggested that a screening and ranking of all known PV programmes by multilateral and bilateral donors be performed in order to identify up to 6 case studies. Experts from within the Task IX Team or associated specialists with a specific appreciation for a particular case would be contracted to perform the case studies.

It is expected that Sub-task 10 could provide substantial input into the case studies (see chapter 4 below).

3.3 Publications

As mentioned above, the publications to be elaborated under Sub-task 20 would basically be a compilation of case study presentations at the workshops accompanied by a comparative analysis of case study findings and the concluding lessons learned cum guiding principles. Five person months of budgets for the publications under Subtask 20 limit the number of publications to a maximum of two. In order to distinguish the Subtask 20 publications from other PVPS publications such as the recently issued Task III book: "Stand-alone PV Applications – Lessons Learned" or the yet to be developed "Recommended Practice Guides" of Subtask 10, the books should exclusively be dealing with approach and programme set-up and not with technical issues. Thus, the publications could be entitled "PV Deployment Programmes: Successful Approaches and Set-ups".

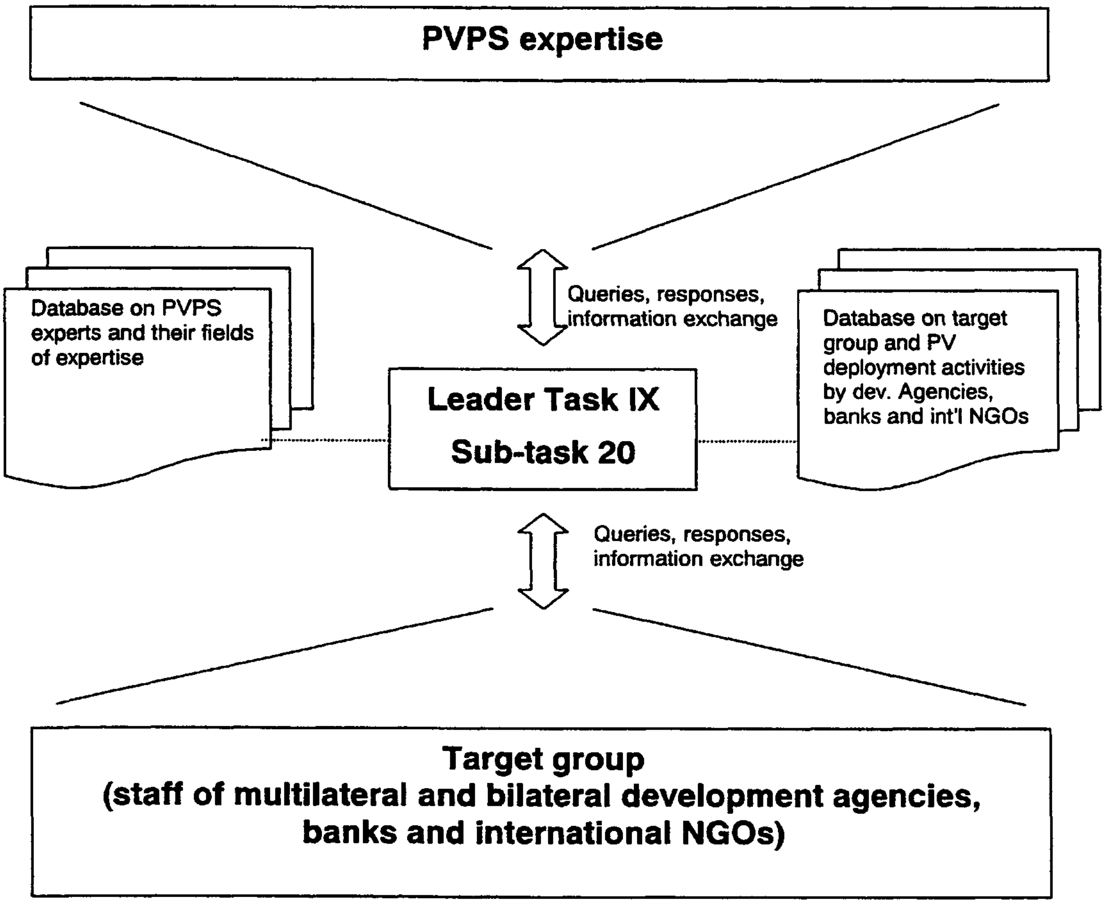
3.4 Other Educational Seminars and Workshops

Workshops and training on PV in developing countries as requested by the workplan cannot be undertaken as pure subtask 20 activities due to limited budget availability. A collaboration with other congresses and seminars will have to be sought. Subtask 20 would be given a time slot of 0.5 to one day within such a Congress or seminar. Task IX experts and associated consultants would be contracted to present case studies and lessons learned at such in-country events. The target group of these additional workshops and educational seminars in developing countries would be officers in national planning and potential implementing agencies (e.g., utilities, electrification authorities) who write up or approve proposals for assistance to aid agencies and development banks.

3.5 Information and Dissemination Services

A one-day seminar workshop on PV system deployment and programme approaches is insufficient for most bank and development agency staff to successfully set up their own programmes. An information service on all issues to PV system deployment would needed and is to be set up by Task IX. As the target groups would not know who among the IEA / PVPS experts would be the right person to contact for a specific question, the Subtask 20 leader would act as a first contact point from where the query would be delegated to the relevant IEA / PVPS expert or associated consultant. Depending on the relevance and complexity of the question asked, the Subtask 20 leader would set a budget limit for the expert mandated to prepare the response. The budget for such responses is currently limited to 5 person months.

The subtask 20 leader would have to establish a database on available experts and their fields of expertise in order to quickly identify the right person preparing the answer.
The information and dissemination service would adopt a pro-active approach to stimulate a dialogue with target groups and would not passively wait for queries to be sent in from bank and development agency staff. Activities from other IEA / PVPS tasks and especially information on new publications and up-coming events would be mailed to the target groups. Questionnaires on new PV related activities at multilateral and bilateral agencies and banks would regularly be sent out and responses be analysed in order to be up-to-date on sector activities and in order to be able to monitor and evaluate progress of subtask 20 achievements. For this purpose, a database on target agency staff and activities would have to be established and updated regularly.



3.6 Co-operation with REWP and IEA / OECD (Activity 22)

This activity is basically a networking and information exchange exercise with IEA / REWP, IEA / Non-member country committee and IEA and OECD Secretariats with the objective to promote PV systems to target groups in developing countries. To initiate the contacts, it is intended to first meet these committees and groups on the occasion of one of their annual events. It would be important to show, what they can expect from a co-operation with Task IX members and that it will pay off to invest time and effort in networking and information exchange. Hence, the information service available from IEA / PVPS Task IX must go beyond what is already available from international magazines such as "Renewable Energy World", "Photon", etc., newsletters and the abundant numbers of web sites on the subject. The strategy here is to offer:

- The possibility of a direct dialogue and exchange with proven experts in the PV field
- Information of particular relevance to the target group such as programme approach, institutional aspects and donor set-up which are not normally found in international publications where focus is mainly on technology.

St. Gallen, 22 November 1999

Peter Eichenberger
Alex Arter

APPENDIX 1: TASK IX FRAMEWORK

Through Task IX, the PVPS will be the first IEA Implementing Agreement with direct co-operation between member and non-member developing countries. Task IX will lead the way for co-operation on all renewable energy technologies as part of the IEA's strategy for implementation of Clean Development Mechanisms (CDM) and Activities Implemented Jointly (AIJ) of the Kyoto Protocol.

The Task will provide the framework for PV co-operation with Developing Countries, enabling the PVPS programme to use its expertise and status to bring together multilateral and bilateral agencies, government and semi-government agencies, NGOs, the PV industry and other target groups required for widespread PV market deployment. PV experts in selected non-IEA member developing countries will be accessed through co-operation with existing networks and frameworks. Task IX will draw upon other similar existing programmes and networks and build upon these to provide an effective and efficient programme that will address the needs and potential of developing countries, multilateral and bilateral donor agencies and development banks.

Task IX can be viewed as a facilitator in the creation of a sustainable PV market through encouraging its target organisations (multi-lateral and bilateral agencies, development banks etc) to adopt PV as a serious candidate for rural electrification strategies as a part of development assistance programmes. Task IX will provide guidance to the these agencies on the most effective way to implement PV rural electrification programmes, ensuring that they are sustainable, effective and replicable and that they lead to the creation of effective and self supporting infrastructures after multilateral and/or bilateral agency funds have been used. The involvement of the donor agencies in Task IX is of particular importance and their active participation is anticipated.

It is important that the Task IX remains independent of direct commercial interests in its interactions with the multilateral and bilateral agencies and other target organisations and that the advice and guidance offered is independent and impartial.

国際エネルギー機関（IEA）

太陽光発電システム実施協定（PVPS）

タスク IX

太陽光発電技術の展開：発展途上国との協力

サブタスク10および20

発展途上国における効果的かつ効率的な展開

－ 共同活動および並行活動 －

作業計画書

共同作成者：

オランダ国 ETC エネルギー社（サブタスク10のリーダー国）
スイス国 ENTEC 社（サブタスク20のリーダー国）

2000 年1月

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序　文

2000年1月10日、オランダ国ユトレヒト市で開催されたIEA PVPS タスク IX 会合中に行われた討議の結果として、IEA PVPS タスク IX のサブタスク10および20の活動計画を1つの文書にまとめて編纂することが決められた。これらのタスクを並列して実行すると、互いに情報や資源をより効果的に利用し、同時に一貫した総合パッケージを外部に提供でき、したがって活動計画をより効率的に実施できることが論じられた。

この並列作業においては、サブタスクのリーダーシップは最初に任命されたサブタスクリーダーの手にとどまる、すなわち、サブタスク10のリーダーはオランダのETC エネルギー社、サブタスク20のリーダーはスイスのENTEC社である。

以下の文書は上記の構想の結果であり、サブタスク10および20の活動計画が提出されてから、タスク IX のリーダー、英国のIT パワー社のコメントを追加して作成された。

要　約

サブタスクリーダー:	サブタスク 10：オランダ(ETC Energy) サブタスク 20：スイス(ENTEC)
目的:	開発途上国におけるPVの効果的かつ効率的な普及に寄与する。
ターゲットグループ:	PV プログラムに関与している既存または有望なクライエント。多国間または二国間の供与および開発担当官庁、銀行、産業界、公益事業体、研究開発機関、研修機関、財団、職業団体、消費者連合等。
方法:	二次的な情報源を利用したり、特定の開発途上国において調査を実施したりして、現行の PV プログラムおよび経験に関する情報を収集する。サブタスクへの情報源を確保し、有望なクライエントに対する効果的かつ効率的な PV 普及を促進する 2 つの目的で、多国間協力官庁、開発銀行、二国間供与機関のためのワークショップを開催する。特定の開発途上国における調査に基づいて国別の報告書を作成する。事例研究を解析し、一貫した「推奨業務ガイド」シリーズとつきあわせて精査する。これらの資料や刊行物をターゲットグループに配布して、効果的かつ効率的なPV普及を促進する。
成果:	- 開発銀行、多国間・二国間協力官庁、開発途上国の専門家および IEA PVPS メンバー国を対象とする実用的な「推奨業務ガイド」の総合的なセット。 - 既存または有望な供与機関を対象として、事例研究報告を作成し、事例研究所見の比較解析とそこから得られた教訓をあわせて編集する。 - 効果的かつ効率的な PV 普及の情報源として、またその推進手段として、一連のワークショップを組織する。 - 開発途上国における PV プログラムの成否を左右する要素に対する意識を高め、理解を深める。 - 現在 PV 普及プログラムに関与していない他国間・二国間供与機関、銀行および開発機関の PV 普及プログラムに対する理解を深める。
期間:	5 年間
予算	未定

1.　はじめに

サブタスク 10 及び 20 の目的達成のためのアプローチと活動には、ある程度の重複がある。

- サブタスク 10 の目的（展開のための基盤構造）は、PV を広く展開させる上での重要な障碍の克服に寄与することである。このためにとるべきアプローチは、多数の目標国において、既存の情報を照合し、必要に応じて調査を実施することである。

- サブタスク 20 の目的（支援と協力）は、寄付機関の活動と銀行ローンの中で PV の占める比率を増大させることである。このためには、PV システムの技術的および経済的ポテンシャル、社会的意義、機会および最良実施について情報を提供し、多国間および二国間の機関と開発銀行との対話を推進する。

両サブタスクのターゲットグループは、PV プログラムの既存クライアントおよびポテンシャルクライアントと定義される。これらのクライアントとしては、多国間および二国間の寄付機関と開発機関、銀行、産業界、電力事業体、研究開発機関、研修機関、財団、職業機関、消費者団体などがあげられる。

2000 年 1 月 10 日に、オランダ国ユトレヒト市で開催された、前回の IEA PVPS Task IX 会合において、両サブタスクの活動を統合して、並行計画行動とすることが決議された。これにより、実施効率を向上し、情報へのアクセスを拡大し、ターゲットグループに対する IEA PVPS Task IX タスクのアピールを改善するものと予想される。

サブタスク 10 およびサブタスク 20 の間には基本的に 3 つの対話の場がある。

- PV の展開および情報の照合・解析に関する過去の経験と、進行中のプログラムを確認する。この場合、両サブタスクは緊密な共同作業を行って、確認作業や連絡作業を重複させて、マネジャーや役員に迷惑をかけないように努めなければならない。その結果、誰がどんな情報を編集するかについての合意が得られる。サブタスク 10 及びサブタスク 20 の間の職務割り振りは、地理的状況またはケースバイケースで決めることができる。
- ケーススタディは両サブタスクの一体部分である。サブタスク 10 は PV 展開プロジェクトの国内成果と過程に集中しているが、サブタスク 20 では、プロジェクトの確認、資金供与の期待および PV 展開プロジェクトの銀行担保能力改善のための条件に重点が置かれる。両サブタスクにまたがる問題のケーススタディには、2 つの専門家チームが目的は違うものの、同じケースについて同時に作業する共同事業として実施する。
- サブタスク 10 は一般に情報およびノウハウの発信を主に行い、サブタスク 20 はこのノウハウを普及させ、利用する機能を果たすことになっているが、両サブタスクの間では効率的かつ専門的な

情報交換を行わねばならない。両サブタスクのリーダーは、互いに自分の作業情報を更新し、それぞれが(たとえば、国内ミッションや調査、資金供与者、銀行および国際NGOによるPVプログラムやワークショップでの発表から)受け取った情報、さらには新たな連絡に関しては完全な透明性を維持しなければならない。

その上、サブタスク10は、特にTask IX/10アクティビティーズ12及び13との関連で、IEA PVPS Task III(独立設置および島嶼用PVシステムの利用)と調整をはかることになっている。すべてのIEA PVPSタスクが、手の届く範囲のターゲットグループに、一貫した見解と支出計画を提示することが重要である。

上記の論議の結果、サブタスク10及び20の目的、期待される成果およびアプローチを記述するこの合同文書が作成された。できる限り、情報収集・推進およびデータ配布に関する活動が、サブタスク10及び20の間の情報交換を改善するための並行活動として計画されている。

下記の目的をもつワークショップには、両サブタスクが共同で出席ないし主催を行う。

1. 編集する資料の情報源として利用する目的で、既存の資金提供者、銀行および開発機関から関連データを収集する。
2. 可能性のある資金提供者、銀行および開発機関に、関連PV経験や予測に関する情報を提供して、効果的かつ効率的なPV展開を促進する。

2. 目的と意図

サブタスク 10 及び 20 の全般的な目的は、発展途上国における効果的かつ効率的な PV 展開に寄与することである。

このためには、選ばれた発展途上国において二次的情報を収集し、調査を実施し、ケーススタディを解析し、多国間および二国間資金提供者、銀行、開発機関のためにワークショップを開催する。調査結果を解析し、解析結果は国別報告書の形で出版される。ケーススタディを実施し、結果を解析し、データを整合的な「推奨実務ガイド」シリーズと照合する。ターゲットグループのために一連のワークショップを開催することは、可能性のある資金提供者、銀行、開発機関に情報を提供し、サブタスクの情報源または情報生成の行事として利用し、効果的かつ効率的な PV 展開について周知させる促進行事としても不可欠である。その結果、このようなポテンシャルクライアントのグループは、PV 展開事業に対する意識を高め、関心を増大させる。

期待される成果は下記の通りである。

- 開発銀行、多国間および二国間の機関、発展途上国の専門家および IEA PVPS 加盟国を対象とする、実用的な「推奨実務ガイド」の包括的なセット。
- 既存および可能性のある資金提供者を対象とする、ケーススタディの報告書、ケーススタディ所見の比較解析、および得られた教訓を網羅した資料の編集。
- 効果的かつ効率的な PV 展開のための情報生成および促進を目指した一連のワークショップ。
- 発展途上国における PV プログラムの成否を決める要因について、ターゲットグループの意識を高め、理解を深める。
- 現在 PV 普及プログラムに関与していない多国間および二国間資金提供者、銀行、開発機関の PV 展開プログラムに対する理解を深める。

下の図には各種関係者の間の関係と情報交換を示す。

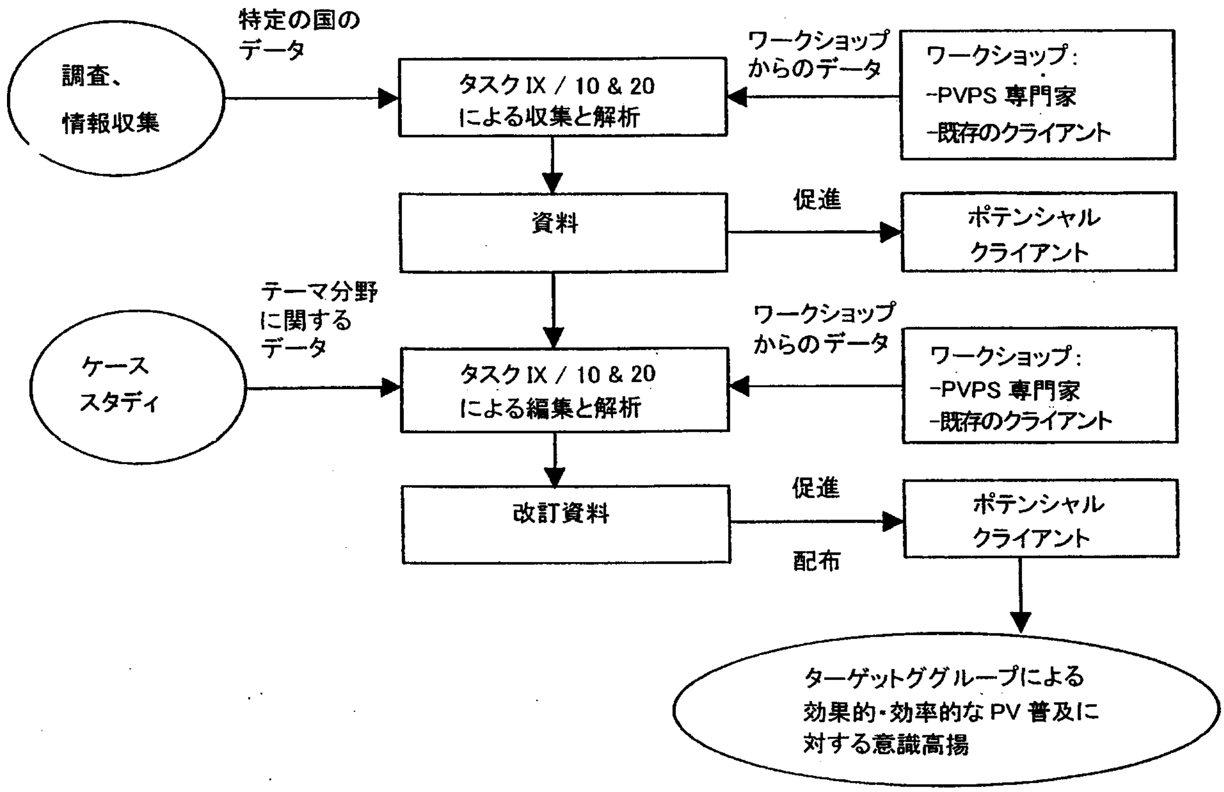


図 1: 当事者間の関係と情報の流れ

3.　論理の枠組み

表 1：論理の枠組み解析マトリクス

サブタスク 10	サブタスク 20		アプローチ	立証可能なインジケータ
アクティビティ 11: 情報の編集と解析	**アクティビティ 21:** 多国間および二国間資金提供機関の活動および銀行ローンに対する支援	**アクティビティ 22:** IEA の再生可能エネルギーワーキングパーティ（REWP）および IEA/OECD との協力	■ **サブタスク 10:** 所定の国における調査、二次的情報の収集、国別報告書の準備、ワークショップ ■ **サブタスク 20:** ワークショップ、所定の国におけるケーススタディ、出版、セミナー、対話、ワークショップによる情報収集、資料配付	■ 所定の国における方法利用のデータベース ■ PVPS 専門家に関するデータベース ■ チェックリスト ■ 国別報告書 ■ 発表資料 ■ 出版物
アクティビティ 12: RPG の準備			■ **サブタスク 10:** 国別報告書、ワークショップの解析によるテーマ分野ごとのケーススタディ ■ **サブタスク 20:** ワークショップ、所定の国におけるケーススタディ、出版、セミナー、連束対話、促進	■ PVPS 専門家に関する拡大データベース ■ 利用可能な RPG ■ 発表資料 ■ 出版物
アクティビティ 13: RPG の普及と促進			■ **サブタスク 10:** 資料の配付、ワークショップの開催、コメントの照合と評価 ■ **サブタスク 20:** ワークショップ、所定の国におけるケーススタディ、出版、セミナー、連束対話、PV 展開プログラムの促進	■ PVPS 専門家に関する拡大データベース ■ 配布された出版物および資料 ■ ワークショップで配布された RPG ■ ウェブサイトで利用可能になった RPG ■ ポテンシャル銀行、資金供与者、開発機関による PV 展開プログラムに対する意識の高揚

4.　サブタスクごとのアクティビティ、アプローチおよびアウトプット

A: サブタスク 10: 展開のための基盤構造

1.　目的と意図

サブタスク 10 の全般的な目的は、広範囲の PV 展開に対する重大な障壁の克服に寄与することである。中心的な作業としては、PV 展開のための諸条件について、推奨実務ガイドラインを作成することが含まれる。これを実施するためのアプローチは、タスク IX の専門家が指定した多数のターゲット国において、既存の情報を照合し、必要があれば追加調査を実行することである。得られた結果は、推奨実務ガイド（RPG）の主要インプットとなる一連の国別報告書と照合される。RPG では国別報告書からのケーススタディを利用して事業の成否を明確にする。

2.　アプローチとターゲットグループ

IEA PVPS タスク IX、および特にサブタスク 10 は、国際的な技術部門および非技術部門の専門家、他の IEA-PVPS タスク、REWP および既存のプログラムやネットワークなどのリソースプールから情報を得ている。タスク IX チームおよび下記の主要ターゲットセクターの間を情報が流れる。

- 政府機関および半政府機関
- 多国間および二国間資金提供機関
- 開発銀行
- 国内および多国籍銀行
- 国内および多国籍産業界
- 国内および多国籍電力事業体
- 研究開発機関
- 非政府機関（NGO）
- 研修教育機関
- 財団
- 職業団体
- 消費者連合

以上の組織の他に、IEA 非加盟の特定発展途上国の PV 専門家にも、既存のネットワークやフレームワークの協力を得てアクセスすることが望ましい。

3. アクティビティ

特にタスク 10 は表 1 に示すアクティビティを実施する。

表 2:サブタスク 10 のアクティビティ

アクティビティ	記述
アクティビティ 11	情報の照合と解析
アクティビティ 12	推奨実務ガイドの作成
アクティビティ 13	推奨実務ガイドの配布と促進

3.1 アクティビティ 11:情報の照合と解析

このアクティビティ 11 では PV を広範囲にわたって成功裏に実施するための基盤構造開発・展開の各種戦略を調べる。PV の展開戦略に関する主要問題を調査・照合して、アクティビティ 12 にインプットを供給する。

調査を実施するために既存のソースやネットワーク(たとえば、PRESSEA、EU 白書、既存 PV サプライヤネットワーク、IEA PVPS タスクIIIの観点から集められた結果等)から情報を収集し、必要に応じて国内ミッションを実施する。調査はそれぞれ特定の分野について、現存の企画や構想に関するデータを収集する。それぞれの調査はタスク専門家による査読を経てから、対応する推奨実務ガイドのインプットとして利用される。

これらの調査で集められた情報は、国別報告書ドキュメントと照合される。このドキュメントはそれぞれのターゲット国における PV 市場と基盤構造の現状に関する見解を提供する。これらの国別報告書は、アクティビティ 12 に対して重要な情報源を提供する。もっと正確にいうと、下記の行動を実行しなければならない。

1. PV 国別報告書のための発展途上国選定基準を定義する

この選定の対象となるのは、PV 商業市場が確立している国およびいわゆる「ハイポテンシャル」の国である。ターゲットとなる可能性のある国としては、アルゼンチン、ボリビア、ブラジル、中国、グアテマラ、ホンジュラス、インド、インドネシア、メキシコ、モロッコ、モザンビーク、フィリッピン、南アフリカ、シリア、タイ国、ヴェトナムがあげられる。

2.　定義した基準に基づいて国を選定する

3.　選定した国に優先順位をつける

4.　情報利用のためにデータベースを設定する

5.　二次的情報の収集と解析

6.　国との対話を開始する

これにはサブタスクやタスクの意図、目的、アウトプットの説明と、必要とする国別インプットの詳細説明が含まれる。

7.　必要な国別情報に関するチェックリストを作成する

この行動には市場のポテンシャルと成長、エンドユーザーの特性、設置したシステムとアプリケーション、政府の政策、研究開発レベル、国内生産、仲介業者等が含まれる。

8.　国内のPV専門家が情報を集めるための下請けと時間枠を設定する
9.　情報の照合と解析

10.　最初の理解と学んだ教訓

この行動は下記のような項目にしたがって実施される:政府の政策とRE計画、資金調達メカニズム、制度開発(供給業者、生産業者、販売業者、仲介業者、銀行等)、研修プログラム、システムの運用と保守、証明・保証システム、システム企画、基盤構造フレームワーク、PRおよび意識の高揚。

3.2　アクティビティ12:推奨実務ガイド

アクティビティ12の目的は明確に理解できる推奨実用展開・実施ガイドシリーズを作成することである。下記の分野に関するガイドが照合される。

- 政府の政策とRE計画
- 資金調達メカニズム
- 制度開発(供給業者、生産業者、販売業者、仲介業者、銀行等)

- 研修プログラム
- システムの運用と保守
- 証明・保証システム
- システム企画
- 基盤構造フレームワーク
- 意識の高揚

確認した各分野について、ケーススタディの一覧表作成、検討、解析を行い、PV 展開のそれぞれの側面の成否から教訓を引き出す。解析の重点はこのような PV 展開側面が関わる効果と効率(ユニット当たりのコスト)に置かれる。

情報は簡単に入手・アクセスできる。検討・解析のプロセスに続いて、各分野のための推奨実務ガイドを作成する。各ドキュメントはそれぞれ独立の出版物として扱われるが、セットとして見ると、ガイドは PV 展開のあらゆる側面について、包括的かつ実用的な推奨実務ガイドとなるように意図されている。各ドキュメントの独立性を強調するために、ガイドは完全セットとして出版するのではなく、1 巻ずつ発行する予定である。

このアクティビティの終了時には、どれが一番有効かについて比較・解析することが可能になる。このようなメタ解析は、PV 展開の進め方についてまだ迷っている多くの国々から歓迎されるだろう。

アクティビティ 11 の国別報告書は推奨実務ガイドと連動して出版される。

ガイドラインはまだ暫定的なものであるが、さらに下記の事項を含むことになる。

1. 序論(ガイドラインの対象となる人のための、意図、重要性、論拠、用法説明、他の PV IEA タスクとのリンクなど)
2. 市場の理解(市場の技術ポテンシャルと資源、応用別の市場細分化、供給業者と仲介業者、消費者、市場戦略など)
3. 政府の役割:政策と実施手段(国家・地方レベル、普及、ライセンス、品質保証、PR、支援における役割など)
4. 資金調達:銀行・投資家の役割(プロジェクト開発業者、投資家、銀行、それらの条件)
5. PV 展開のための最良実務のモデル(特定の国のパラメータの下で PV 展開の最善の方法)
6. 結論とフォローアップ勧告

ガイドラインの作成には下記の行動が含まれる。

1. 両ターゲットグループの代表者から専門家委員会を組織し、タスクIXを形成し選定基準、作業のToR等を作成する。
2. サブタスク10のグループが関連教訓に関する国別ドキュメントを解析する。
3. サブタスク10のグループがガイドライン文書の第1稿を作成する。
4. 専門家委員会とともにガイドライン案に関するワークショップを開き、専門家のコメントにより同案を改訂する(準備)。
5. 専門家委員会のコメントと改善案によりガイドライン文書の最終稿を作成する。

3.3 アクティビティ13:推奨実務ガイドの配布と促進

推奨実務ガイドはサブタスク20で作成・確認されたネットワークを介して配布される。推奨実務ガイドの配布は、対象とする機関がこれを実施・活用することを保証する上で、きわめて重要である。

ガイド配布の主要目標は、現実の実施プログラムにおいて、実用レベルでのガイド実施を保証することである。この目標を達成するためには、農村電化計画の一体部分として、推奨実務ガイドを採択するように、関連機関に助言する。このプロセスには、特定の国における関連機関や、製造業者・電力事業体・研修機関などを対象とする、一連のワークショップやセミナーの開催が含まれる。

このアクティビティには下記の具体的行動が含まれる。

1. 配付先リストの作成(サブタスク10の当事者、タスクIIIの当事者その他に送るリスト案)。
2. 読者宛の紹介状を作成する。論拠・可能なフォローアップ・他のサブタスクや他のIEAタスクとのリンケージ。
3. ウェブサイト、E-メール、スネールメールによる配布。
4. 読者のコメントを集める。
5. 読者のコメントを評価する。

4. 期待されるアウトプット

サブタスク10の主な成果は、発展途上国、PV専門家、多国間および二国間資金供与機関、開発銀行および利害関係者の間で、世界的な協力や調整が増加すると期待されることである。

直接的なアウトプットには下記の項目が含まれる。

- 発展途上国において現存する PV 関連刊行物の照合と解析。
- 技術協力プロジェクトやプログラムから得られた、過去の経験や教訓から導かれた PV システムの導入や拡張の成功に対する推奨実務ガイド。
- IEA 非加盟国におけるワークショップ。二国間および多国間供与機関または非政府機関との間を調整して、発展途上国のインプットやコメントが得られるようにする。
- 特定の発展途上国のターゲットグループの積極的な参加。
- 二国間および多国間供与機関のスタッフとの対話および接触により、作成する文書のインプットやコメントを得る。

サブタスクの結果は参加者および発展途上国の関連専門家がアクセスできるようにする。サブタスク 10 の主な結果に関する公開報告は、PV システムに関係するすべての個人・会社・機関がアクセスできるようにする。これらについては表 2 に要約されている。

表 3:アクティビティ/アウトプットのマトリックス

アクティビティ	アウトプット
アクティビティ 11: 情報の編集と解析	発展途上国における現存の PV 関連刊行物の照合と解析
アクティビティ 12: 推奨実務ガイドの作成	PV システムの導入成功のための推奨実務ガイド
アクティビティ 13: RPG の配布と推進	特定発展途上国において適当な手段で推奨実務ガイドを配布する

5.　タイムスケジュール

表 4:5 年間のタスク期間中に行われるサブタスクの割り当て

年	1		2		3		4		5	
アクティビティ 11:情報の編集と解析										
PV 国別報告のための発展途上国選定基準										
基準に基づく国の選定										
選定した国の優先順位決定										
情報利用のためのデータベース作成										
二次情報の収集と解析										
国との対話を開始する:サブタスクおよびタスクの意図・目的・アウトプットおよび必要な国のインプットについて説明										
必要な国情報のチェックリストを作成										
国内 PV 専門家が情報を集めるための下請けや時間枠を設定										
情報の照合と解析、国別報告										
最初の理解と得られた教訓										

年	1		2		3		4		5	
アクティビティ 12:推奨実務ガイド										
両ターゲットグループの代表者から専門家委員会を組織し、タスク IX を形成し選定基準、作業の ToR 等を作成する。										
サブタスク 10 のグループが関連教訓に関する国別ドキュメントを解析する。										
サブタスク 10 のグループがガイドライン文書の第 1 稿を作成する。										
専門家委員会とともにガイドライン案に関するワークショップを開き、専門家のコメントにより同案を改訂する(準備)。										
専門家委員会のコメントと改善案によりガイドライン文書の最終稿を作成する。										

年	1		2		3		4		5	
アクティビティ 13：推奨実務ガイドの配布と促進										
配付先リストの作成（サブタスク 10 の当事者、タスク III の当事者その他に送るリスト案）。										
読者宛の紹介状を作成する。論拠・可能なフォローアップ・他のサブタスクや他の IEA タスクとのリンケージ。										
ウェブサイト、E-メール、スネールメールによる配布。										
読者のコメントを集める。										
読者のコメントを評価する。										

6. 予算と資源

3 つのサブタスクについて国が関与する可能性のある分野を表 4 に示す。この表に記述した関心の表現は、加盟国が約束したことを示すものではない。ここではアクティビティと期待される作業量のアイデアを示すだけである。

サブタスク	関心をもつ可能性のある国
サブタスク 10	AUS, CHE, DEU, FRA, GBR, ITA, JPN, NLD, USA

サブタスク	アクティビティ	人・月
10	アクティビティ 11:情報の編集と解析	60
	アクティビティ 12:RPGs (7)	20
	アクティビティ 13:RPGs の配布と推進	30
	小計	110

項目	コスト／作業量
タスク IX の作業量	110 人・月
2 回のワークショップ開催費推定値[1]	60,000 USD
RPGs のデザイン／印刷費推定値[2]	100,000 USD

[1] ワークショップのコストは後で詳細に計算する。ワークショップのコストはサブタスクとサブタスクとで分担する。

[2] これらのコストは一次近似で、負担者はこれから決めることになる。

B: サブタスク 20: 支援と協力

1. 概要

サブタスク 20 の目的: 支持と協力は下記の通りである。

PV システムの技術的・経済的ポテンシャル、社会的意義、機会および最良の実務に関するターゲットセクターの間の意識と関心を刺激し、多国間および二国間機関および開発銀行との対話を確立する。

全体的な目標は資金調達機関の活動と銀行の資金供給における PV の比率を増加させることである。

サブタスク 20 は以下の 2 つのアクティビティに分割される。

- **アクティビティ 21**: 多国間および二国間機関および開発銀行に対する支援
- **アクティビティ 22**: IEA の再生可能エネルギー作業パーティ(REWP)および IEA/OECD との協力

2. タスクの定義と解釈

2.1 ターゲットセクター

ターゲットセクターには下記のものが含まれると理解される。

- 多国間機関
- 開発銀行
- 二国間資金供与機関
  - IEA/PVPS 加盟 21 カ国の技術協力機関(GTZ、SDC、SIDA、CIDA など)
  - PVPS 加盟 21 カ国の財政支援機関(KfW、SECO など)
  - 国際 NGO(ロックフェラー財団/E&Co.、ウィンロック、ヘルヴェタス(CH)など)
  - PVPS 非加盟国(たとえば、ニュージーランド、ベルギーなど)の技術・財政支援機関

2.2 意識のギャップ

上記ターゲット機関の意識のギャップは、相対的に多岐にわたっているが、以下の問題と関連しているように思われる。

- **学んだ教訓が周知されていない**: 過去の PV プログラムの一部で成果が得られなかった根本原因が、ターゲット機関に広くは知られていない。十分な知識がないまま、失敗の原因を技術(とくに部品の信頼性)に押しつける場合が多く、プログラムへのアプローチ、補助金のレベル、販売後のサービスなどについての反省が少ない。そのため、資金供与機関のプロ

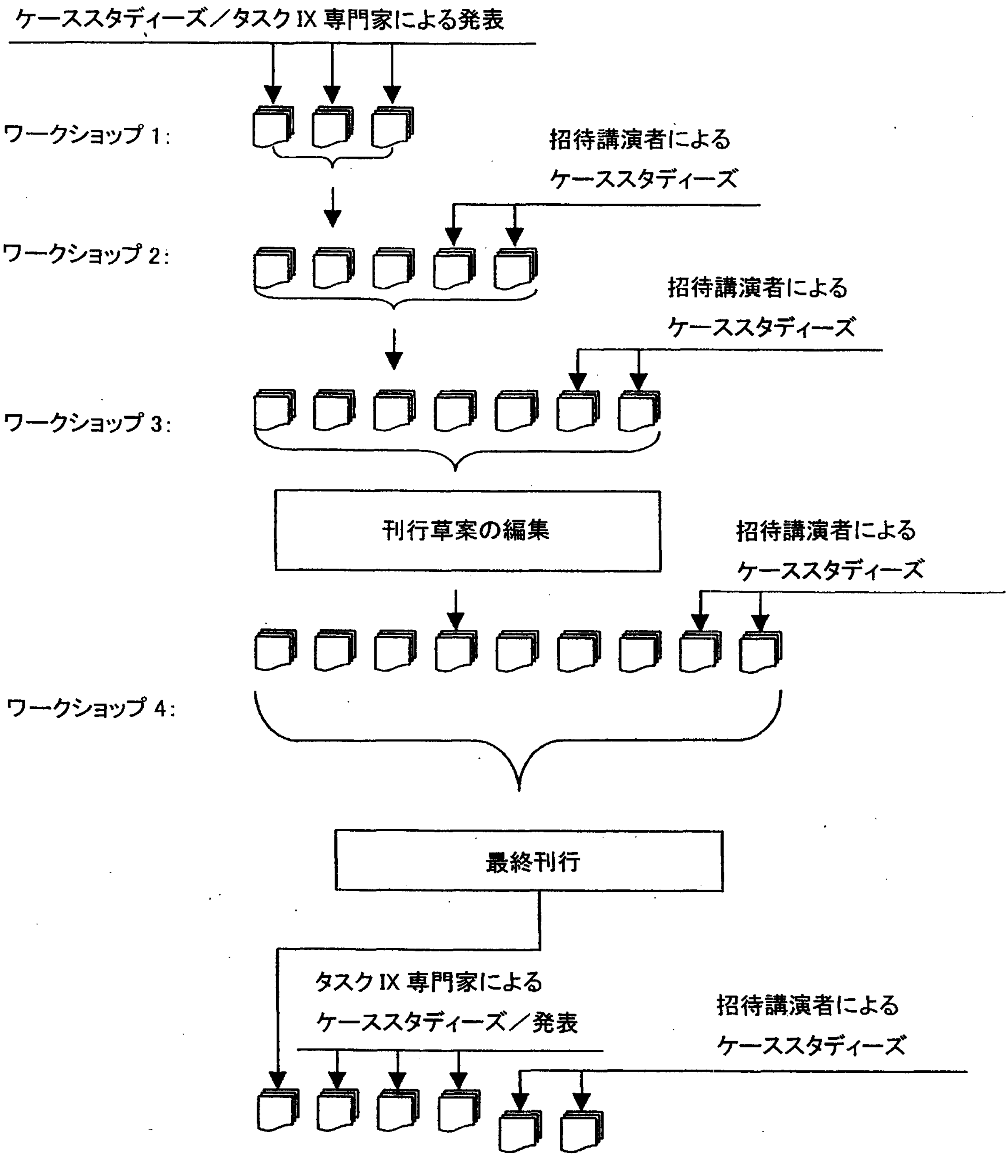
グラムや貸出運用において、PV よりも他のエネルギー技術が優遇されることになる。その上、失敗したプログラムから得られた教訓は、供与機関により広く周知されることがない。というのは、供与機関のアプローチやセットアップが不十分だったことが、失敗の根本原因であるというあまり愉快でない事実が明らかになる場合が多いからである。

- **代替実施プロセスの必要性**: PV システムの展開プログラムは、他の再生可能エネルギー技術、とくに農村電化のための系統電力システムの普及プログラムとは、かなり違った性格をもっている。PV オプション(ソーラーホームシステム)の場合には、それぞれの家庭が自家用の小型発電機を家の中に備えなければならないので、焦点は技術問題から組織面に移行する。言い換えれば、複雑な系統問題を取り扱うために少数の作業員を訓練・監督する仕事から、多数の作業員(電気工事業者、ソーラーホームシステムの所有者)を訓練・監督する単純な仕事へと移り変わってきた。このことは、金融メカニズムについても新しいアプローチをもたらした。資金供与機関、銀行および国内プロジェクト実行者は、この新しいタスク(プログラムセットアップおよび実施プロセス)にどう取り組むべきか、必ずしも理解していない。
- **開発のための横断的テーマおよび原動力としてのエネルギー**: エネルギーは未だ社会的・経済的開発の原動力としては認知されていない。資金供与機関や銀行は、貧困の緩和から性差別の撤廃や食糧確保に至るまで、事実上あらゆる開発課題において役割を果たすことのできる、横断的テーマとしてのエネルギーをほとんど注目していない。

2.3　　一般的アプローチ

サブタスク 20 のリーダーも、タスク IX と関連した他の専門家も、本題に関して現在行われている活動に関するすべての情報を把握しているとか、PV システム展開に関する過去の経験の完全記録をもっているとはいえない。ここに提案するアプローチは、関連した実務経験を持つ招待講演者が、ワークショップで自分の見解を発表して、タスクIXのチームがPV技術の展開におけるノウハウや経験を拡張できるように、ワークショップを組織することである。このアプローチを下図に図解で示す。

ワークショップ準備段階



上記のアプローチにより下記のことが保証される。

- 最大限の数のプロジェクトやプログラムの事例を、サブタスク 20 の予算を超えることなく、照合・発表する。
- 発表される情報は少数の専門家のデスクワークではなく、利害関係者全体の見解や経験を示すことになる。

3. アクティビティの具体化

3.1 概要

タスク IX のワークプランによると、ターゲット機関の上記の意識ギャップは下記の方法で対処することができる。

- 資金供与機関、銀行およびクライアント国スタッフに対する教育的セミナーおよびワークショップ
- 刊行を含む情報・普及サービス
- IEA／REWP、IEA／非加盟国委員会および OECD 事務局との協力

3.2 ワークショップ(アクティビティ 21)

ワークショップは下記の要領で開催される。

1. サブタスク 10「展開の基盤構造」と協力して、PV プログラムまたは他のエネルギーセクターの介入に関する 2～3 のケーススタディを行い、上記の意識ギャップを明示するとともに、PV 展開プログラム成功条件の概要を述べる。
2. 多国間機関、できれば前の作業で知られている機関(たとえば、ワシントン WB の ASTAE)で 1 日のワークショップを開催する。大きなイベント(たとえば、2000 年 4 月 10～14 日の世界銀行グループのエネルギー週間)と共催でワークショップを開くことも可能である。
3. ワークショップの定義は講義を聴くだけではなく、双方向の交流や意見交換なので、参加者には PV その他の再生可能エネルギー普及プログラムに関する経験を、公式に発表する機会を与えなければならない。このために、2～3 の専門家(インド、インドネシア、フィリッピン、モロッコその他の国の行政官や PV 展開プログラムのマネジャー)を招待して具体的事例について発表してもらう。
4. 参加者によるこれらの発表には、インプット資料としてのアブストラクトや要約、今後のワークショップのための参考文献として含める。
5. PV 展開プログラムの一般的な難点や欠点を確認し、ワークショップや刊行物の中でこれらを発表・論議する。

ワークショップの時期と場所

2000 年と 2004 年との間に、ほぼ毎年 1 回の割合で、4 回のワークショップ開催を計画している。開催場所としては下記の候補地が考えられている。

- ワシントンの世界銀行グループ(WB)
- ニューヨークの国連開発プログラム
- マニラのアジア開発銀行(ADB)
- ラテンアメリカの米州開発銀行(IDB)国内オフィス
- アビジャンのアフリカ開発銀行(AFDB)
- ブラッセルのヨーロッパ共同体委員会(EC)

ワークショップの開催順序は、これらの地域でのスタッフや同時開催イベントの有無によって決められる。

参加者

発表者と参加者との双方向交流が効果的に行われるために、参加者総数は50を越えないようにする。ワークショップはもっぱら多国籍銀行の本部で開催するが、二国間機関のスタッフを閉め出すわけではなく、もっとも近いか、またはもっとも便利な開催地まで旅をするようにしてほしい。講演者および発展途上国の所定の代表者にのみ、旅費・宿泊費が支給される。(予算は 1 回のワークショップにつき、US$ 30,000.-に制限)。ワークショップの回数(4)や参加者数(4×50)に制限があるので、予想される目標を達成するためには、機関や銀行のスタッフの適切な選択が決定的である。過去や現行の PV 展開プログラムに関与した人々は容易に確認できるが、非エネルギーセクターのスタッフは見つけることが困難である。IEA 加盟国のエネルギー部門の協力を得て、それぞれの国のポートフォリオを徹底的に調べれば、揚水、SME、教育、通信、保健その他の分野の、ポテンシャルPV応用を取り扱うことのできる行政官を見つけることができる。およそ 10 の国際 NGO のスタッフについても、同様のアプローチを使うことができる。

ケーススタディ

ケーススタディは下記の問題に集中することを意図している。

- 発展途上国で PV システムを使用するエネルギーセクターの介入を定式化するメカニズム(プロジェクト/プログラムを確認)。
- 使用したプログラムアプローチ。
- いろいろな利害関係者の役割、とくに資金供与機関や銀行の役割。
- 使用したプロジェクト/プログラム実施セットアップと得られた教訓。
- 発展途上国において PV 展開プログラムを実行可能にする枠組み条件。
- PV システムのターゲットグループが PV 展開プログラムで成功するための最低条件。

- PV展開プログラムから期待できる社会・経済的インパクト。

研究開発、標準化、試験、ハイブリドシステム等の技術的問題は、プログラムのアプローチやセットアップに関係がある場合にのみ取り扱う。

完全なケーススタディを行うためには、およそ2.5人/月の専門家作業が必要である。サブタスク20のケーススタディ予算は15人/月分あるので、実施可能なケーススタディの総数は6件である。多国間および二国間資金供与機関によるすべてのPVプログラムを調べて順位付けした上で、6件のケーススタディを選定することが望ましい。タスクIXチームまたは特定の事例の特定評価のための専門家と契約して、ケーススタディを実施する。

サブタスク10はケーススタディに実質的なインプットを提供できると期待される(下記の4章参照)。

3.3 出版

前に述べたように、サブタスク 20 で行う出版は、基本的にはワークショップでのケーススタディ発表を編集し、ケーススタディ所見の比較解析と学んだ最終教訓およびガイド原理を添えることである。サブタスク20の出版予算は5人/月であるから、出版回数は最大2回に制限される。最近出版されたタスクIIIの書物「独立型PV応用----その教訓」や、これから作成されるサブタスク10の「推奨実務ガイド」など、他のPVPS出版物から、サブタスク20の出版物を区別するために、後者では技術問題は抜きにして、アプローチやプログラムセットアップのみを取り扱うべきである。したがって、出版物の表題は「PV展開プログラム:成功するためのアプローチとセットアップ」とする。

3.4 他の教育セミナーとワークショップ

発展途上国から要請のあった PV に関するワークショップや研修は、予算に限りがあるのでサブタスク20だけのアクティビティとしては開催できない。他の会議やセミナーとの共催を考えるべきである。このような会議やセミナーでは、サブタスク20に0.5ないし1日の日数を割り当てるべきである。このような国内イベントでは、タスク IX の専門家や関連コンサルタントと契約して、ケーススタディや教訓を発表するようにする。このような発展途上国における追加ワークショップや教育セミナーのターゲットグループとしては、開発機関や銀行に対する支援策を作成・認可する国の企画・実施機関(たとえば、電力事業体や電化実施機関)の職員とする。

3.5 情報・普及サービス

PVシステム展開およびプログラムアプローチに関する1日のセミナー・ワークショップでは、大部分の銀行や開発機関のスタッフが、自身のプログラムを作成するには不十分である。PVシステム展開のためのあらゆる問題に関する情報サービスが必要で、これはタスク IX でセットしなければならない。ターゲットグループでは、特定の問題について、IEA/PVPS 専門家の誰に問い合わせてよいかわからないので、サブタスク20のリーダーが問い合わせの受け口になって、ここから質問を関連IEA/PVPS専門家またはコンサルタントに回送する。受けた質問の妥当性や複雑度に応じて、サブラスク 20 のリーダ

ーは回答作成を委任する専門家のための予算限界を設定する。このような質問応答のための予算は、現在 5 人/月に制限されている。

サブタスク 20 のリーダーは委託可能な専門家とその専門分野に関するデータベースを作成して、応答作成のための適切な人選が速やかにできるようにしなければならない。

情報・普及サービスは積極的アプローチ策を採用して、ターゲットグループとの対話刺激をはかり、銀行や開発機関スタッフからの質問を受動的に待つことはしない。他のIEA/PVPSタスクのアクティビティ、とくに新しい出版や間近なイベントに関する情報は、メールでターゲットグループに送る。多国間および二国間機関や銀行における新しい PV 関連活動に関するアンケートを、定期的に発送し回答を解析して、セクターの活動を更新したり、サブタスク 20 の成果を監視・評価できるようにする。この目的のために、ターゲット機関の職員と活動に関するデータベースを作成し、定期的に更新しなければならない。

PVPS 専門知識

PVPS 専門家とその専門分野に関するデータベース

質問・応答・情報交換

タスク IX サブタスク 20 のリーダー

ターゲットグループおよび開発機関、銀行、国際 NGO による PV 展開アクティビティに関するデータベース

質問・応答・情報交換

ターゲットグループ(多国間および二国間開発機関、銀行、国際 NGO の職員)

3.6 REWP および IEA/OECD との協力(アクティビティ 22)

このアクティビティは基本的には、発展途上国のターゲットグループにPVシステムをアピールするためにIEA/REWP、IEA/非加盟国委員会、IEAおよびOECD事務局とのネットワーク形成および情報交換からなっている。接触を開始するために、これらの委員会やグループの年間行事を利用してそのメンバーと会見する。タスク IX メンバーとの協力から何が得られるか、そしてそれがネットワーク形成や情報交換に対する時間や労力の投資に十分見合うものであることを示すことが重要である。したがって、IEA/PVPS タスクIXから得られる情報サービスは、「再生可能エネルギーワールド」「フォトン」などの国際雑誌や、この話題に関するニュースレターや多数のウエブサイトから得られるものとは、ひと味違うものでなければならない。この場合の戦略としては、下記の提供が考えられる。

- PV 分野の著名は専門家との直接対話や意見交換ができること。
- ターゲットグループがとくにほしい情報。たとえば、プログラムアプローチ、制度面、資金供与機関の設定など。これらについては技術重視の国際雑誌には普通掲載されない。

付録 1: タスク IX の枠組み

タスク IX により、PVPS は発展途上の加盟国と非加盟国との間の直接協力を行う最初の IEA 実施協定である。タスク IX は、京都プロトコルのクリーン開発機構（CDM）および共同実施アクティビティーズ（AIJ）を実現する IEA 戦略の一環として、すべての再生可能エネルギー技術に関する協同作業を先導するものである。

このタスクは発展途上国との PV 協力の枠組みを提供し、PVPS プログラムがその専門知識と地位とを利用して、多国間および二国間の支援機関、政府機関、半政府機関、NGOs、PV 産業、その他広範囲な PV 市場展開に必要なターゲットグループをまとめることを可能にする。特定の IEA 非加盟発展途上国の PV 専門家とは、既存のネットワークやフレームワークの協力によりアクセスする。タスク IX は他の同様な既存プログラムやネットワークを利用し、それらに基づいて発展途上国、多国間および二国間の支援機関、および開発銀行のニーズやポテンシャルと取り組むことのできる、効果的、かつ効率的なプログラムを構築する。

タスク IX は、開発支援プログラムの一環として、ターゲット機関（多国間および二国間の支援機関、および開発銀行）に、農村電化戦略の有力な候補者として PV を採用するよう奨励することにより、持続可能な PV 市場を創成するまとめ役と見なすことができる。タスク IX は、PV 農村電化を実現するためのもっとも効果的な方法について、これらの機関を指導し、これらのプログラムが持続的・効果的・反復可能であり、多国間および二国間の支援機関の資金を投入した上は、効果的で自律的な基盤構造が構築できることを保証する。支援機関がタスク IX に参加することが極めて重要で、これら機関の活発な参加が期待される。

タスク IX が、多国間および二国間の支援機関やその他のターゲット機関とつき合う際に、直接的な商取引の利害関係から独立を保ち、提供する助言や指導が独立かつ公正であることが何よりも大切である。

World Bank Solar Home Systems Projects: Experiences and Lessons Learned 1993-2000

World Bank Rural and Renewable Energy Thematic Group[1]
{http://www.worldbank.org/html/fpd/energy/ruralenergy.htm}
and Asia Alternative Energy Program
{http://www.worldbank.org/astae}

Eric Martinot, Anil Cabraal, and Subodh Mathur

Working Draft For Comment--Not For Citation Or Quotation
January 24, 2000

Executive Summary

Twelve World Bank Group projects provide basic "energy services" such as lighting, radio, television, and operation of small appliances to rural households without access to electricity grids through the use of solar home systems. Among other objectives, projects are designed to develop markets for solar home systems and to overcome the key barriers to their widespread and accelerated dissemination. Project designs continue to evolve with increased understanding of best practices. Most projects are just beginning implementation; none are yet completed.

This paper reviews key features of these projects, experience from early implementation, and emerging lessons applicable to future project design and evaluation. Projects incorporate a combination of six basic features:

1. Pilot private-sector and NGO delivery models. Projects employ two basic models for delivery of solar home systems: "dealer sales" and "energy-service company." With dealer sales, qualified dealers receive project support in the form of business finance, capacity building, and/or market assistance. For energy-service concessions, projects also develop regulatory and selection/bidding frameworks. The review suggests that solar-home-system delivery firms face a myriad of difficulties operating in rural areas; those with rural experience and/or distribution infrastructure will do better. Most will benefit from training and support in obtaining business finance and other business skills. And all need project flexibility in allowing them to develop good business models.

2. Pilot consumer credit delivery mechanisms. For dealer sales, consumer credit makes systems more affordable to rural households. Consumer credit is provided by three mechanisms: through dealers, through microfinance organizations, or through development finance institutions. The review suggests that credit risk is a serious concern of both financiers and dealers and makes

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[1] This paper has been prepared with support from the Climate Change Thematic Group. Eric Martinot is a consultant to the World Bank and Associate of the Stockholm Environment Institute—Boston. Anil Cabraal is a Senior Renewable Energy Specialist in the Asia Alternative Energy Program. Subodh Mathur is a consultant to the World Bank and its Africa Rural Energy Initiative. The paper is a web-based document; hyperlinks are underlined.

credit sales particularly challenging. Dealers are reluctant to extend credit to customers with little credit history, and credit administration and collections may be costly. Local financiers need to take some commercial risk to increase project sustainability but have the same concerns. Partial credit guarantee schemes, microfinance lending, and partnering promise viable models to reduce risks. Longer credit terms stimulate demand by poorer households but increase risks.

3. Pay first-cost subsidies and offer affordable systems. Some projects incorporate per-system subsidies to make systems more affordable and to reduce initial and/or monthly payments by households. Some projects also allow smaller system sizes or simpler components to improve affordability. The review suggests that customers desire a range of component options and service levels and can benefit from even small systems. Even with subsidies and smaller systems, customers in early market phases may still be limited to the wealthiest rural households.

4. Support policy development and capacity. Projects support or influence policy in several ways: technical assistance to regulatory agencies for energy-service concession bidding, contracting, monitoring and regulation; influence on government planning and policy related to rural electrification and power sector reform; industry participation in policy and planning; and reduced import duties for components. The review suggests that concession tariff-setting, bidding and regulation require substantial time and resources. Projects must recognize the link between rural electric-grid extension and solar home system demand; clear, open and realistic rural electrification policies will help create and/or stabilize market demand.

5. Enact codes and standards and establish certification, testing, and enforcement institutions. Poor-quality equipment and installation and exaggerated performance claims hurt markets. Most projects develop or establish equipment standards and create or strengthen certification and testing institutions to ensure quality, safety and long-term reliability. Projects also provide capacity building for dealers to meet standards and for agencies to verify compliance. The review suggests that establishing reasonable equipment standards and certification procedures for solar home system components that ensure quality service while maintaining affordabilty is not difficult. Few technical problems have been encountered with systems.

6. Conduct consumer awareness and marketing programs. Most projects conduct some type of consumer awareness and marketing program and may also conduct detailed market surveys. The review suggests that marketing campaigns can be extremely costly and time consuming in rural areas, often requiring door-to-door and direct contact. Simple consumer awareness is usually insufficient by itself. Dealers benefit from marketing assistance in early phases of new market development until a "critical mass" of customers develops that makes marketing easier.

Five leading projects in Bangladesh, Dominican Republic, India, Sri Lanka and Vietnam have installed more than 5,000 systems. Installation targets from all projects total more than 500,000. But commercial sustainability and replication of viable models has not yet been achieved or conclusively demonstrated in any project. A key challenge is to demonstrate business models in which all firms in the supply and service chain make profit. Other challenges are to demonstrate regulatory models for energy-service concessions and to integrate rural electrification policy with solar-home-system delivery. Future projects need to draw from these lessons, incorporate flexibility and adaptation, and allow sufficient time to develop and test viable models.

Introduction

Since 1992, the World Bank Group has approved twelve projects that provide basic "energy services" such as lighting, radio, television, and operation of small appliances to rural households that lack access to electricity grids through the use of "solar home systems" (see Table 1).[2] A solar home system consists of a photovoltaic solar panel, a storage battery, a battery charging controller, and various end-use equipment like florescent lamps (see Photos 1-4). Solar home systems can eliminate or reduce the need for candles, kerosene, LPG, and/or battery charging. Direct economic benefits include avoided costs of battery charging and LPG or kerosene purchases; other significant benefits include increased convenience and safety, improved indoor air quality, a higher quality of light than kerosene lamps for reading, and reduced CO2 emissions. Solar home systems already provide basic electricity services to more than 500,000 households in developing countries (see the World Bank's Solar Electricity web page {http://www.worldbank.org/html/fpd/energy/subenergy/solar/solar_pv.htm}; see also Foley 1995; Cabraal et al 1996; Kammen 1999; Loois and Hemert 1999).

In the early 1990s, the World Bank recognized that solar-home-system technology was maturing, costs were declining, and commercial markets were developing. At the same time, population growth was outpacing the ability of electric utilities to extend rural electricity grids and developing countries were increasingly recognizing the economic difficulties of achieving full grid-based rural electrification. The World Bank and many governments began to perceive that solar home systems could provide least-cost rural electrification and could supplement grid-based electrification policies (World Bank 1997). Because of the many obstacles to delivering solar home systems in rural areas, and because of the development and environmental benefits, the World Bank and Global Environment Facility (GEF)[3] have considered assistance for solar home systems to be highly relevant and have jointly supported these projects. In many projects, solar home systems are but one component of a larger project with a variety of development objectives like power sector reform, rural electrification, and rural development.

Solar-home-systems project designs have continuously evolved with increased understanding of best practices. In general, projects are designed to overcome the key barriers to the widespread and accelerated dissemination of solar home systems in a given country context (see Box 1). The key elements of a sustainable rural PV market include customer satisfaction, affordability, dealer profitability, and effective supply and service chains. Considering these elements, most projects incorporate six basic features:

1. Pilot private-sector and NGO delivery models
2. Pilot consumer credit delivery mechanisms
3. Pay first-cost subsidies and offer affordable systems
4. Support policy development and capacity
5. Enact codes and standards and establish certification, testing, and enforcement institutions
6. Conduct consumer awareness and marketing programs

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[2] Some of these projects also target other applications of PV, such as agricultural, commercial and village power applications, which are beyond the scope of the present paper.

[3] See Martinot and McDoom 1999 for more details on the GEF and its projects. Also see the GEF web site {www.gefweb.org}.

Each project feature is intended to overcome a specific set of key barriers. Projects take many different approaches to incorporating these features; some projects take more than one approach simultaneously to determine which approach is more effective or viable in the country concerned (see Table 2). Projects are essentially experimental because there simply isn't enough accumulated experience yet from any institution, government, or firm to provide definitive answers about the best approaches (see references for related materials). Nevertheless, most project designs will face four basic design questions that can be addressed with a combination of project features (see Table 3). Elaborations of the six project features and emerging lessons from initial implementation experience are described in the following sections.

In all projects, demonstration of a viable business model, whether that business is public or private, is key to achieving project sustainability and replication. Viability means clearly showing expenses and receipts, cashflow, profits (or required subsidies), and management arrangements that demonstrate a business can continue to exist and function. "There is a high value-added [by projects] in terms of developing and improving business models...you want to stimulate markets based on these business models" said a dealer in one project. For commercial firms, profit is the ultimate measure of whether a business model is viable and whether to operate in a given market. For non-profit organizations or public firms (i.e., public utilities), ongoing subsidies may be part of the business model based on public objectives (e.g., rural electrification and development). All projects in some way help firms maximize income (related to demand, pricing and affordability) and minimize expenses (for marketing, service, training, and operations).

Solar-home-system installations as a direct result of projects supported by the World Bank Group could total more than 500,000 systems. But most projects are relatively new and offer little implementation experience so far. The five leading projects are in Bangladesh, Dominican Republic, India, Sri Lanka and Vietnam. Through these projects, by the end of 1999, approximately [3000] systems had been installed in the Dominican Republic, 1000 in Sri Lanka, 1100 in Bangladesh, and 500 in Vietnam. The India project has targeted a variety of photovoltaic applications and has mostly installed PV in commercial markets rather than in rural residential markets.

All projects can offer pilot experience of potentially effective approaches, and the five leading projects mentioned above are closest to doing so. But commercial sustainability and replication of successful models has not yet been achieved or conclusively demonstrated in any project.[4] It is simply too early in the evolution of the portfolio. Further implementation progress for all projects is needed before more definitive conclusions can be drawn about experience, lessons, and effective project designs. The development, evolution and testing of successful approaches requires time, money, flexibility and risk-taking, elements which are sometimes missing in existing projects but are essential for future projects.

[4] There are several examples of successful commercialization of solar home systems that have occurred without direct donor assistance, notably in China, Indonesia, Kenya and Zimbabwe. These cases also illustrate alternative delivery models that are not dedicated solar PV businesses, like battery companies and sellers of household goods in Kenya and household furnishings chains and hardware/electronics stores in Zimbabwe. See for example Kammen 1999.

1. Pilot Private-Sector and NGO Delivery Models

Projects have employed two basic private-sector models for delivery of solar home systems: "dealer sales" and "energy-service company." A dealer-sales model means that a dealer purchases systems or components from manufacturers and sells them directly to households, usually as an installed system, and sometimes on credit (as in **Indonesia**, **India**, **Sri Lanka**, **Vietnam**, **Bangladesh** and **China**). The household owns and is responsible for servicing the system, although the dealer may provide service contracts or guarantees. An energy-service-company (ESCO) model means that the ESCO owns the system, charges a monthly fee to the household, and is responsible for service. The ESCO may be a monopoly concession regulated by the government to serve specific geographic regions (as in **Argentina**, **Benin**, and **Togo**), or it may operate competitively without any explicit monopoly status (as in the **Dominican Republic**). Combinations of these two forms of ESCO start with monopoly concessions and progressively open up markets to competition after some years (as in the **Cape Verde**).

The **India** project has promoted sales of photovoltaic systems through large industrial enterprises, which could take advantage of favorable government tax credits, but these enterprises have focused on commercial markets. At the same time, small dealers financed through the project began to develop rural distribution systems and sell to rural households. ESCO models are also being employed. In **Indonesia**, a dealer-sales model has been employed. Dealers can participate in the project based upon eligibility criteria, such as existing business competence, sales/service infrastructure in related rural markets, and a credit agreement with a participating bank. The **China** project also uses a dealer-sales model and supports the development of local dealers similar to the Indonesia project. Any dealer in China who passes the project's eligibility criteria will be able to participate in the project (at least 10 dealers are expected initially; others may become eligible later). An ESCO concession model was considered unworkable in China and was rejected early in project design, partly because no appropriate authority exists, in either the electric power or agricultural/rural sectors, to regulate concessions.

In **Argentina**, the regulated ESCO concession model is used, partly because Argentina already had substantial experience with regulatory frameworks for concessions in other sectors (see Box 2). Also, the low percentage of households which remained unelectrified led the government to believe that the "bundling," economies of scale, and lower transaction costs possible with rural energy concessions were necessary to attract the private sector. The World Bank project is part of a broader, nationwide rural electrification program, in which rural energy concessions were already established in two provinces. Under the project, eight provinces have agreed to participate. For each of these eight provinces, the government awards a monopoly concession based upon a competitive selection process. The concession provides and maintains solar home systems (or other technologies it chooses) for households and collects a monthly fee-for-service. Concessions will be committed and obligated to provide electricity services (upon request from customers) to populations in a specific province over a period of at least 15 years.

Potential advantages of the concession approach are:

- can attract larger, better organized private companies with their own sources of financing;

- has the potential to serve a large number of customers in just a few years;
- has the potential to reduce equipment costs (through volume discounts), transaction costs, and operation and maintenance costs (through economies of scale); and
- ensures service to the customer over a long period (e.g., 15 years).

Potential disadvantages include:

- regulation may be costly and require substantial regulatory capacity;
- lack of competition may stifle innovation, new products and services, and cost reductions;
- technological change can undermine regulatory and contractual conditions;
- quality of service may be difficult for regulatory agency to ensure; and
- monthly fee collection costs may be high.

The Argentina government is still exploring how best to regulate concessions and the project will help to pilot regulatory models and approaches. Two key issues are tariff structures (including tariff levels, government subsidies, negotiation procedures, and how often tariffs are reviewed and renegotiated) and the question of how to regulate the quality of services provided to customers by the concessions (i.e., provisions in contracts between concessions and their customers).

Following Argentina, three more recent projects in **Benin, Togo, and Cape Verde** also use the ESCO concession model. The Benin and Togo projects each attempt to establish financially viable private-sector installation and service companies by the project's completion. Like Argentina, monopoly concessions would be granted for 15 years in targeted regions to the winners of a competitive selection.

The **Sri Lanka** project was designed to accommodate both dealer-sales and ESCO models. Both types of firms, as well as NGOs, were allowed to apply for business financing from commercial banks under the project. Early in the project one firm tried to operate as an ESCO for awhile but found the costs of monthly collections among the highly dispersed and remote rural populations to be high. The firm did not have sufficient rural infrastructure and standing in rural communities to handle collections effectively and efficiently. Rather, this firm and one other firm are focusing on direct sales facilitated consumer credit from a microfinance organization (see next section on consumer credit delivery). Initially, an NGO also attempted to sell systems on credit it supplied, but ceased operations when it was unable to satisfactorily service and maintain the systems it had sold (Martinot, 1999).

Availability of business financing is an important element of all private-sector delivery models. In **Sri Lanka**, dealers, NGOs and cooperatives are eligible to borrow from commercial financiers participating in the project. The two primary dealers in that country have had no difficulty in obtaining business financing under the project. That situation could change after the project, but the dealers don't expect much trouble because they believe commercial financiers' perceptions have changed about the profitability and risk of the business. Under ESCO delivery models, financing for ESCOs comes from either government or multilateral sources, but may be channeled through commercial financiers; in **Argentina**, ESCO concessions receive financing from provincial and federal government sources.

Two IFC projects are also providing business financing for solar home systems businesses, which may deliver systems under a variety of models. The Photovoltiac Market Transformation Initiative provides business financing for companies in PV markets in **India**, **Kenya**, and **Morocco** through a competitive solicitation and selection of business plans. The Small and Medium Scale Enterprise Program (SME) is providing business financing for dealers in **Bangladesh**, the **Dominican Republic**, and **Vietnam**. The SME program also provides added incentives for firms to demonstrate sustainability; if firms generate profits they receive partial debt forgiveness. In Vietnam, the dealer has been selling systems on cash and credit terms, but as rural grid extension continues in Vietnam, the dealer is looking to an ESCO concession approach and hopes the government may consider supporting such an approach in the future.

In the **Dominican Republic**, the dealer has been developing a successful fee-for-service business model that targets 50% of the rural population and charges $5 to $20 per month for electricity service from solar home systems. Through continuous tuning of its business model to maximize income and minimize expenses, this firm is approaching profitability and "proof of concept" for an installed base of 5000 systems. The firm is attempting to scale-up the business model to 25,000 systems but recurring overhead costs and slim profits make expansion difficult: "this is a lean margin business; you don't want to burden a $1 million company with the overhead costs of building a $10 million company" the firm said.

There is also a need to develop the commercial skills of delivery firms. Delivery firms may be small, inexperienced ventures. Or existing firms operating in rural areas may decide to expand their product lines to include solar home systems but need training in PV technologies. In **Indonesia**, because dealer cash flow was a key constraint in selling solar home systems on credit, dealer training focused on how to develop business plans and approach banks for business financing. In **Sri Lanka**, grants to dealers covered up to 50% of external consultant costs for preparing project finance proposals for commercial financiers. The Sri Lanka project also has provisions for business support, but dealers have not requested much assistance under the project. In **China,** the project helps dealers to improve system quality (through cost-sharing of design, testing and certification), market their products, and provide warrantees and after-sales service. In **Cape Verde,** project assistance to ESCOs covers business planning, technical training for staff and managers, distribution infrastructure, and market development and research.

Lessons Suggested by Early Implementation Experience

- Private dealers with prior experience in rural markets and NGOs with close ties to local communities will find delivery much easier.
- The difficulties of operating a PV business in rural areas and making a profit can easily be under-appreciated by project designers. Small dealers face huge challenges.
- Developing good business models (operations, servicing, and financing) and fine-tuning them are critical to the success of these low-margin businesses.
- Energy-service concessions require the existence of a government agency at an appropriate level that can serve as an effective regulator.

- Private dealers, especially small ones, have difficulties preparing acceptable business plans for commercial financiers.
- Initial cash sales to wealthier customers are a way to financially strengthen smaller dealers.
- Flexibility to experiment with and change delivery mechanisms and models during the project is crucial. Project implementation units must be able to manage flexibly.
- Companies may benefit from additional business support and training, but may be working so hard to operate the business that they don't recognize their needs or request assistance. Projects should hire business development consultants to be easily available to dealers.
- Projects can have indirect influences on attracting other potential distribution channels into the solar PV business, like department stores, retailers of household goods and appliances, and providers of other rural services (this is occurring in Sri Lanka with a department store).

2. Pilot Consumer Credit Delivery Mechanisms

With a dealer-sales model, consumer credit is important for making systems affordable to rural households. Market studies associated with World Bank projects have revealed that majorities of rural households with incomes less than $250/month and not connected to rural electricity grids typically pay $3 to $15 per month for energy, in the form of candles, kerosene, battery charging and disposable batteries (GEF 1998a, 1998b, 1998c, [China Market Study]). These surveys have revealed a household willingness to pay for energy to meet the end-uses valued most, such as entertainment, information, and high-quality lighting. In a fee-for-service arrangement, monthly fees can be regulated or set to levels competitive with these expenditures. But dealer sales of solar home systems must overcome the first-cost barrier--their high initial cost relative to these conventional alternatives--and provide a means whereby households can continue to pay amounts roughly equivalent to their conventional energy purchases. Long-term consumer credit is one means to make monthly payments more comparable to conventional energy expenditures.

Consumer credit is provided through three primary mechanisms in World Bank projects: dealer-extended credit, credit through a microfinance organization[5], and credit through a local development finance institution. Consumer credit through commercial firms was first tried in **India**. This project provided credit through IREDA to commercial firms. The firms were supposed to purchase systems from manufacturers (realizing substantial government tax credits in the process) and then sell the systems to rural households on credit. A separate service firm, under contract to the manufacturer, was supposed to provide marketing, installation, commissioning, and after-sales service. This approach proved infeasible because the commercial firms were unwilling to lend to rural households due to credit-risk and collection concerns.

In **Indonesia**, a dealer-credit model was introduced partly because of the prior success of a private dealer in Indonesia selling systems on credit. This entrepreneur was able to sell more than 4000 systems on credit. In the original project concept, business financing would be extended by commercial financiers to dealers, and then in turn dealers would extend consumer

[5] For more on microfinance see Dicter 1999 and Ledgerwood 1999.

credit, at terms of up to four years, to their customers. The commercial banks would bear the dealer credit risk, and the dealer would bear the consumer credit risk. Dealers sales of 200,000 systems were targeted through this model. Unfortunately, the project was never implemented because of Indonesia's macroeconomic crisis and will now be canceled. So the expected experience with dealer-supplied credit there has not materialized.

The **Bangladesh** project demonstrates an initially successful application of the dealer credit model. The (non-profit) dealer, Grameen Shakti, performs marketing, sales, service, credit provision, collections, and guarantees. Before receiving an IFC loan under the Small and Medium Scale Enterprise Program, Grameen Shakti could obtain financing for terms of one year only, so was able to extend consumer credit only for one year terms. This greatly limited customer demand. With the IFC loan, Grameen Shakti is able to extend three-year credit to customers, which has made a large difference in its business. Grameen Shakti's credit terms and customers are quite different from traditional Grameen Bank microfinance terms and customers. Grameen Bank members, typically poorer households, receive microenterprise loans (for income-generation purposes only) of $100 or $200, for terms up to one year, at 20% interest. In contrast, Grameen Shakti loans are roughly $500 for terms up to three years, at 12% interest. Grameen Bank loans are regularly repeated, while Grameen Shakti loans are one-time. Thus there is a clear distinction between "business microfinance" by the Grameen Bank for its members, and "consumer credit" by Grameen Shakti for customers purchasing solar home systems.

Dealer credit was tried early in the **Sri Lanka** project but soon rejected by the dealers themselves. Dealers found collections too difficult and time consuming and favored (and led) the shift away from a dealer-credit or fee-for-service model to a microfinance model. Building a rural "service infrastructure" with technicians is a very different business from building a rural credit delivery and collection infrastructure, said the suppliers. "The success of credit depends on local connections, knowledge and institutions already in place" said one industry observer.

So the **Sri Lanka** project has instead turned to microfinance organizations for extending consumer credit, with one large national microfinance organization participating so far in the project. This microfinance organization borrows from the commercial financiers participating in the project and lends to customers. Customers purchase solar home systems from the dealers, who are responsible for marketing, sales, and after-sales service. The microfinance organization is responsible for collections. The microfinance organization and dealers coordinate expected sales and credit delivery. The credit provided by the microfinance organization for purchase of solar home systems is similar in kind to that provided for enterprise development. The microfinance organization typically offers microenterprise loans from $100 to $600 with terms of up to four years at 24% interest; terms for solar-home-system loans are similar: $500 with 20% down payment, terms of up to five years, and 24% interest rate. Sri Lanka has a long history of rural microfinance, which has greatly helped the viability of a microfinance model there.

In **Vietnam**, sales by a private dealer are assisted by a complex credit delivery scheme involving the Vietnam Women's Union (VWU), an NGO, and the Vietnam Bank for Agriculture and Rural Development (VBARD), a development finance institution. VWU markets the dealer's systems and performs collections for consumer loans provided by VBARD. The dealer installs systems and is responsible for service. VBARD provides credit, assuming risk for 75% of the purchase price. The dealer provides a collateralized guarantee to VBARD for 5-10% of the purchase price and the customer covers the remaining 15-20% as a down-payment. In case of loan default, the dealer repossesses and refurbishes the system and VWU finds a new buyer. VBARD can recover any losses involved with repossession from the dealer's collateralized guarantee. Credit terms to consumers are only 6 to 18 months, however, which limits demand. Despite instructions from the head office, some conservative branch managers of VBARD have been reluctant to participate; where this has happened, the dealer has extended consumer credit itself.

A cash sales model without credit is employed in **China.** Extending credit to rural households was not considered feasible given the almost complete absence of experience with consumer credit in general in China. However, the project provides flexibility so that dealers may also offer innovative payment mechanisms to increase affordability.

Lessons Suggested by Early Implementation Experience

- Local financiers should be encouraged to carry some of the credit risk, not simply act as administrative conduits, in order to increase post-project sustainability and replication.
- Commercial financiers may be reluctant or unwilling to provide consumer credit to rural households because of the credit risk.
- Small dealers face sufficient business and technology risks that they are reluctant to assume consumer credit risks and incur the costs of credit administration and collections.
- Small private dealers should be encouraged to work with local microfinance organizations and/or partner with larger firms that can extend credit.
- Microfinance may work in countries that have well established microfinance institutions, but NGOs do not necessarily have the commercial orientation or business skills necessary for rapid delivery of credit. Scale-up and outreach can become problematic.
- Credit collection can be costly if rural customers are dispersed over large territories with poor transport infrastructure. Business organization for marketing, installation and service may not be suited for credit collection.
- Projects should allow dealers flexibility to innovate new ways to make systems affordable.
- Adequate after-sales service is key to credit repayment performance.
- Some customers with seasonal income (i.e., paddy farmers with semi-annual harvests) may require credit repayment schedules tied to income (i.e., semi-annual rather than monthly).

3. Pay First-Cost Subsidies and Offer Affordable System Sizes

Besides providing consumer credit, some World Bank/GEF projects incorporate first-cost subsidies to reduce high-first-cost and affordability barriers. These subsidies are intended to reduce the initial payment and/or the monthly payments households have to make, with the objective of making monthly payments as equivalent to current monthly payments for conventional energy (e.g., kerosene and batteries) as possible (see Box 3). Grants are paid to delivery firms, to commercial financiers, or to microfinance organizations upon installation and proper inspection and documentation of a solar home system. Certification of installation is either done by the project or by commercial financiers. Subsidies are used in different ways in different projects. For example, in **Sri Lanka**, the microfinance organization providing consumer credit reduces the amount of each monthly credit repayment by a share of the subsidy. Subsidies are incorporated into projects in **China**, **Indonesia**, **Argentina**, **Benin**, **Togo**, **Cape Verde**, and **Sri Lanka**.

Some projects offer fixed cash grants for each system installed. In **China**, a cash grant equal to $1.50/Wp of installed capacity is paid directly to the dealer. In **Sri Lanka**, a $100 grant is paid to the commercial financier. In **Indonesia**, grants of $75 in Java and $125 elsewhere are paid directly to dealers after the project receives documentation of customer acceptance of installation and a completed hire-purchase contract between the customer and dealer. Originally only 50 Wp systems were eligible for these grants in Indonesia, but in consideration of customers who want to purchase smaller, more affordable systems, the grants were extended to cover 30 Wp systems as well. The Indonesia project required that dealers offer credit to their customers as a condition of eligibility to receive the grant, which caused problems among dealers who didn't want to borrow or extend credit. This requirement has become a problem in **Sri Lanka** as well, where one dealer was purchased by a large multinational corporation and thus no longer needs commercial financing, but must obtain financing under the project in order to qualify for grants.

Declining cash grants on a sliding scale over the life of the project are built into more recent projects. The idea of declining grants is that as the project gets closer to completion, existing businesses will be able to offer cheaper systems to customers, and thus smaller grants are needed for the same levels of affordability. For example, in **Argentina**, the ESCO concessions are given a variable cash grant for each system installed during the initial five years of the project, upon certification by the provincial government that the system has been installed in accordance with pre-established standards and conditions. The cash grant declines for installations made in later years of the project and also depends upon system size. The grants decline gradually to zero by the end of the project. In **Benin, Togo, and Cape Verde**, declining grants also were enacted similar to Argentina. One drawback to providing grants on a sliding scale is the added administrative complexity of tracking systems in terms of when they are installed and thus for what level of subsidy they are eligible.

Many projects specify a minimum system size of 50 Wp. However, some projects allow sales of smaller-size systems or lower-cost components initially, and provide trade-in or resale mechanisms for consumers to "trade up" to more expensive systems. The **Sri Lanka** project has modified systems specifications to allow more affordable systems of capacity 30 Wp and less to be eligible for GEF grants under the project. Most sales in Sri Lanka have in fact been of 32 Wp systems (selling for about $450). **Indonesia** also modified specifications to allow 30 Wp systems. In **China**, systems as small as 10 Wp are allowed as long as components meet the relevant standards. Sales of 50 Wp systems predominate in **Bangladesh**, where the dealer has been able to achieve very low system costs of roughly $500 for a 50 Wp system because of cheaper domestically produced components and favorably-priced PV module purchases.

Lessons Suggested by Early Implementation Experience

- Mixed recipients of subsidies in the same market complicates dealer marketing and pricing. If a commercial financier or the customer receives the subsidy, then dealers may try to charge higher prices. But if dealers receive subsidies, they can offer lower prices. If the two modes exist in the same market, dealer pricing can appear inequitable.
- Customers desire and are able to benefit from smaller systems, such as 30 Wp or even smaller, so allow project flexibility to specify and deliver smaller systems with a greater range of consumer choice as to components and service levels.
- In smaller or less established markets, individual dealers may have difficulty negotiating favorable prices from PV module suppliers.
- Even with subsidies, smaller systems sizes, and consumer credit, the bulk of customers in early market phases may be only the wealthiest rural households, who purchase solar home systems as a "luxury good" for reasons of convenience, aesthetics, lighting quality, and/or novelty, rather than for economic benefits.

4. Support Policy Development and Capacity

Several policy-related issues have factored into project design and experience:

Regulatory assistance for concessions. For projects using the ESCO concession model, technical assistance to national regulatory agencies is also included for concession bidding and contracting, training of agency staff, and monitoring and regulation of concessions. Examples of regulatory agencies are the provincial governments in **Argentina**; the national energy agency (INERG) in **Cape Verde**; and the Agence d'Electrification Rurale (AER) in **Benin** and **Togo**. In Argentina, sustainability is enhanced by strengthening provincial regulatory functions and institutions and appropriate incentives and returns for the concessions.

Rural grid extension planning and policy. Projects indirectly or directly influence government planning and policy related to rural electrification. For example, in **Sri Lanka**, the project has encouraged the national electric utility and the government to more explicitly recognize and incorporate solar home systems into rural electrification planning, and to recognize that unrealistic political promises and uncoordinated grid extension harm the market for solar home systems. Such encouragement may lead the national electric utility to admit to populations in specific rural areas that "the grid isn't coming; consider a solar home system instead" (or even, "we will provide you with electricity, it just won't be grid-based").

Electric power sector reform. Power sector reform activities associated with other World Bank projects bear on future solar home system markets. For example, power sector reform in **Sri Lanka** will result in the establishment of an "independent utility regulator" accountable to parliament. When this happens, the World Bank expects to see more realistic grid expansion plans for rural areas, greater accountability, and fewer false promises by politicians. This should help stabilize and solidify geographic areas of solar home system demand.

Industry participation in policy and planning. In **Sri Lanka,** a project workshop led to the creation of a solar energy industries association, with eligibility limited to dealers who have a proven sales record. In part this association formed to act as a unified voice for companies to interact with the World Bank, the government, and the national electric utility on project matters and rural electrification policy and planning.

Import duties. Reduced import duties on PV components can remove market distortions and make solar home systems more affordable for rural households. The government of **Sri Lanka** reduced import duties in conjunction with the project from 30% to 10% (10% is duty for all other non-protected goods). (Ironically, the 30% import duty was originally designed to protect a domestic PV manufacturing plant, but when that plant was closed (prior to the project), the import duty served to depress the emergence of a PV dealer industry using imported components.) In **China,** import duties were eliminated for PV components in conjunction with China's policy that all government-approved renewable energy projects can import materials duty free (although most components are expected to be produced domestically because China has a large PV industry).

Lessons Suggested by Early Implementation Experience

- There are numerous issues that must be resolved in concession tariff-setting, bidding, award, and regulation. Resolution of these issues may not be straightforward and projects should allow sufficient time and resources to address them adequately and completely.
- The influence of customers' perceptions of future rural electric grid extensions, whether based upon concrete government plans or merely unrealistic political promises, has a much greater detrimental effect on demand for solar home systems than projects have expected.
- Consumers are going to prefer being connected to the grid rather than receiving energy services from a solar home system, all else being equal. But there is additional value from solar home systems if customers have to wait some years for the grid to arrive.
- Lower import duties can harm domestic producers of PV equipment.
- The threat of rebound in import duties after the project casts a shadow on future market development, project sustainability and replication.

5. Enact Codes and Standards and Establish Certification, Testing and Enforcement Institutions

Historically, the reasons for failure of solar home systems projects included poor quality products, poor installation and maintenance, and systems being "oversold" (marketing claims that raise expectations higher than the technology can deliver). Codes, standards and certification (and marketing restraint) are important elements to address these issues, as well as reduce commercial risks.

Enforcement of standards, including associated institutional capacity, is equally important. During a World Bank project, the project itself can ensure that standards are enforced. After project completion, this task will be left to the government and/or institutions created or strengthened during the project. Since no projects have been completed yet, post-project enforcement of standards (and voluntary adoption by firms) has yet to be tested.

Most projects develop and establish PV component and systems standards to ensure quality, safety and long-term reliability. Dealers who wish to participate in the project must then get their equipment certified at an approved testing laboratory. For example, in the **Benin** and **Togo** projects, the rural electrification agency issues and enforces a "PV code of practice" and technical standards. In **Indonesia**, dealers are required to furnish certifications from acceptable testing facilities that their components meet or exceed the selected specifications before they can sell. Assistance is provided to participating dealers to get equipment certified by international laboratories. The **China** project hopes to develop and disseminate equipment standards so they are adopted outside the project, as a proposal for national standards National certification in China could indirectly encourage certified Chinese products to be sold internationally, similar to what is happening in Indonesia--products certified under the World Bank project are being sold to other countries.

Sri Lanka at first adopted the standards used in Indonesia, but then modified the standards to allow smaller systems (30Wp) better suited to Sri Lanka consumer demand and solar insolation characteristics. Later, in both **Indonesia** and **Sri Lanka**, minimum requirements were further reduced due to consumer demand and dealer capabilities.

In **Sri Lanka**, equipment certification held up the project for the first year as there were no certified products available to sell. The project design didn't expect that it would take nearly this long to get certified products into the hands of suppliers, perhaps because the project originally thought the systems would be imported from Indonesia, where presumably a market based around World Bank approved standards was to have developed in parallel with the Sri Lanka project. Even then, batteries would not meet the established specification and the Sri Lanka project had to declare a moratorium on the battery specifications for several additional months.

Domestic certification and testing agencies are also important. The **Indonesia** project provides technical assistance for strengthening capabilities of the Agency for the Assessment and Application of Technology for solar PV testing and certification. In **China**, grants provide equipment and training to create a national PV Testing and Certification Center. Assistance is also provided to strengthen PV module and balance-of-system testing and certification agencies, as well as strengthening the capabilities of a design-assistance center.

Most projects also provide capacity building to ensure quality systems are installed. This assistance is important not only to protect consumers under the project, but also the reputation of an industry striving towards large scale commercialization. In **Sri Lanka**, assistance to dealers was planned for testing and quality improvements, but dealers did not appear to need or be interested in such assistance. In Sri Lanka, grant funds are also available to commercial financiers to verify that solar home system designs meet project specifications and that systems are installed properly. Grant funds also maintain a facility for investigating unresolved consumer complaints against dealers and seeking appropriate solutions. In **China**, capacity building is provided for quality assurance and consumer protection. In **Benin** and **Togo**, the rural electrification agency will develop the capability to spot check installed systems and conduct regular consumer surveys to ensure good technical performance of private operators.

Lessons Suggested by Early Implementation Experience

- Establishing reasonable equipment standards and certification procedures for solar home system components that ensure quality service while maintaining affordabilty is not difficult, and few technical problems have been encountered with systems.
- Allow flexibility in standards-setting, so that if initial standards are too high for local dealers/ESCOs to meet, the standards can be relaxed.
- Use standards only to the degree to which they contribute to adequate consumer satisfaction and thus a sustainable market, but do not excessively stifle the market.
- Installation of quality products lowers future marketing burdens and costs and lowers future service costs.
- Project schedules should allow sufficient time for dealers or ESCOs to establish suppliers and procure supplies of certified products before anticipating the beginning of sales or service. In some cases several months may be required before products can actually be sold or delivered.
- Consumer education in proper maintenance and operating procedures, during sale or installation of a solar home system, is important for minimizing maintenance costs and enhancing battery life and overall system reliability.

6. Conduct Consumer Awareness and Marketing Programs

Most projects conduct some type of consumer awareness and marketing program. Such programs are usually preceded by a market survey conducted as part of project preparation activities (such as in **India** and **Indonesia**) or by an existing market survey done by others (such as in **Sri Lanka**). The **China** project conducted an extensive survey of rural consumers{document link} to better understand the market because there was very little existing demographic data (including population, income, expenditures, household structure, etc.) available on which to base project strategies. Surveys of a sample of 2000 households, including existing owners of solar home systems, revealed important information about affordability and household budgets [report now being written]. The China project also provides grants to dealers to assist them with sales and marketing activities.

In **India**, IREDA has been conducting promotional campaigns for photovoltaic technologies in the media, but these campaigns may not have reached rural households. Within the Sri Lanka marketing program {link to Sri Lanka marketing program}, the project hired a consultant specifically to lead village-level workshops throughout the country to promote solar home systems. In these workshops, dealers are able to demonstrate their products and village leaders learn about the technology. In addition, potential local microfinance organizations have learned about the project and gauged local interest in solar home systems, and have been invited to participate in the project and provide consumer credit to the local community. Such workshops were being conducted twice monthly and were considered moderately successful, although dealers felt the workshops did not sufficiently attract the actual customers of solar home systems.

Projects also support ESCO concessions in their marketing and consumer awareness activities. In **Argentina**, provincial governments assist concessions by preparing detailed market studies, conducting information dissemination workshops, and preparing studies on how to improve the availability of DC appliances compatible with solar home systems in dispersed rural areas. In **Benin and Togo**, the rural electric utility conducts marketing activities to support the ESCOs; the utility polls communities on their interest in solar home systems and willingness to pay, and collects information on the demographics of these villages. In addition, ESCOs can conduct market surveys themselves using project grants.

Further details of consumer awareness and marketing programs are available directly from project implementing agencies but have not been collated for this report.

Lessons Suggested by Early Implementation Experience

- Consumer awareness does not by itself create a larger market. Other factors, such as affordability, demonstrations, opinions of neighbors, service presence, and trust in technological performance are equally important.
- Marketing campaigns can be extremely costly and time consuming in rural areas, as potential customers may live far from village centers, may not be able to read, may be very skeptical of the technologies, and may require direct person-to-person contact through community gatherings or even door-to-door marketing.
- Marketing campaigns should be sure to target potential customers in rural areas, not just village leaders and potential commercial participants.
- Marketing becomes easier once a "critical mass" of customers exists in specific rural areas.
- Door-to-door and direct contact is much more effective than TV or radio campaigns.
- It may be quite difficult to assess the impact or effectiveness of marketing campaigns in rural areas.

Table 1: World Bank Group Projects with Solar Home System (SHS) Components

Project Name	Approval dates and status	Bank/GEF funding & total project cost	SHS component description	Implementing agencies
India Renewable Resources Development Project {http://www.worldbank.org/astae/lcg.htm#credit24490-IN}	GEF: 1991 Bank: 1992 *under implementation*	GEF: $26 m. Bank (IDA): $115m. Bank (IBRD): $75m. Total: $450 m.	2.5 MWp of PV in various applications, (commercial, water pumping and SHS)	India Renewable Energy Development Agency (IREDA)
Small and Medium Scale Enterprise Program {http://www.worldbank.org/pics/ifcspi/11s07327.txt}	GEF: 1994/1997 IFC: 1995 *under implementation*	GEF: Vietnam: $0.75 m. Bangladesh: $0.75 m. Dominican Republic: $75,000	Finance commercial SHS business ventures	Financial intermediaries and recipient firms
Indonesia Solar Home Systems Project {http://www.worldbank.org/astae/lcg.htm#loan35544-IND}	GEF: 1995 Bank: 1997 *will be cancelled*	GEF: $24 m. Bank (IBRD): $20 m. Total: $118 m.	200,000 SHS sold and installed by private dealers/ entrepreneurs	Project management unit and participating firms
Sri Lanka Energy Services Delivery Project {http://www.worldbank.org/astae/lcg.htm#credit2938-LK}	GEF: 1996 Bank: 1997 *under implementation*	GEF: $5.9 m. Bank (IDA): $24 m.	30,000 SHS sold and installed through dealers and microfinance organizations	Ceylon Electricity Board and project management unit
PV Market Transformation Initiative {http://www.gefweb.org/wprogram/1096/pvmti.doc}	GEF: 1996 IFC: 1998 *under implementation*	GEF: $30 m. Total: $90-120 m.	Finance commercial SHS business ventures in India, Kenya and Morocco	"External Management Agent" and recipient firms
Lao PDR Southern Provinces Rural Electri-fication Project {http://www.worldbank.org/astae/lcg.htm#credit30470-LA}	GEF: 1997 Bank: 1998 *under implementation*	GEF: $0.7 m. Bank (IDA): $1.5 m. (for off-grid component only)	20 solar battery charging stations by national utility and village electricity associations as demonstrations	Electricité du Laos (EdL)
Argentina Renewable Energy in Rural Markets Project {http://www.gefweb.org/wprogram/nov97/ar-pcd.pdf} [need PAD]	GEF: 1997 Bank: 1999 *under implementation*	GEF: $10 m. Bank (IBRD): $30 m. Total: $121 m.	66,000 SHS in households through regulated energy-service concessions	Secretariat of Energy and provincial governments
Cape Verde Energy & Water Sector Reform and Development {http://www.gefweb.org/wprogram/mar98/worldbank/capeverde/capever.doc	GEF: 1998 Bank: 1999 *under implementation*	GEF: $4.7 m. Bank (IDA): $17.5 m Total: $48 m.	4,000 SHS in households through regulated energy-service concessions	Ministry of Infrastructure and Housing, national electric and water utility (ELECTRA)
China Renewable Energy Promotion Project {http://www.gefweb.org/wprogram/mar98/worldbank/china/china1.doc} [PAD]	GEF: 1998 Bank: 1999 *under implementation*	GEF: $35 m. Bank (IBRD): $100m Total: $444 m.	10 MWp of SHS and PV-wind hybrid systems installed through private dealers	State Economic and Trade Commission
Global Solar Development Corporation {http://www.worldbank.org/pics/ifcspi/1ws09137.txt}	GEF: 1998 IFC: 1999	GEF: $10 m. IFC: $6 m. Total: $50 m.	Finance PV-related businesses and provide technical assistance and business services	Triodos PV Partners (fund manager) and recipient firms
Benin Off-Grid Electrification/Traditional Energy {http://www.gefweb.org/wprogram/Oct98/Wb/benin.pdf}	GEF: 1998 Bank: to be approved	GEF: $1.1 m. Bank: $2.2 m. Total: $5.7 m.	5,000 SHS through regulated energy-service concessions	Ministry of energy, mines and water
Togo Off-Grid Electrification/Traditional Energy {http://www.gefweb.org/wprogram/Oct98/Wb/togo.pdf}	GEF: 1998 Bank: to be approved	GEF: $1.1 m. Bank: $2.2 m. Total: $5.7 m.	5,000 SHS through regulated energy-service concessions	Ministry of mines, industry, transport, post and telecommunications

Table 2: Project Features and Approaches

Project Feature	Summary of Project Approaches	Key Barriers Addressed
1. Pilot private-sector and NGO delivery models	Private dealers or NGOs sell systems (Indonesia, India, Sri Lanka, Vietnam, Bangladesh, China). Energy-service companies (i.e., monthly fee-for-service) operate as regulated concessions (Argentina, Cape Verde, Benin, Togo). Energy-service companies (i.e., monthly fee-for-service) operate in an open market (Dominican Republic, India). Provide business information, training, and consulting services to private dealers, ESCOs and NGOs (Indonesia, Sri Lanka, China, Cape Verde, Argentina, Benin, Togo).	Lack of established market Lack of successful business models Lack of business financing Lack of business skills Unwillingness of utilities to provide off-grid electricity services High transactions costs
2. Pilot consumer credit delivery mechanisms	Offer consumer credit through dealers (India, Indonesia, Sri Lanka, Bangladesh, Vietnam). Offer consumer credit through established microfinance (microenterprise) organizations (Sri Lanka). Offer consumer credit through local development finance organizations (Vietnam).	High first-cost and affordability Lack of consumer financing High transactions costs
3. Pay first-cost-subsidies and offer affordable system sizes	Pay one-time-per-system subsidies, at levels either constant over life of project (Indonesia, Sri Lanka, China) or declining over life of project (Argentina, Benin, Togo, Cape Verde). Specify and sell smaller, more affordable systems, (Indonesia, Sri Lanka, China, Cape Verde, Benin, Togo).	High first-cost and affordability Lack of an installed base ("critical mass") that would enable after-sales service activities to be profitable and would lower marketing costs
4. Support policy development and capacity	Provide technical assistance to national regulatory agencies for concession bidding and contracting and regulation of concessions (Cape Verde, Argentina, Benin, Togo). Build capacity of public renewable energy agencies (India) Incorporate solar PV into rural electrification policy and planning (Sri Lanka). Lower import duties (Sri Lanka, China)	Lack of experience regulating rural energy-service concessions High import duties Unrealistic political promises of grid extension Uncertain rural electrification policies
5. Enact codes and standards and establish certification, testing, and enforcement institutions	Develop equipment standards for use in project-financed installations (Indonesia, Sri Lanka, China, Benin, Togo). Provide support for certification and testing agencies and laboratories (Indonesia, China). Provide capacity building for dealers to meet standards and for regulatory agencies or financiers to verify compliance with standards (Indonesia, Sri Lanka, China, Benin, Togo).	Poor system quality Uncertain technological track record Lack of information about product quality and performance
6. Conduct consumer awareness and marketing programs	Conduct promotional ads on TV and radio. Distribute information at local fairs and community events. Conduct door-to-door marketing.	Uncertain technological track record Lack of information about products, costs, and benefits

Table 3: Project Design Questions and Relevant Project Features

Project Design Questions	Relevant Project Features
(a) How to effectively deliver and service quality systems to households that suit consumer preferences? *(private dealers, energy-service concessions, business finance, marketing, codes and standards, regulatory development)*	Private-sector and NGO delivery models (#1) Policy development and capacity (#4) Codes, standards, certification, enforcement (#5) Consumer awareness and marketing (#6)
(b) How to make systems affordable to households? *(market competition, fee-for-service, bulk purchasing, subsidies, smaller system sizes, consumer credit, economies of scale, lower transaction costs)*	Private-sector and NGO delivery models (#1) Consumer credit (#2) First-cost subsidies and systems sizes (#3)
(c) What forms of consumer credit, if any, are most viable in a given context? *(dealer credit, microfinance, development financiers)*	Consumer credit (#2)
(d) What is the proper role of SHS within rural electrification policy and planning? *(geographic determinants of service cost, least-cost planning, planning processes and institutions, role of private sector, subsidies and income considerations)*	Private-sector and NGO delivery models (#1) Policy development and capacity (#4)

Box 1: Key Barriers to the Widespread and Accelerated Dissemination of Solar Home Systems

Lack of established market. Without an established market, many commercial firms are reluctant to enter the solar home system business and commercial financiers are uncertain about the profitability and viability of this type of business.

Lack of successful business models. As yet there are no clearly successful business models for delivery of solar home systems in developing countries, so any solar home system business is by nature experimental.

Lack of business financing. Solar home systems businesses may have difficulty obtaining business financing from commercial banks, who may be uncertain about the profitability of this type of business and may be unfamiliar with the technology.

Lack of business skills. Small solar home systems firms in developing countries may lack sufficient business skills for obtaining business financing, marketing, service, and management.

Unwillingness of utilities to provide off-grid electricity services. Without government regulation, utilities accustomed to servicing urban and rural grid-based electricity may be unwilling or unable to provide off-grid electricity services, such as with solar home systems, for a variety of reasons.

High transactions costs. Project identification may be expensive and time consuming, especially for urban-based PV companies or financiers. Numerous small-scale installations may make project implementation challenging. Pre-investments risks associated with the costs of marketing, contracting, and information collection may be high. Costs of credit collections may be high if customers live in very dispersed and remote areas.

High first cost and affordability. Solar home systems represent an initial capital investment that reduces or eliminates a stream of future payments for fuels and batteries. But the high "first cost" of this capital investment may make affordability an important constraint.

Lack of consumer financing. Credit can improve affordability but there may be a lack of credit access and credit delivery mechanisms. Financiers may perceive the credit-worthiness of rural households as insufficient. Lack of practical collateral or legal enforcement of contracts may inhibit financing.

Uncertain technological track record. There may be an insufficient technological "track record" to dispel misconceptions about SHS costs, benefits and performance among users, financiers and dealers. Experience may exist elsewhere, but must become accessible, visible and credible to a specific locality.

Uncertain or unrealistic grid expansion plans. Unrealistic political promises for future electric grid expansion can reduce demand for SHS if households believe "the grid is coming." But such promises may lack substance or financial backing. The lack of coordination between SHS market development and rural electrification programs and policies can impare markets. "Our main competition is the false promise...not each other " said one supplier when asked about competition between the different suppliers in the market.

Other policy constraints. Conventional-fuel subsidies, inappropriate tariff structures, import duties for renewable energy equipment, lack of attention to environmental externalities and other policy conditions can be serious obstacles.

Lack of objective market, business and quality information. Information may be lacking about the financial condition and business track record of entrepreneurs, or about the technical characteristics and quality of their systems. Market information may be needed about potential households, their incomes, their interest in SHS, and their current expenditures on candles, kerosene and other forms of energy. Information about solar resources may also be lacking.

Box 2: Rural Energy Service Concessions in Argentina

The World Bank/GEF "Renewable Energy in the Rural Market" project aims to supply electricity to 66,000 households with individual solar home systems (of size 50Wp to 400Wp), 1,100 public facilities with solar photovoltaic systems, and 3,500 households with village-power systems (using mini-hydro or hybrids such as solar/wind, wind/diesel or solar/diesel) through province-level energy service concessions. Concessions are free to select which technology to apply in any given situation, including diesel-only village power systems. Concessions will be obligated to:

- provide electricity services to rural off-grid customers anywhere in the province for a period of at least 15 years, upon request;
- carry out all necessary maintenance, repairs or replacement of components as needed to ensure the continuity of the electricity service to each and every customer;
- provide "state-of-the-art commercial service standards" for connection requests, billing, collection and claim handling; and
- provide the provincial utility regulatory agency (ENRESP) with periodic reports on the status of the concession including but not limited to performance indicators such as number of connections by type of consumer and method and technology supply, outages statistics, and financial results.

Concessions are eligible to re-bid for their business every 15 years up to a total of 45 years, competitively against other eligible firms. The 15-year period was seen as a compromise between the need for a short period for the quasi-monopoly and a long period for the annuity calculations of the concession. After 15 years, the government can modify the concession rules to account for new technological developments, or may even decide to abandon the concession system and open the market to competition. During the 15 year period, the concession, provincial government and provincial utility regulatory agnecy renegotiate the tariffs every 2 years.

Eight provincial governments (out of 22 total) are eligible to participate in the project. Each of these provinces has privatized or is in the process of privatizing its power sector, or at least has made a legal commitment to privatize. Four of these provinces have existing private concessions serving the concentrated (urban) market that are regulated by the provincial governments. Under the project, these governments will first try to negotiate a rural concession contract with their existing concessions (as an amendment to the existing contract). If such negotiation fails, or if there is no existing concession for that province, then a new concession contract will be awarded according to international competitive bidding procedures.

Source: Martinot and Reiche 1999

Box 3: GEF Justification of First-Cost Subsidies

GEF subsidy payments are generally justified as the "incremental costs" of a solar home system, which in most projects are assessed as the difference between the lifecycle costs of the solar home system and the baseline costs of kerosene, candles, and other fuel sources displaced (Ahuja 1993). First-cost subsidies are justified on the basis that cost reductions are expected over the life of the projects due to several factors, which should eliminate the need for subsidies in the long term in order to make continued installations commercially viable. These factors include:

- larger market volume and increased competition
- improved financial strength of individual dealers after an initial volume of sales
- refinement of procurement methods and bulk purchasing
- economies of scale in sales and service networks and assembly of balance-of-system
- standardization of components and installation processes
- general cost reductions in PV module costs internationally
- increases in rural household income as economic conditions improve
- increased familiarity of commercial banks' with the SHS business (lower risk premiums)
- improved quality and acceptance of technology with introduction of technical standards and certification

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世界銀行　住宅用ソーラーシステムプロジェクト 1993～2000年の経験と教訓

世界銀行　農村・再生可能エネルギーテーマグループ[1]
及びアジア代替エネルギープログラム

エリック・マルティノー、アニル・カブラル、スボト・マルトゥール

コメントを求めるための作業原稿（引用／参照不可）

2000年1月24日

要　約

世界銀行グループの12のプロジェクトにより、住宅用ソーラーシステムを利用して、電力系統にアクセスできない農村家庭に、照明・ラジオ・テレビジョンおよび小型電気機器の使用等の基本的なエネルギーサービスが提供される。いろいろな目的のほかに、これらのプロジェクトは住宅用ソーラーシステムの市場を開発し、その広範かつ急速な普及を阻む主な障碍を克服するようにデザインされている。最良の実務の理解が増すにつれて、プロジェクトのデザインは発展し続ける。大部分のプロジェクトは実施を開始したばかりで、まだ完了したものはない。

本論文はこれらのプロジェクトの主な特徴、初期の実施から得られた経験、将来のプロジェクトデザインおよび評価に適用できる新たな教訓を総括するものである。これらのプロジェクトは6つの基本的な特徴を組み合わせて包含している。

1.　私企業および非政府組織（NGO）のパイロット供給モデル

これらのプロジェクトでは住宅用ソーラーシステムの供給に2つの基本モデルを採用している。ディーラーによる販売とエネルギー事業体による供給である。ディーラーによる販売の場合、資格を得たディーラーが営業資金、生産能力造成および／または市場援助の形で、プロジェクトの支援を受ける。エネルギー事業体による供給の場合には、プロジェクトは規制および選択・入札の枠組みを決める。本調査によれば、住宅用ソーラーシステムの供給会社は、農村地域での運用に当たって数多くの困難に直面すると予想される。農村での経験のある会社および／または販売基盤構造をもつ会社の方が、うまくいくかもしれない。営業資金や業務技能を得るための研修や支援があれば喜ばれることだろう。いずれの場合も適切な営業モデルを発展できるように、プロジェクトが柔軟性を

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[1] 本報告書は気候変動テーマグループの支援を得て作成された。エリック・マルティノーは世界銀行のコンサルタント兼ボストンのストックホルム環境研究所職員である。アニル・カブラルはアジア代替エネルギープログラムの再生可能エネルギー担当主任専門家である。スボト・マルトゥールは世界銀行およびそのアフリカ農村エネルギー構想のコンサルタントである。本報告書はウェブベースの文書で、ハイパーリンクには下線を施してある。

もつことが望ましい。

2. 消費者にクレジット供給するパイロット機構

ディーラーによる販売の場合、消費者クレジットを利用できれば、農村所帯でもシステム購入が可能になる。消費者クレジットには 3 つの仕組みがある:ディーラーによるクレジット、消費者金融機関によるクレジット、および開発金融制度によるクレジットである。調査によれば、クレジットのリスクは金融業者にとってもディーラーにとっても重要な懸念の種で、クレジット販売はまさに挑戦である。ディーラーは取引経験の少ない顧客にクレジットを拡張するのを嫌がるし、クレジットの管理や集金には高いコストがかかる。地方の金融業者は、プロジェクトの持続性を増すためにある程度の金融リスクを覚悟しなければならないが、同じような不安を抱いている。部分的クレジット保証スキーム、少額貸付、およびパートナー約束はリスク軽減の有力なモデルである。長期間のクレジットは貧困所帯の需要を刺激するが、その分リスクが増大する。

3. 先払い補助金・後払い手頃価格システム

一部のプロジェクトでは、システムを購入しやすくし、各所帯の手付け金や月払い額を低くするシステムごとの補助金制度が設けられている。小型サイズのシステムや単純な部品を提供して購入しやすくしているプロジェクトもある。調査によれば、顧客は部品のオプションやサービスレベルが広い範囲から選べることを望み、小さいシステムでも利益が得られることが示唆される。補助金や小型システムを提供しても、市場の初期段階では顧客は農村所帯の中でももっとも富裕な層に限られるだろう。

4. 支援政策の立案と能力

プロジェクトはいくつかの方法で、政策を支援したり、影響を与えたりする。たとえば、エネルギーサービス免許の入札、契約、監視、規制などについて、監督官庁に専門的支援を提供する。農村電化および電力部門の組織改編に関する政府の企画や政策に影響を与える。政策や企画に産業界が参画する。部品の輸入関税を引き下げる。本調査では、免許料の設定、入札、規制には相当の時間と労力が必要である。プロジェクトは農村への電力系統延長と、住宅用ソーラーシステムの需要との関連を認識しなければならない。透明で開かれた、しかも現実的な農村電化政策が、市場需要の創製と安定化に役立つ。

5. 法規と標準の制定および証明・試験・施行制度の確立

品質の劣った機器や設置、性能の誇張宣伝は市場を傷つける。大部分のプロジェクトでは、機器の標準を作成・施行し、証明・試験制度を制定・強化して、品質・安全性・長期信頼性を保証している。プロジェクトはまた、ディーラーが基準を満たし、官庁が法令遵守を確認できるように、生産能力の造成を提供する。本調査によれば、手頃な価格を維持しながら、高品質のサービスを保証する、住宅用ソーラーシステム部品のための適切な機器標準と証明制度を設定するのは困難ではない。このようなシステムが解決すべき技術的問題はほとんどない。

6. 消費者の意識調査とマーケティング計画の実施

大部分のプロジェクトでは、何らかの形の消費者意識調査とマーケティング計画を実施し、さらに詳

細な市場調査を行っている。本調査によれば、販売運動は農村地域では特にコストと時間がかかり、しばしば戸別訪問や直接面談が必要となる。単純な消費者意識は通常それ自体では不十分である。顧客の数が「臨界値」に達して販売が容易になるまでは、ディーラーは新規市場開拓の初期段階の販売支援により大きな利益を受ける。

バングラデシュ、ドミニカ共和国、インド、スリランカおよびベトナムにおける 5 つの大きなプロジェクトにより、5,000 基以上のシステムが設置された。全プロジェクトの目標設置総数は 500,000 基である。しかしどのプロジェクトにおいても、有望モデルの商業的持続性や複製は達成されていないし、決定的に実証されてもいない。供給およびサービスチェーンのどの会社もが利益を得るような営業モデルを実証することが大きな挑戦である。そのほかにエネルギーサービス免許の規制モデルを実証すること、および住宅用ソーラーシステムの普及と農村電化政策とを一体化することも、重要な挑戦である。将来のプロジェクトはこれらの教訓から学び取り、柔軟性と適応性を具現し、有望モデルの開発・試験に十分な時間を割く必要がある。

序　文

1992 年から、世界銀行グループは、「家庭用太陽光発電システム」によって電力系統への接続が不足する周辺地域の家庭への照明やラジオやテレビ或いは小規模装置の運転のような基礎的な「エネルギーサービス」を供給する 12 のプロジェクトを承認してきた(表 1 を参照)[2]。家庭用太陽光発電システムには、太陽電池パネル、蓄電池、蓄電制御装置及び開花用農業用ランプのような種々の最終ユーザー用装置が含まれる(写真 1～4 を参照)。家庭用太陽光発電システムは、蝋燭や灯油や LPG 或いは充電の必要性を削減または省略できる。直接的な利益は、充電や LPG や灯油の購入コストを省く事である。他の重要な利益は利便性と安全性であり、それは室内の空気汚染を改良したり、読書のために灯油ランプよりも高品質な照明を供給したり、二酸化炭素の放出を減少する事である。既に家庭用太陽光発電システムは、発展途上国の 50 万を越える家庭で基本的な電力供給として機能している。(世界銀行太陽光発電 web page を参照)
http://www.wolrdbank.org/html/fpd/energy/subenergy/solar_pv.htm
1999 年 Foley、1996 年 Cabraal、1999 年 Kammen、1999 年 Loois と Herert を参照)

1990 年代初期に、世界銀行は、家庭用太陽光発電システム技術が成熟し、コストが下落し、商業市場が発展していることを認めた。同時に、人口増加は地方への電力系統を拡張する電力事業者の能力を凌ぎ、発展途上国は、益々、完全な系統電力による地方電化を成し遂げるための経済的困難性を感じていた。世界銀行と多くの政府は、家庭用太陽光発電システムが最小コストの地方電化を可能とし、電力系統による電化政策を補完し得ることに気が付いた(世界銀行 1997 年)。周辺地域への家庭用太陽光発電システムを供給する事への障害が故に、そして発展と環境の利

[2] これらのプロジェクトのいくつかは農業用や商業用や村落用の電力供給装置のような他の太陽光発電の利用も狙っているが、本文の対象外である。

益が故に、世界銀行と地球環境機関(GEF)[3] は家庭用太陽光発電システムの支援が重要であり、連携してこれらのプロジェクトを支援した。多くのプロジェクトにおいては、家庭用太陽光発電システムは、電力分野の改良や地方電化や地方振興のような色々な発展目的を持つ、より大きなプロジェクトの一部分である。

家庭用太陽光発電システムプロジェクト設計は、最良の実施の積み重ねにより、次々と発展していった。一般に、プロジェクトは、与えられた国の背景における家庭用太陽光発電システムの、広範かつ加速的な普及に対する主たる障害を克服するようにデザインされている(囲み1を参照)。持続可能な周辺地域太陽光発電市場の主たる要因は、顧客の満足や供給可能性や業者の利益や有効な供給とサービスのチェーン化である。こうした要素を考慮すると、殆どのプロジェクトは六つの基本的な特徴を備えている。

1. 私企業及び非政府組織(NGO)のパイロット供給モデル
2. 消費者にクレジット供給するパイロット機構
3. 先払い補助金・後払い妥当価格システム
4. 支援政策の立案と能力
5. 法規と標準の制定及び証明・試験・施行制度の確立
6. 消費者の意識調査とマーケティング計画の実施

それぞれのプロジェクトの特徴は、主要な障害のうち特定のものに対応したものである。プロジェクトは、これらの特徴を取り入れるための多くの異なるアプローチをとっている。あるプロジェクトは、関係する国でより有効で生存可能な方法を同時に決定するための一つ以上のアプローチを有している(表 2 を参照)。最良のアプローチに関する有効な解決策を得るためには、如何なる機関や政府や商社から集められた経験であっても十分ではないが故に、プロジェクトは本質的に経験的である(関係する重要事項に対する参照を見ること)。しかしながら、殆どのプロジェクトのデザインは、プロジェクトの特徴の組み合わせに関連し得る四つの基本的なデザイン問題に対応し得る(表 3 を参照)。六つのプロジェクトに関する特徴の詳細と最初の実施の経験の現れた教訓は、次の節で記述する。

全てのプロジェクトにおいて、公的或いは私的であるを問わず、生存可能な商業モデルの実証は、プロジェクトの持続性と反復可能性を成し遂げることが鍵である。生存可能性は、事業を実証する支出と収入や資金繰りや利益(或いは必要な補助金)そして管理の取り決めが存在し機能し得る事を、明確に示している。「(プロジェクトにより)商業モデルを開発し改良する事に高い価値がある。あなたは、これらの商業モデルに基づく市場を形成することを望む。」とあるプロジェクトにおいて事業者は言った。商業事業者にとって、利益は商業モデルが生存し得るか否か、与えられた市場で動けるか否かを見極める究極の物差しである。非営利団体或いは公営企業体(即ち電力事業者)にとって、実施中の補助金は、公的目的(例えば地方電化や振興)に基づく商業モデルの一部と

[3] GEF とそのプロジェクトの詳細は、Martinot と McDoom1999 年を参照。GEF web site(www.gefweb.org)も参照

成るだろう。ある面においては、全てのプロジェクトは、企業の(需要や価格付けや供給可能性に関する)収入を最大化し、(マーケティングや事業実施や訓練や運転のための)支出を最小化するだろう。

世界銀行グループにより支援されたプロジェクトの直接的成果である家庭用太陽光発電システムの設置は、500,000システムを越えることが出来た。しかしながら、殆どのプロジェクトは、相対的に新しく、今までのところ僅かな実施上の経験が得られているだけである。五つの先導的なプロジェクトが、バングラディシュやドミニカ共和国やインドやスリランカやベトナムにある。これらのプロジェクトにより、1999 年末迄に、約[3000]システムがドミニカ共和国に、1000 がスリランカに、1100 がバングラディシュに、そして 500 がベトナムに設置された。インドのプロジェクトは、多様な太陽光発電の利用形態が目指され、地方の住宅用市場よりは商業市場に、主として、太陽光発電を設置した。

全てのプロジェクトは、潜在的に有効なアプローチの先導的な経験となっており、前述した五つの先導プロジェクトは、正にそれとなっている。しかしながら、成功したモデルの商業的持続性と反復可能性は、あらゆるプロジェクト[4]において未だ成し得ていないが、結論として示されている。資産形成の対象とするに時期尚早である。経験や教訓や有効なプロジェクトデザインに関するより最終的な結論が引き出される前に、全てのプロジェクトのための更なる改良の進展が必要となっている。成功するアプローチの開発や発展や試験は、現在のプロジェクトでは時には見失うが、将来のプロジェクトでは必須である時間や資金や柔軟性や危険性を必要としている。

1. 私企業及び非政府組織(NGO)のパイロット供給モデル

プロジェクトには、家庭用太陽光発電システムの普及に対して、二つの基本的な私的分野モデルを用いている。それは、「業者販売」と「エネルギー供給事業者」である。業者販売モデルは、(インドネシア、インド、スリランカ、ベトナム、バングラディシュ及び中国におけるように)業者が工場からシステムあるいは部品を購入し、家庭に直接販売するものである。それは通常設置されたシステムとしてであり、時には信用販売がなされる。業者が保守契約や保証を行い得るとしても、家庭はシステムを所有し維持する責任を負う。エネルギー供給事業者(ESCO)モデルは、ESCO がシステムを所有し、家庭に毎月の使用料を課し、保守の義務を負うものである。(アルゼンチン、ベナン及びトーゴにおけるように)ESCO は特定の地域において政府から独占権を保証されている事もある。あるいは、(ドミニカ共和国におけるように)明白な独占状態なしに競って運営される事もある。(カボベルデ諸島におけるように)ESCO の二つの形態の組み合わせが、独占権を持って開始し、数年後には次第に競争市場が開けて行った。

[4] 中国、インドネシア、ジンバブエにおいて、直接的な寄付を行う者無しに顕著に実現した家庭用太陽光発電システムの成功した商業化の幾つかの事例がある。これらの場合には、ケニアにおける蓄電池企業や家庭用品の販売事業者やジンバブエにおける家庭向け配達チェーンや金物／電化製品販売店のような、太陽光発電事業に貢献しない代替的な普及モデルを示している。Kammen 1999 年を参照のこと。

インドのプロジェクトは、大企業により太陽光発電システムの販売が進められ、それは有利な政府の税額控除の特典をもってなされたが、これらの企業は商業市場を目指している。同時に、プロジェクトにより財政援助された小規模事業者が、周辺地域用のシステムを開発し、周辺地域の家庭に販売を始めた。ESCO モデルも用いられ始めている。インドネシアにおいては、業者販売モデルが採用された。業者は、事業資格のような資格基準や周辺地域の市場に関係する販売／提供基盤や関係する銀行による信用供与協定に基づくプロジェクトに参加することが出来る。中国のプロジェクトもまた業者販売モデルを用いており、インドネシアのプロジェクトと同様に地方の販売業者の発展を支援している。中国におけるプロジェクトの資格基準に合致するいかなる業者も、プロジェクトに参加することが可能である(少なくとも 10 の業者が当初に期待されており、更には他の業者も資格を有することとなるだろう)。特権を取り締まる電力や農業／地域分野における適切な担当機関が存在しない事が幾らかは理由として、ESCO の特権モデルは中国では機能せず、プロジェクト計画には最初から排除された。

アルゼンチンにおいては、既に他の分野における権限に対する規制上の枠組みに対する十分な経験があるが故に、規定化されたESCO特権モデルが採用されている(囲み2を参照)。また、非電化状態にある極く僅かな家庭が政府に「束になった」規模の経済を志向させることとなり、周辺地域のエネルギー特権による可能な低い処理コストは、私的分野を引きつけるに必要であった。世界銀行プロジェクトは、広く全国的な周辺地域の電化計画の一部であり、周辺地域エネルギー特権は既に二つの州で確立している。そのプロジェクトにおいて、八つの州が参加を承認した。これら八つの州の各々に対して、政府は競争的選択過程に基づく独占権を与えている。この特権は、家庭に対し家庭用太陽光発電システム(あるいはそれを選択する他の技術)を供給し維持しており、月毎のサービス課金を徴収する。特権は、少なくとも 15 年の期間に渡り特定の地域の住民に対し、(顧客の要求に応じ)電力供給を約束し義務を負う。

権限アプローチの潜在的な利点は次のとおり。

- それぞれの財政的資源を有する、より大きく、より良い組織化された私企業を引きつける。
- 僅か 2～3 年のうちに多数の顧客を対象とする潜在力を有する。
- (量産効果による)装置コスト、処理コストそして(規模の経済による)運営と維持コストを低減する潜在力を有する。
- 長期間(例えば 15 年)に渡り、顧客に対するサービスを保証する。

潜在的な欠点は次のとおり。

- 規則は手間がかかり、重大な規制の能力を要する。
- 競争の欠如は、革新、新たな製品とサービスそしてコスト低減を阻害する。
- 技術変化は、規則や契約上の条件を揺さぶる。
- サービスの質は、規制機関が保証することは困難である。
- 毎月の料金収集コストは大きいものである。

アルゼンチン政府は、特権の規制をいかに最良に行うかを今だ探索しており、プロジェクトは先導的な規則モデルとアプローチを助けるだろう。二つの重要な論点は、(税率、政府補助金、交渉過程、そしていかに度々関税が見直され調整されるかを含めた)関税構造であり、特権により顧客に供給されるサービスの質(即ち、特権とそれら顧客間の契約上の規定)をいかに規制するかの観点である。

アルゼンチンに続き、ベナン、トーゴ及びガボベルデ諸島における三つ以上の最新プロジェクトもまた、この ESCO 特権モデルを採用している。ベナンとトーゴのプロジェクトは、プロジェクトの完了までに財政的に独立可能な私的分野の施設やサービス会社の設立を、各々試みた。アルゼンチンのように、競争的な選択の勝者となることが目指された 15 年間、独占権が保証されている。

スリランカのプロジェクトは、業者販売と ESCO モデル双方が企画された。NGO と同様に双方の事業タイプは、プロジェクトの下において商業銀行からの事業融資を受けていた。プロジェクトの初期段階では、暫くは ESCO のように運営に努めていたが、ひどく分散し離れた周辺地域住民からの毎月の集金のコストは高くつくことに気付いた。他の事業者は、効果的で能率的な集金を行うための周辺地域社会における十分な周辺地域の基盤と地位を有していなかった。むしろ、この事業者と他の事業者は、小規模融資制度による消費者信用に促進された直接販売に志向した。最初に、NGO は、それが供給された時に信用でシステムを販売することを試みたが、販売したシステムを満足にサービスし維持することが不可能となった時に運営をやめた(Martinot 1999 年)。

事業融資の利用価値は、全ての私的分野の供給モデルの重要な要素である。スリランカにおいて、販売業者、NGO そして協同組合は、プロジェクトに参加する商業的金融業者から融資を受けることが適切である。当該国における二つの最初の販売業者は、プロジェクト下の事業融資を受けるに困難はなかった。こうした状況はプロジェクト後に変化したが、この事業の収益性とリスクに関する商業的金融業者の考えが変わらないと信じるが故に、多くの問題を予想していなかった。ESCO 供給モデルにおいて、ESCO の融資は政府及び多国間の供給源から得られているが、商業的金融業者からのものも存在している。アルゼンチンにおいては、ESCO 特権は州及び連邦政府から融資を受けている。

二つの IFC プロジェクトもまた、家庭用太陽光発電システム事業に対する事業融資を受けており、多様なモデルのシステムを供給している。太陽光発電市場促進機関は、事業計画の競争的な提案と選択により、インド、ケニアそしてモロッコにおける太陽光発電市場の企業に事業融資を行っている。小規模及び中規模企業計画(SME)は、バングラディシュ、ドミニカ共和国そしてベトナムにおける販売業者のための事業融資を行っている。SME 計画はまた、継続を表明した事業者への付加的な誘因策を用意しており、もし事業者が利益を生み出した場合、一部の負債免除が受けられる。ベトナムにおいては、販売業者は現金と信用でシステムを販売していたが、ベトナムにおける周辺地域の電力系統の拡張に伴い、販売業者は ESCO 権限アプローチを検討始め、将来は政府がこうしたアプローチを支援することを期待している。

ドミニカ共和国においては、販売業者は、周辺地域住民の 50%を対象とし、家庭用太陽光発電シ

ステムからの電力供給に対する毎月＄5から＄20の料金を課す、成功した利用料金サービス事業モデルを開発した。収入を最大化し支出を最小化するための事業モデルの継続的な調整により、この事業者は5000のシステム設置に対する収益性と「コンセプトの実証」を行っている。この事業者は、25,000 のシステムに事業モデルの拡大を試みているが、多くの一般経費と少ない利益が拡張を困難としている。「これは利益の少ない事業である。＄1千万の企業を構築する一般経費で＄100万の企業を担うことを望まないだろう」とこの事業者は言った。

供給事業者の商業的技術を開発する必要もある。供給事業者は小規模で未経験なベンチャー企業である。周辺地域で活動している事業者は、家庭用太陽光発電システムを含む彼らの生産ラインの拡張を決定するだろうが、太陽光発電技術の訓練も必要である。インドネシアにおいては、販売業者の資金繰りは家庭用太陽光発電システムの信用販売の重要な制限事項であるが故に、販売業者の訓練は事業融資のための事業計画の策定と銀行の調整を如何に行うかに向けられる。スリランカにおいては、販売業者への補助金は、商業的金融業者に対するプロジェクトの金融提案を用意するための外部のコンサルタントコストに、50%以上が向けられる。スリランカのプロジェクトは、事業支援のための規定をも有しているが、販売業者はプロジェクト下の更なる支援を要求しない。中国においては、プロジェクトは、(設計、試験及び証明のコストを共有することにより)販売業にシステムの質を改善させ、彼らの製品を市場化し、保証と販売後サービスを供給する手助けをする。ガボベルデ諸島においては、ESCO に対するプロジェクトの支援は、事業の計画策定、職員と管理者の技術訓練、供給基盤、そして市場開拓と調査を対象としている。

初期の設置経験が示す教訓

- 周辺地域に事前の知識を持つ私企業や周辺地域社会と密接な NGO は、より簡単に供給方法を発見する。
- 周辺地域での太陽光発電事業の運営と利益の産み出しは、プロジェクトの立案者には容易には理解されない。小規模起業者は大きな挑戦に直面する。
- (運営、サービス及び融資の)優良事業モデルの開発とこれらの微調整は、これら低収益性事業の成功に重要である。
- エネルギー供給特権は、有効な制度として機能し得る程度の政府機関の存在が要求される。
- 私的販売業者、とりわけ小規模事業者は、商業的金融業者のための受け入れられる事業計画の作成が困難である。
- 金持ちへの最初の現金販売は、小規模販売業者を財政的に強くする方法である。
- プロジェクト期間中の実験への柔軟性と供給方式とモデルの変更は重要である。プロジェクトの実施単位は柔軟に運営されねばならない。
- 企業は付加的な事業支援や訓練から利益を得ることができるが、彼らのニーズや望む支援を認識しない事業の運営は、厳しいものとなる。
- プロジェクトは、百貨店や家庭用品と器具の小売業者そして他の周辺地域サービスの供給者のような、太陽光発電事業への他の潜在的な流通経路を引きつける間接的な影響を有することができる(このことは、スリランカでは百貨店で起こった)。

2. 消費者にクレジット供給するパイロット機構

業者販売モデルとともに、消費者信用は周辺地域の家庭にシステムを利用可能とするための重要事項である。世界銀行プロジェクトに関連する市場研究は、典型的な月に＄250 以下の収入しかなく、周辺地域の電力系統に接続されていない周辺地域の家庭の大多数が、蝋燭、灯油、蓄電池の充電そして使い捨て電池の形態で、エネルギーに月に＄3 から＄15 を支払っていることを示している(GEF 1998a、1998b、1998c[中国市場調査])。これらの調査は、家庭は娯楽や知識や高品質な照明のような、最も価値ある最終消費品に出会うためのエネルギーに喜んで支払う事を示した。サービスのための料金協定において、毎月の料金は、これらの出費と競争し得るレベルに規定されるかを調整し得る。しかしながら、家庭用太陽光発電システムの業者販売は、従来の代替品に比べて高い初期コストである最初の価格障壁を克服し、家庭が従来のエネルギー購入とおよそ同等な価格を支払い続けるところの手段を用意しなければならない。長期の消費者信用は、毎月の支払いが従来のエネルギー支出に比較し得ることを可能とする一つの方法である。

消費者信用は、世界銀行プロジェクトにおいて三つの基本的な仕組みが用意されている。販売業者が拡張する信用、小規模融資機関[5]による信用そして地域振興融資協会による信用である。商業事業者による消費者信用がインドで最初に実施された。このプロジェクトは、商業事業者に対しIREDA の信用を与えている。事業者は、(生産過程において十分な政府の税額控除を実現する)生産者からシステムを購入し、そして信用で周辺地域の過程システムを販売することを考えた。生産者と契約した別々のサービス事業者は、販売、設置、就役そして販売後サービスを行うことを求められている。商業事業者が周辺地域住民に信用リスクと料金収集の関心を負わせることに気がすすまないために、このアプローチは実行に適さないものと言える。

インドネシアにおいては、既に私的な販売業者が信用でシステムを販売することに成功しているために、販売業者信用モデルは部分的に導入された。この事業家は、信用で 4000 以上のシステムを販売することが出来た。本来のプロジェクトの概念においては、事業融資は販売業者に対し商業的金融業者からなされるものであり、その次に販売業者は消費者信用を、4年の期間をもって、彼らの顧客に提供する。商業銀行は販売業者信用リスクを耐え、販売業者は消費者信用リスクを耐えねばならない。このモデルにより、販売業者は 200,000 システムの販売を目指した。不幸にも、インドネシア全体の経済不安により、このプロジェクトは実行されず、現在中止となっている。販売業者が供給する信用による期待された経験は実現されなかった。
バングラディシュのプロジェクトは、販売業者信用モデルの最初に成功した適応事例である。(非営利)販売業者である Grameen Shakti は、市場を形成し、販売し、信用制度を整備し、集金し、そして保証を行っている。小規模及び中規模企業計画による IFC ローンを受ける前は、Grameen Shakti は 1 年間の期限を限って融資を得ることが出来、それで消費者信用も 1 年間限りとなった。これは顧客の需要を大いに制限した。IFC ローンにより、Grameen Shakti は顧客に対する信用期間を 3 年間延長することが可能となり、そのことは、その事業に大きな違いを生じさせた。Grameen

[5]小規模融資機関に関する詳細は、Dicter 1999 年と Legerwwod 1999 年を参照。

Shaktiの信用期間と顧客は、従来のGrameen銀行の小規模融資の期間と顧客とは全く違ったものとなっている。Grameen 銀行の会員は、典型的には貧しい世帯であるが、1年間に限り、20%の金利で、(収入を生み出す目的にのみ対し)＄100或いは＄200の零細企業融資を受ける。対象的に、Grameen Shakti ローンは、おおよそ3年間で12%の金利で＄500である。Grameen Shakti ローンが1度であるのに対し、Grameen 銀行ローンは定期的に繰り返される。このように、Grameen 銀行による会員への「事業用小規模融資」と家庭用太陽光発電システムを購入する顧客のためのGrameen Shakti による「消費者信用」との間には明らかな違いがある。

スリランカプロジェクトにおいては、販売業者信用は最初に試みられたが、間もなく販売業者自身により拒絶された。販売業者は、集金は困難で時間を消費するものと気付き、販売業者信用或いは小規模融資モデルに対するサービスへの料金方式から離れようとした(そして離れた)。専門家による周辺地位の「サービス基盤」を構築すること、周辺地域向け信用供与と集金基盤を構築することとは、全く異なる事であると、供給事業者は言った。「地域との連携、知識そして施設が既に適所にあるか否かが、信用制度の成功を左右する。」とある企業の観察者が言った。

それで、スリランカのプロジェクトは、それまでプロジェクトに参加していた一つの大きな小規模金融機関から、現在の消費者信用を行う多数の小規模金融機関に変更した。この小規模融資機関は、プロジェクトに参加する商業金融業者から資金を得て、顧客に貸す。顧客は、販路、販売そして販売後サービスの責任を持つ販売業者から家庭用太陽光発電システムを購入する。小規模金融機関は集金を受け持つ。小規模金融機関と販売業者は、協調して販売と信用供与を行う。家庭用太陽光発電システム購入用に小規模金融機関から提供された信用制度は、企業発展のために用意されたものと同じ様なものである。小規模金融機関は、典型的に 4 年の期間、24%の金利で、＄100 から＄500 の小規模企業ローンを提供する。家庭用太陽光発電システムの期間は同じである。20%の頭金を含む＄500の資金と4年の期間と24%の金利である。スリランカは周辺地域小規模融資の長い歴史を有し、そこでは多様な小規模融資のモデルを大いに育てた。

ベトナムにおいては、私的販売業者による販売は、ベトナム女性同盟(VWU)、NGO、ベトナム農業及び地域振興銀行(VBARD)、開発融資機関を含む複雑な信用供与組織に支援されている。VWUは販売業者のシステムを販売し、VBARDから供給された消費者ローンの集金を行う。販売業者はシステムを設置しサービスの責任を担う。VBARD は、購入価格の 75%のリスクを引き受ける信用を供与する。販売業者は購入価格の 5～10%を VBRAD に担保保証し、顧客は頭金として残りの 15～20%を支払う。債務不履行の場合、販売業者はシステムを再取得し再整備し、VWU は新たな買い手を見つける。VBRAD は、販売業者の担保保証により再取得を含む損失を賄える。消費者への信用供与期間は僅かに6～18ヶ月であり、それは需要を制限している。本社からの命令にもかかわらず、VBRADの保守的な支社の管理者は参加することを嫌がる。こうした場合は、販売業者は消費者信用までも担当する。

中国では、信用無しの現金販売モデルが実施されている。一般に中国では消費者信用の経験が殆どないために、周辺地域の世帯までも信用制度を拡張することは不可能と考えられていた。しかしながら、販売業者が革新的な支払い方法を増加させるために、プロジェクトは柔軟に運営されて

いる。

初期の実施経験が示す教訓

- 管理上の観点のみならず、プロジェクト後の持続と拡大を行うために、地方の金融業者は信用リスクの一部を担うべきである。
- 商業金融業者は、信用リスクが故に、周辺地域世帯向けの消費者信用を提供するのを好まないし気がすすまないものである。
- 小規模販売業者は、消費者信用リスクを引き受け信用の管理と集金のリスクを招くことを好まないような多くの事業と技術に直面する。
- 小規模私的販売業者は、信用を供与する大企業とパートナーを組む地方の小規模金融機関を必要としている。
- 小規模融資は、十分に小規模金融機関が設立されている国において機能し得るが、NGO は急速な信用供与に必要な商業指導と事業技量を必ずしも有していない。事業拡大と対象拡大は問題を引き起こすこととなりかねない。
- 周辺地域の顧客が、貧弱な交通機関しかない広大な領域に分散している場合は、信用に伴う集金はコストがかかることとなる。
- プロジェクトは販売業者に、システムを供給可能とする新たな方法を取り入れるための柔軟性を与えるべきである。
- 十分な販売後サービスは、信用返済の実行の鍵である。
- 季節的な収入の顧客(即ち、半年毎の収穫をするアイルランド人)は、収入に応じた信用貸し返済計画を必要とする(即ち、月毎よりも半年毎となる)。

3. 先払い補助金・後払い妥当価格システム

消費者信用の供給のほかに、いくつかの世界銀行/GEF プロジェクトは高い初期コストと供給の障害を減ずるための、初期コスト補助金を取り入れている。これらの補助金は、最初の支払いに家庭の毎月の支払いも含めて、これを減ずることを目論んでおり、その目的は可能な限り従来のエネルギー(即ち、灯油と蓄電池)の現下の毎月の支払いと同等となることが目的となっている(囲み3を参照)。補助金は、家庭用太陽光発電システムの設置や正式の検査や証明書類に関する配送企業や商業金融業者や小規模融資機関に支払われる。設置の証明は、プロジェクトによるか或いは商業金融業者によりなされている。補助金は、異なるプロジェクトにおいて異なる方法で使われる。例えば、スリランカにおいては、消費者金融を供給する小規模金融機関は、補助金の割り当てにより各々の毎月の信用貸しの返済の額を減じている。補助金は、中国、インドネシア、アルゼンチン、ベナン、トーゴ、カボベルデ諸島そしてスリランカにおけるプロジェクトに適応された。

いくつかのプロジェクトには、設置された各システムに対し一定の現金の補助金が適応される。中国においては、設置容量の＄1.5/Wp に等しい現金補助金が、販売業者に直接支払われる。スリランカにおいては、＄100 の補助金が商業金融業者に払われる。インドネシアにおいては、プロジェクト

が設置に関する顧客の同意書を受け取り顧客と販売業者間の賃貸或いは購入契約が完了した後に、ジャワでは＄75 が他の地域では＄125 の補助金が直接販売業者に支払われる。本来は 50Wp のシステムのみがインドネシアでは有効であったが、より小型でより供給可能なシステムの購入を望む顧客を考慮して、補助金は 30Wp システムまでも対象とした。インドネシアのプロジェクトは、補助金を受け取る資格条件として、販売業者が彼らの顧客に信用貸しを提供することを要求したが、そのことが借りることも信用貸しを提供することも望まない販売業者の間で、問題を引き起こしている。このことは、スリランカにおいても問題を起こしており、そこでは、1 社の販売業者が大きな多国籍企業によって買収され、それにより商業融資は既に必要なくなったが、補助金の資格を得るためにプロジェクト下の融資を得なければならなかった。

プロジェクトの期間を越えて現金補助金額が低下していくことは、より最新のプロジェクトを構築していく。補助金額減少の考えは、プロジェクトが完了に近づいていることを示しており、事業として顧客に安価なシステムを提供できるようになり、それで同じレベルの供給に対してはより少ない補助金しか要さなくなる。例えば、アルゼンチンにおいては、システムが事前に確立した基準と条件に従って設置されたことの州政府による証明により、ESCO 特権はプロジェクトの最初の 5 年間において設置された各々のシステムに対する多様な額の補助金を与えられている。設置に対する現金補助金額の低下は、プロジェクトの後半で行われ、システム規模にも応じている。補助金は、プロジェクトの最後に次第にゼロに低下する。ベナン、トーゴそしてカボベルデ諸島においても、アルゼンチンと同様に補助金額が低下した。低下していく補助金額を提供することへの一つの障害は、それが設置された期間にシステムを追跡しそれで補助金のレベルが選ばれるという管理上の複雑さを加えることとなった。

多くのプロジェクトに、50Wp という最小システム規模が含まれている。しかしながら、いくつかのプロジェクトでは、初期段階には、より小規模なシステム或いはより低価格部材の販売がなされており、より安価なシステムを「購入したい」消費者のための下取り或いは転売も行われている。スリランカのプロジェクトでは、30Wp 容量でプロジェクト下の GEF 補助金の対象より小さい、より供給可能なシステムを対象とするよう、システム仕様を変更した。事実、スリランカで最も販売されたのは 32Wp システム(約＄450 で販売された)である。インドネシアも、30Wp システムを対象するよう仕様を変更した。中国では、部材が適切な基準と合致する限りは、10Wp 程度の小型のシステムも対象とされている。バングラディシュでは、50Wp システムが最も販売されており、国内で安価に部材が生産され好意的な価格で太陽電池モジュールが購入できるために、販売業者は 50Wp システムをおおよそ＄500 の非常に低価格システムコストとして事業が行えている。

初期実施経験が示す教訓

- 同じ市場に複数の補助金が導入されると、販売業者の販路開拓と価格付けを複雑にする。もし商業金融業者或いは顧客が補助金を受けた場合、販売業者は価格を上げようとするだろう。しかしながら、もし販売業者が補助金を受けた場合、彼らは価格を下げるだろう。もし、同じ市場にこの両者のタイプが存在したら、販売業者の価格は不公平になるだろう。

- 顧客は 30Wp 程度の小規模のシステムを希望し使おうとし、そのことは部材とサービス水準に関して消費者の選択の範囲を拡大するといった、プロジェクトの柔軟性と、より小型のシステムの供給を進めることとなるだろう。
- 小さな市場の場合、個々の販売業者は、太陽電池モジュールの供給会社からの好意的な価格の交渉は困難なものとなる。
- 補助金やより小型のシステムや消費者信用があっても、初期の市場段階における顧客の大部分は、最も裕福な周辺地域の世帯であり、それは家庭用太陽光発電システムを、経済的利益より利便性や美学や照明の質や或いは珍しいものである「贅沢品」として購入している。

4. 支援政策の立案と能力

プロジェクトの設計と経験において、幾つか政策に関する論点がある。

*特権のための制度支援。*ESCO 特権モデルを適用しているプロジェクトに対し、国の規制機関の技術的支援が、特権の入札、契約、職員の訓練、権限の監視と取り締まりなども行っている。規制機関の事例としては、アルゼンチンにおける州政府や、カボベルデ諸島の国家エネルギー庁(INERG)や、ベナンとトーゴにおける周辺地域電化庁(AER)がある。アルゼンチンにおいては、特権に対する州の規制の機能と施設そして適切な誘因と利益を強化することによって、より持続出来るものとなっている。

*周辺地域電力系統延長計画と施策。*プロジェクトは、間接的にも直接的にも、周辺地域電化に関する政府の計画と施策に影響する。例えば、スリランカにおいては、プロジェクトが、国家電力事業体と政府に対し、周辺地域の電化計画に家庭用太陽光発電システムをより明白に認識させ取り入れさせ、そして非現実的な政策上の将来見込みと同調しない電力系統の拡張は家庭用太陽光発電システムの市場を損なうことを認識させた。こうした状況は、国家電力事業体が特定の地域の住民に対して、「電力系統はやってこない。代わりに家庭用太陽光発電システムを考えよ。」(或いは、「電力は供給されようが、それは電力系統ではない。」とさえも)と言ったことを認めさせることを促進している。

*電力分野改革。*世界銀行プロジェクトに連合する電力分野の改革活動は、将来に家庭用太陽光発電システム市場を生み出す。例えば、スリランカの電力分野改革は、国会に責任のある「独立電力規制機関」の確立を招いた。この時に、世界銀行は、周辺地域へのより現実的な電力系統の延長を、政治家のより責任のある、より不正確でない約束として、期待している。このことは、家庭用太陽光発電システムを必要とする地理上の地域を固定させ強固にする。

*政策と計画への産業の関与。*スリランカにおいては、プロジェクトの研究会は、証明された販売記録を有する販売業者を制限する資格を有した、太陽エネルギー産業協会の設立を導いた。一部分は、この協会は、プロジェクトの問題と周辺地域電化政策と計画に関して、世界銀行と政府と国家電力事業体と影響し合うための企業のための統一された声として機能している。

輸入関税。太陽光発電部材への減免された輸入関税は、市場の歪みを取り除き、周辺地域世帯に家庭用太陽光発電システムをより供給可能としている。スリランカ政府は、プロジェクトと協力して輸入関税を 30%から 10%に減じた(10%は全ての他の非保護物資のための税率である)。(皮肉にも、この 30%の輸入関税は、元々、国内の太陽光発電製造設備を保護するためのものであるが、(プロジェクト前に)この設備は閉鎖され、その輸入関税は輸入部材を使用する太陽光発電販売産業の出現を押し下げることとなった。)中国では、輸入関税は、全ての政府が認可する再生可能エネルギープロジェクトが免税で材料を輸入できる中国の政策と協力する太陽光発電部材のために削除された(しかしながら、中国は大きな太陽光発電産業を有しているために、殆どの部材を国内で生産されることが期待されている。)

初期実施経験が示す教訓

- 関税の設定、入札、判定そして規則の権限等、解決しなければならない多くの論点がある。これらの論点の解決は簡単ではなく、プロジェクトは適切かつ完全にそれらを対応するための十分な時間と資源を与えなければならない。
- 具体的な政府の計画であるか単に非現実的な政治的約束であろうとなかろうと、将来の周辺地域電力系統の延長に関する顧客の感覚の影響は、プロジェクトが期待するよりも家庭用太陽光発電システムへの要求に関する有害な影響を、より増している。
- 消費者は、全てが平等であるという考えで、家庭用太陽光発電システムから得られるエネルギー供給よりは、電力系統の接続を望んでいる。しかしながら、顧客が電力系統の利用に数年間待たなければならないとすれば、家庭用太陽光発電システムには追加的な価値がある。
- 低い輸入関税は、太陽光発電装置の国内生産者を阻害する。
- プロジェクト後の輸入関税の跳ね返りの恐れは、将来の市場の発達、プロジェクトの安定性そして繰り返しに陰を投げかける。

5. 法規と標準の制定及び証明・試験・施行制度の確立

歴史的には、家庭用太陽光発電システムプロジェクトの失敗の原因は、貧弱な製品品質や貧弱な設置と保守やシステムの「過剰販売」(技術的に行えるよりも高い期待を市場が要求する)にあった。法制度、標準及び証明(そして市場抑制)は、商業リスクを減ずることと同様にこれらの論点を論じる重要な要素である。

関係する機関の能力を含めた標準化の推進は、等しく重要である。世界銀行のプロジェクトの間、プロジェクト自身は標準化の実施を着実に進めている。プロジェクト完了後は、この事業は政府或いはプロジェクト中に設立され強化された機関に引き継がれることとなる。いかなるプロジェクトも完了していないから、プロジェクト後の標準化の実施(そして企業による採用)は、未だ試されていない。

殆どのプロジェクトは、品質や安全性や長期の信頼性を確かにする太陽光発電部材とシステムの

標準の開発と確立を行っている。プロジェクトに参加を希望する販売業者は、認可された試験研究機関で証明された装置を取り扱うにちがいない。例えば、ベニンとトーゴのプロジェクトでは、地方電化機関が「太陽光発電制度の実施」と技術的標準を進めている。インドネシアでは、販売業者は、彼らが販売する前に、彼らの部材が選択された仕様に合致し上回っていることを認められている試験機関からの証明がなされることを求められている。参加する販売業者に対し、国際研究機関から証明された装置を得ることを支援している。中国では、プロジェクトの外で適応されるよう装置の標準を定め普及させようとしており、そのことは、中国での国家標準と国家認証の提案が、中国製品を国際的に販売可能とするように間接的に支援することとなり、これと同様のことがインドネシアで起こっている。即ち、世界銀行プロジェクト下で証明された製品が他の国々で販売されている。

スリランカでは、最初には、インドネシアで用いられた標準が採用されたが、その後、スリランカの消費者の需要と太陽日射特性に、より合致した小型のシステム(30Wp)を含む標準に変更された。後に、インドネシア及びスリランカ両国で、最小限の必要条件を消費者需要と販売業者能力のために更に緩和された。

スリランカでは、売ることが可能であると証明された製品が存在しないために、最初の年においては、プロジェクトは装置の証明を実施した。プロジェクト計画は、供給者に証明された装置が得られるのに時間がかかるとは想定していなかったが、これは多分に、システムはインドネシアから輸入されるものと、元来、プロジェクトが想定していたことによっており、インドネシアでは、恐らく市場は、世界銀行に認可された標準に基づいており、スリランカと併行して開発されるものであった。たとえそうでも、蓄電池の仕様が決定出来ず、スリランカのプロジェクトは、その後数ヶ月にわたり蓄電池の仕様の一時停止をなさねばならなかった。

国内の証明と試験の機関も、また重要である。インドネシアプロジェクトのおいては、太陽光発電の試験と証明のための技術評価適応庁の能力強化を目指した技術支援を実施している。中国では、国家太陽光発電試験証明センターの設備と訓練に補助金が供給された。設計支援センターの能力強化と同様に、太陽電池モジュールと周辺機器の試験及び証明センターの強化にも支援がなされた。

殆どのプロジェクトは、高品質のシステムが設置されることを支援する能力を有している。こうした支援は、プロジェクト下の消費者を保護することのみならず、産業がより大きな規模の商業化に向かい努力することのために重要である。スリランカでは、試験と品質の改良のための販売業者への支援がなされたが、販売業者にはそうした支援への必要も興味もなかった。スリランカでは、補助金基金が、家庭用太陽光発電システムの設計がプロジェクトの仕様に合致し、そしてシステムが正しく設置されていることを立証するために、商業金融業者に利用されている。補助金基金は、解決の困難な販売業者に対する消費者の不満の研究と適切な解決の調査にも利用されている。中国においては、品質保証と消費者保護が進められている。ベニンとトーゴにおいては、地方電化庁は、設置されたシステムの抜き取り検査と私的運用者の技術向上を目指した定期の消費者調査を行う能力を身に付けるだろう。

初期実施経験が示す教訓

- 供給可能性の維持が困難でなく、システムに技術的な問題が殆どない間は、高品質のサービスを確かにする家庭用太陽光発電システムのための適切な装置の標準と証明の手順を確立すること。
- 標準の制定に柔軟性を持たせること、そこで、最初の標準が地方の販売業者や ESCO 特権者にとって高過ぎる場合には、標準は緩められるべきである。
- 市場を過度に窒息させるのではなく、消費者に満足を、すなわち持続し得る市場を与えることに寄与する方向にのみ標準を使用する。
- 高品質の製品の設置は、将来の市場の負担とコストを減じ、将来のサービスコストを減ずる。
- プロジェクトの期間は、販売やサービスの開始する前に、供給者を確立し証明された供給品を調達するための、販売業者あるいはESCO 特権者のための十分な時間をとるべきである。
- 正しい保守と運転手順に関する消費者教育は、家庭用太陽光発電システムの販売或いは設置の間、維持コストを最小化し蓄電池の寿命とシステム全体の信頼性の向上に重要である。

6. 消費者の意識調査とマーケティング計画の実施

殆どのプロジェクトは、消費者意識と市場の問題を引き出している。このような問題は、(インドとインドネシアにあるような)プロジェクト準備の一部である市場調査や、(スリランカにおけるように)他社が行った市場調査により、通常明確になる。プロジェクト戦略の基礎として利用可能な(人口、収入、出費、家族構成等の)人口統計学データが極めて不足していたために、中国のプロジェクトは、市場をより良く理解するための大規模な周辺地域消費者調査(文書はリンクされている)を進めた。家庭用太陽光発電システムの所有者を含む 2000 世帯のサンプル調査は、供給可能性と世帯の予算に関する重要な情報を明らかにした[現在出筆中]。中国のプロジェクトもまた、販売と市場活動を支援する販売業者への補助金を与えている。

インドでは、IREDA は、マスコミに太陽光発電技術のための促進運動を行ったが、しかしながら、これらの運動は周辺地域の家庭にまでは届かなかった。スリランカ市場計画(Sri Lanka marketing program にリンク)において、プロジェクトは、国中に家庭用太陽光発電システムを促進するための村落レベルの研究会を行うために、特別に専門家を雇った。この研究会においては、販売業者は彼らの製品をデモすることが出来、村落の指導者は技術を学んだ。更に、潜在的な地方の小規模融資機関が、プロジェクトを学び、家庭用太陽光発電システムへの地方の興味を評価し、プロジェクトへの参加を誘発し、地域社会への消費者信用を提供した。このような研究会は、毎月2回開催され適度に成功したものと考えられたが、販売業者はこの研究会を家庭用太陽光発電システムの実際の顧客を十分に惹き付けるものとは感じてなかった。

プロジェクトは、市場開拓や顧客の自己認識活動に関して、ESCO 特権者をも支援した。アルゼンチンにおいては、州政府は、詳細な市場調査を用意したり、情報普及研究会を開催したり、分散した周辺地域における家庭用太陽光発電システムに関する、両立し得る直流器具の有効性に対す

る改善の方法の研究を用意したりすることにより、特権者を支援した。ベナンとトーゴにおいては、周辺地域の電力事業者は、ESCO 特権者を支援する市場活動を行っている。それは、これらの村落の人口統計に関する情報の収集である。更に、ESCO 特権者は、プロジェクトの補助金を使って、彼ら自身が市場調査を行う事が出来る。消費者の自己認識と市場計画の更なる詳細は、プロジェクト実施機関から直接入手可能であり、この報告では対象としない。

初期実施経験が示す教訓

- 消費者の自己認識は、それ自体では大きな市場を産み出さない。供給可能性、デモ、隣人の意見、サービスの実体そして技術的性能の信用といった他の要素も、ひとしく重要である。
- 販売会社は、周辺地域では非常にコストがかかり、時間を消費するものであり、それは潜在的な顧客は村落の中心から離れて住んでいるかもしれないし、読むことが出来ないかもしれないし、技術に極めて懐疑的であるかもしれないし、地域社会の会合を通しての直接差し向かいの接触或いは戸別訪問での販売さえも要求するかもしれないからである。
- 販売会社は、村落の指導者や潜在的関係者ではなく、周辺地域の顧客を対象と確信すべきである。
- いったん特定の周辺地域に顧客の「臨界点を超えた集団」が存在すると、市場取引は容易になる。
- 戸別訪問や直接の接触は、TV やラジオのキャンペーンよりもっと効果的である。
- 周辺地域での販路開拓キャンペーンのインパクト或いは有効性を評価することは極めて困難である。

表.1：住宅用太陽光発電システム(SHS)を含む世界銀行プロジェクト

プロジェクト名	認可日と状況	銀行/GEF 資金及び全プロジェクトコスト	SHS 構成説明	実施機関
インド再生可能資源開発プロジェクト (http://www.worldbank.org/astae/lcg.htm#credit24490-IN)	GEF 1991 銀行:1992 実施中	GEF: $ 26m 銀行(IDA): $ 115m 銀行(IBRD): $ 75m 合計: $ 450m	様々な形態の2.5MWpの太陽光発電(商用、水ポンプ、SHS)	インド再生可能エネルギー開発庁(IREDA)
小規模及び中規模企業計画 (http://www.worldbank.org/pics/ifcspi/lls07327.txt)	GEF:1994/1997 IFC:1995 実施中	GEF: ベトナム: $ 0.75m バングラデュシュ: $ 0.75m ドミニカ共和国: $ 75,000	商業融資 SHS 事業ベンチャー	融資仲介及び受納企業
インドネシア家庭用太陽光発電システムプロジェクト (http://www.worldbank.org/astae/lcg.htm#loan35544-IND)	GEF:1995 銀行:1997 中止の見込み	GEF: $ 24m 銀行(IBRD): $ 20m 合計: $ 118m	200,000SHS が私的販売業者/企業家により販売及び設置	プロジェクト管理団体及び参加企業
スリランカエネルギーサービス供給プロジェクト (http://www.worldbank.org/astae/lcg.htm#credit2938-LK)	GEF:1995 銀行:1997 実施中	GEF: $ 5.9m 銀行(IDA): $ 24m	30,000SHS が販売業者と小規模融資機関により販売及び設置	セイロン電力委員会及びプロジェクト管理団体
太陽光発電市場形成誘導 (http://www.gefweb.org/wprogram/1096/pvmti.doc)	GEF:1996 IFC:1998 実施中	GEF: $ 0,7m 合計: $ 90-120m	インド、ケニア、モロッコにおける商業融資 SHS 事業ベンチャー	「外部管理代理店」と受納企業
ラオス人民民主共和国南部周辺地域電化プロジェクト (http://www.worldbank.org/astae/lcg.htm#credit30470-LA)	GEF:1997 銀行:1998 実施中	GEF: $ 0.7m 銀行(IDA): $ 1.5m (電力系統外の構成部材のみ)	20 の太陽光発電蓄電池充電ステーションを実証用に国家電力事業体と村落電力組合が設置	ラオス電力事業体(EdL)
アルゼンチン周辺地域市場再生可能エネルギープロジェクト (http://www.gefweb.org/wprogram/nov97/ar-webpdf)(PAD が必要)	GEF:1997 銀行:1999 実施中	GEF: $ 10m 銀行(IBRD): $ 30m 合計: $ 121m	家庭に66,000SHSが規定されたエネルギーサービス特権者により設置	エネルギー及び州政府事務局
カボベルデ諸島エネルギー水分野改善開発 (http://www.gefweb.org/wprogram/mar98/worldbank/capeverve/capever.doc)	GEF:1998 銀行:1999 実施中	GEF: $ 4.7m 銀行(IDA): $ 17.5m 合計: $ 48m	家庭に 4,000SHS が規定されたエネルギーサービス特権者により設置	社会基盤・住宅省及び国家電力・水公社(ELECTRA)
中国再生可能エネルギー促進プロジェクト (http://www.gefweb.org/wprogram/mar98/worldbank/china/china1.doc)	GEF:1998 銀行:1999 実施中	GEF: $ 35m 銀行(IBRD): $ 100m 合計: $ 444m	10Mp の SHS 及び太陽光風力発電ハイブリッドシステムが私的販売業者で設置	経済局及び貿易委員会
世界太陽エネルギー開発団体 (http://www.worldbank.org/pics/ifcspi/1ws09137.txt)	GEF:1998 IFC:1999	GEF: $ 10m IFC: $ 6m 合計: $ 50m	太陽光発電関連事業融資及び技術的支援と事業サービスの供給	Triodos 太陽光発電共同出資者(資金管理者)及び受容企業
ベナン共和国非系統電化/伝統的エネルギー (http://www.gefweb.org/wprogram/Oct98/Wb/benin.pdf)	GEF:1998 銀行:参加予定	GEF: $ 1.1m 銀行: $ 2.2m 合計: $ 5.7m	5,000SHS が規定されたエネルギーサービス特権者により設置	エネルギー・鉱山・水担当省
トーゴ共和国非系統電化/伝統的エネルギー (http://www.gefweb.org/wprogram/Oct98/Wb/togo.pdf)	GEF:1998 銀行:参加予定	GEF: $ 1.1m 銀行: $ 2.2m 合計: $ 5.7m	5,000SHS が規定されたエネルギーサービス特権者により設置	鉱山・産業・輸送・郵便・通信担当省

表.2:プロジェクトの特徴と手法

プロジェクトの特徴	プロジェクトの手法と概要	特記すべき主たる障害
1.先導的私的分野及びNGO供給モデル	私的販売業者或いはNGOがシステムを販売(インドネシア、インド、スリランカ、ベトナム、バングラディッシュ、中国) エネルギーサービス企業(即ち、月毎のサービスに対する料金) 規定された特権者としての運営(アルゼンチン、ガボベルデ諸島、ベナン、トーゴ) エネルギーサービス企業(即ち、月毎のサービスに対する料金) 自由市場での運営(ドミニカ共和国、インド) 私的販売業者、ESCO 特権者、NGO への事業情報、訓練、コンサルタントサービスの提供(インドネシア、スリランカ、中国、ベトナム、ガボベルデ諸島、アルゼンチン、ベナン、トーゴ)	確立した市場の不足 成功した事業モデルの不足 事業融資の不足 事業技量の不足 非電力系統電力供給を行う電力事業者の非自発性 高い取り引きコスト
2.先導的消費者信用供与方式	販売業者を通した消費者信用の提供(インド、インドネシア、スリランカ、バングラディッシュ、中国) 設立された小規模融資(小規模企業)機関による消費者信用の提供(スリランカ) 地方開発融資機関による消費者信用の提供(ベトナム)	高い初期コストと供給可能性 消費者融資制度の不足 高い処理コスト
3.初期コスト補助金の支出と供給可能なシステムサイズ	プロジェクト期間一定(インドネシア、スリランカ、中国)、或いはプロジェクト期間減少(アルゼンチン、ベナン、トーゴ、ガボベルデ諸島)するシステム毎に一回の補助金の支払い より小規模、より供給可能なシステムの指定と販売(インドネシア、スリランカ、中国、ガボベルデ諸島、トーゴ)	高い初期コストと供給可能性 販売後サービス活動を有益なものとし市場コストを低減する設置された根拠地(「臨界点を超えた集団」)の不足
4.開発と能力の支援施策	権限の付与、契約、取締を所管する国家規制機関への技術支援の提供(ガボベルデ諸島、アルゼンチン、ベナン、トーゴ) 公的再生可能エネルギー機関能力向上(インド) 太陽光発電への周辺地域電化政策と計画の取り入れ(スリランカ) 輸入関税の引き下げ(スリランカ、中国)	周辺地域エネルギーサービス特権を規制するための経験の不足 高い輸入関税 信頼出来ない技術実績 信頼出来ない周辺地域電化政策
5.法制度及び標準の制定と証明、試験、施行機関の設立	財政支援されたプロジェクトで使用する設備標準の開発(インドネシア、スリランカ、中国、ベナン、トーゴ) 証明、試験を行う機関、研究所への支援(インドネシア、中国) 販売業者への標準と規制機関或いは融資事業者への標準承認の立証を行う能力育成の支援(インドネシア、スリランカ、中国、ベナン、トーゴ)	貧弱なシステム品質 信頼出来ない技術実績 製品品質と性能に関する情報の不足
6.消費者自覚と市場形成計画の指導	TV及びラジオでの促進広告の指導 地方フェアーと地域社会行事の情報の配布 個別販売の指導	信頼出来ない技術実績 製品、コスト、利益に関する情報の不足

表.3:プロジェクト設計疑問と適切なプロジェクト特徴

プロジェクト設計疑問	適切なプロジェクト特徴
(a)消費者の好みを満足させる高品質システムを家庭に、如何に効果的に供給しサービスするか。 (私的販売業者、エネルギーサービス特権者、事業融資、市場、法制度と標準、規制の開発)	私的分野とNGO供給モデル(#1) 開発と能力の施策(#4) 法制度、標準、証明、施行(#5) 消費者自覚と市場(#6)
(b)如何にシステムを家庭に供給可能とするか。 (市場競争、サービス課金、大量購入、補助金、小規模システムサイズ、消費者信用、規模の経済、低処理コスト)	私的分野とNGO供給モデル(#1) 消費者信用(#2) 初期コスト補助金とシステムサイズ(#3)
(c)所与の状況に最も実行できるものが、もしあれば、何が消費者信用を策定するか。 (販売業者信用、小規模融資、開発融資事業者)	消費者信用(#2)
(d)周辺地域電化政策と計画に関するSHSの適切な役割は何か。 (サービスコストの人口統計学的決定因子、低コスト計画、計画過程と制度、私的分野の役割、補助金と収入報酬)	私的分野とNGO供給モデル(#1) 開発と能力の施策(#4)

International Energy Agency
Photovoltaic Power Systems Programme

Task IX

Deployment of Photovoltaic Technologies: Co-operation with Developing Countries

2nd Experts Meeting
MINUTES

Draft

Washington DC, USA

8th – 9th February 2000

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1. Welcome

The meeting was formally opened by Bernard McNelis on behalf of Enno Heijndermans of the World Bank. The Task IX participants would like to thank the ASTAE Unit at the World Bank for hosting the meeting. Thanks are due to Enno Heijndermans and Pikul Malasiddhgeissa of the ASTAE Unit and to Mark Fitzgerald and Robert Hassett for their assistance in the organisation of the meeting.

2. Agenda

The agenda was agreed as issued – see Annex 1.

3. Participants

The meeting participants are listed below.

Country	Representative name		Organisation
Australia	Gordon	THOMPSON	CASE
Australia	Geoff	STAPLETON	GSES
Canada	Gerry	COLLINS	CIDA
Canada	Josef	AYOUB	CANMET-EDRL
Denmark	Peter	AHM	PA Energy A/S
France	Hubert	BONNEVIOT	IED
Germany	Rolf	POSORSKI	GTZ
Germany	Klaus	PREISER	FhG-ISE
Italy	Roberto	VIGOTTI	ENEL
Japan	Tsunehisa	HARADA	JPEA
Japan	Kazuo	YOSHINO	Yoshino Consultant
Japan	Eiichi	WAKI	NEDO
Japan	Yoshiko	YURUGI	NEDO
Netherlands	Winfried	RIJSSENBEEK	ETC
Netherlands	Chris	WESTRA	ECN
Netherlands	Jan	CLOIN[2]	ECN/UNDP
Spain	Emiliano	PEREZAGUA	Isofoton
Switzerland	Alex	ARTER	ENTEC AG
Switzerland	Stefan	NOWAK[1]	NET Ltd for CHE Govt
UK	Bernard	MCNELIS	IT Power Ltd
UK	Jonathan	BATES	IT Power Ltd
USA	Robert	HASSETT	US DOE
USA	Allan	HOFFMAN	US DOE
USA	Mark	FITZGERALD	ISP
USA	Roger	TAYLOR	NREL
	Eric	MARTINOT	World Bank/IEA
	Suresh	HURRY	UNDP
	Enno	HEIJNDERMANNS	ASTAE Unit, World Bank
	Peter	VARADI[2]	PVGAP
	Dana	YOUNGER[2]	IFC
USA	Robert	LEE[2]	AED

Also invited were:

[1] 7 February only
[2] 8 February only

Country	Representative name		Organisation	Comments
France	Jean-Louis	BAL	ADEME	Apologies
Denmark	Jean-Paul	LAUDE	DANIDA	Without Notice
Finland	Heikki	TIKKANEN	Fortum AES	Apologies
Japan	Takeyuki	TANI	IEEJ	Apologies
	Mark	RADKA	UNEP	Apologies
	Erik	USHER	UNEP	Apologies
C.E.C.	Paul	DOYLE	CEC DGXVII	Without Notice
C.E.C.	Claas	HELMKE	JRC Ispra	Apologies

4. Approval of Minutes of 1st Experts Meeting

The minutes were approved with minor changes.

5. Review of Actions

Outstanding actions from the 1st Experts meeting were identified.

Action	By	Status
Investigate REWP schedules	GBR	Complete
Distribute information on Italian bilateral programmes	ITA	
3rd Meeting Jakarta – 2-3 October 2000	GBR	TBC
Prepare Task IX Flyer	GBR	

6. Presentation of Workplan for Subtasks 10 and 20

A detailed workplan for Subtasks 10 and 20 was circulated to all participants prior to the meeting.

Winfried Rijssenbeek presented the detailed Workplan to the meeting (see Annex 2). Following the presentation a discussion was initiated and is summarised below.

Suresh Hurry observed that Task IX needs to take into account work already being undertaken by the UNDP and the world Bank and should not repeat this work. The Task also needs to be sure who its clients are and who are the Recommended Practice Guides to be targeted at.

Roger Taylor felt that PV is still in its infancy with respect to implementation in developing countries and that it may be premature for Best/Recommended Practice Guides and that perhaps we should focus on lessons learned.

Stefan Nowak felt that Task IX had set itself a very ambitious programme and needed to be sure who was going to undertake the work in order to ensure the objectives will be achieved. It was suggested that the RPG production be prioritised to ensure effective use of resources.

Rolf Posorski thought the number of guides could be reduced by restricting the number of target groups.

Erik Martinot suggested that it may be possible to publish a mixture of both RPGs and Lessons Learned documents to ensure the appropriate documentation for each respective subject area.

Jonathan Bates said that the Guides were most likely to be largely internet based publications which would allow them to be updates relatively easily. The guides would be published in English in the first instance. Some of the guides would be published jointly with Task III.

7. Presentation of Workplan for Subtask 20

Alex Arter gave a brief presentation on Subtask 20. It was important that Subtask 20 was not delayed because of awaiting information to be supplied from Subtask 10.

The Subtask Leader would therefore make contact with donor agencies and development banks to find out whether they were interested in the support that Task IX could potentially offer and to ascertain their requirements.

Enno Heijndermanns said that ASTAE would primarily be looking for support in peer review of documents.

Suresh Hurry said this would be an area of interest to UNDP as well as possibly providing training workshops.

It was emphasised that the support to be provided by Task IX would in no circumstances amount to free consultancy for external organisations.

8. Presentation of Workplan for Subtask 30

The objectives of Subtask 30 were presented to the meeting. The subtask will investigate the techno-economic aspects and potential of PV systems, and the roles of utilities in developing countries. This Subtask will identify areas of specific concern to developing country applications requiring further research and feed this into other parts of the IEA PV programme.

Three activities with Subtask 30 were proposed:

Activity 31	Stand-alone PV systems
Activity 32	Village grid and hybrid systems
Activity 33	Grid-connected PV systems

Japan informed the meeting that it was not in a position to act as Subtask Leader for Subtask 30 but confirmed its intention to remain involved in the Subtask.

Klaus Preiser said that the Subtask would be of particular interest to the Fraunhofer Institute but that there would be difficulties in getting funding for the Subtask. This was confirmed by Rolf Posorski who stated that should Germany confirm its participation in Task IX, it would be mainly involved in Subtasks 10 and 20.

Roger Taylor suggested the Task could possibly be co-led by USA and DEU should Germany be able to obtain funding.

Gordon Thompson suggested setting up a small Working Group to define the workplan for Subtask 30 in the absence of a Subtask Leader. This was agreed as the most appropriate way forward. AUS (G Thompson), DEU (K Preiser), USA (R Taylor) and JPN (T Tani, cc E Waki) would constitute the group.

9. Target Country Identification

The responses from the completed questionnaires that were distributed were summarised (see Annex 3).

Target countries have been provisionally identified as: Argentina, Brazil, China, Dominican Republic, Ghana, Honduras, Kiribas, Indonesia, India, Morocco, Philippines, South Africa, Vietnam and Zimbabwe.

It was noted that in some countries there may be difficulties in obtaining accurate data, especially when these conflicted with *targets*. The UNDP had 136 Field Officers around the world and these could be accessed to help 'open doors'.

In order to ensure that most effective use is made of the available data, information requirements should be targeted at specific countries. In order to achieve this a matrix would developed to marry countries to specific outputs.

There was some discussion as to the inclusion of Mexico in the target country list but it was agreed it this could be politically difficult due to Mexico's membership of the PVPS and its decision not to participate in Task IX.

10. Summary of the Photovoltaic Consultative Group Meeting

A number of the Task IX representatives had attended the PV consultative Group Meeting organised by the World Bank on 7th February. Bernard McNelis and Jonathan Bates represented Task IX at this meeting. The Committee has been set up to facilitate discussion between the PV industry and the World Bank on future PV programmes

The meeting was addressed by the President of the World Bank, Mr James Wolfennson.

It was agreed that a Working Group would be set up to identify the role and modalities of operation of such a consultative committee. Bernard McNelis, as Task IX Operating Agent, volunteered to serve on this Working Group. The importance of Task IX's interaction with this Group was highlighted.

11. Further review/discussion of World Bank Quap-PV Manuals

As discussed at the first meeting, the ASTAE Unit at the World Bank has funded the development of QA documentation on:

- Quality Management in Photovoltaics: Manufacturers Quality Control Training Manual – (developed by PVGAP)
- Manual for design and modification of solar home system components – (developed by ECN)
- Training Manual for Quality Improvement of Photovoltaic Testing Laboratories in Developing Countries – (developed by FSEC)
- PV Installation and Maintenance Practitioner Certification Infrastructure: Development Procedures – (developed by ISP)

At the 1st Experts Meeting, the consensus was that there was certainly a need for a quality standard of some kind for World Bank and other programmes and that these manuals went a long way towards addressing this.

The contracts with the World Bank are almost completed so there is no requirement for Task IX input at this stage. However, the ASTAE Unit is keen that these manual are continually developed and are 'living' documents. The ASTAE Unit made it clear that Task IX would be welcome to further develop the manuals if it wished.

It was recognised that the manual developed by Mark Fitzgerald of ISP (PV Installation and Maintenance Practitioner Certification Infrastructure: Development Procedures) was particularly relevant to Task IX and that the Task should thoroughly review the manual and develop it further if necessary. It was agreed that Jonathan Bates, Peter Ahm, Hubert Bonneviot, Geoff Stapleton, Winfried Rijssenbeek, Gordon Thompson, Josef Ayoub would review the manual. Jonathan Bates would co-ordinate comments and suggestions.

Interest was also expressed in the manual developed by FSEC, (Training Manual for Quality Improvement of Photovoltaic Testing Laboratories in Developing Countries). Klaus Preiser, Roger Taylor and Peter Ahm requested copies of the manual for review. Comments would be co-ordinated by Roger Taylor.

12. IEA PVPS Task IX Collaboration with the World Bank

Bernard McNelis gave a short presentation to the meeting on the objectives of Task IX and outlined the areas of possible co-operation between the Bank and Task IX.

13. World Bank SHS Projects: Experiences and Lessons Learned 1993-2000

Eric Martinot made a presentation on the experiences and lessons learned from World Bank Solar Home Systems projects. Copies of his paper were handed out to the participants.

14. Recommended Practice for Training Programmes

This agenda item was covered in the discussion on World Bank Qual-PV Manuals.

15. Market Status for GHG Credits

Robert Lee of AED Inc made a presentation to the meeting on the various carbon credit mechanisms and their market status. The presentation is in Annex 4.

16. Proposals for 3rd and 4th Expert Meetings

In order to enable Task IX to interact with experts from developing countries it is intended that the experts meeting will be held in developing countries as far as possible. Possible dates and locations for the 3rd and 4rd Experts Meetings are:

28th – 29th October 2000 – Marrakech, Morocco.
Feb/March 2001 – Jakarta, Indonesia.

Note: the 2nd Meeting was originally planned to take place in Marrakech (Morocco) in conjunction with a GEF PV workshop. This Workshop was then delayed and so the meeting was re-scheduled for Washington DC. It has subsequently been learned that the GEF PV Workshop will be held in Marrakech on 25-27 September 2000. It is proposed therefore to hold the 3rd Experts Meeting in Marrakech on 28-29th October 2000.

The 4th Meeting will be held in Indonesia in Feb/March 2001.

17. Technical Tour

A visit was organised to the BP Solarex 'breeder' plant at Frederick Maryland. Special thanks are due to Sarah Howell for hosting this.

18. List of Actions

The actions arising from the meeting were agreed as follows.

Action	By	Date
Reserve ieapvpstask9.org for website	USA	
Confirm Jakarta for 2-3/10/2000.	GBR/CHE	
Visit to KL?	GBR/CHE	
Confirm event attached to 3rd Mtg.	GBR/CHE	28/2
Matrix for countries vs outputs circulate and return	GBR	10/2
Continue to explore collaboration co-op-ration w REWP & April mtg	GBR	
Test case UNDP document for peer review	UNDP/CHE	15/3
Ad hoc group to develop ST30 workplan	AUS, USA, JPN, (DEU)	30/4
Task IX OA to explore serving on WB PV Consultative Cttee	GBR	June/July
Develop strategy for interaction with this Group	GBR	April
Circulate all Quap-PV manuals	GBR	6/3
'Adopt' training manual?		
Circulate mtg documents.	GBR	6/3
Mtg w ASTAE/CHE to discuss further co-operation areas	CHE	10/2
Finalise data collection mechanisms for ST10 and start collection	NLD	31/4
Task IX flyer	GBR	31/3
Investigate funding for DC reps to attend meetings	All	3/10
Explore T9 w/shop for ADB	UNDP/CHE	31/3
France to confirm manpower input	FRA	28/2
Distribute CD rom on Qual-pv manuals		

Annex 1: 2nd Experts Meeting Agenda

International Energy Agency Photovoltaic Power Systems Programme, Task IX

Deployment of Photovoltaic Technologies: Co-operation with Developing Countries

HOSTED BY ASTAE

Agenda – Tuesday 8 February	***Discussion Leader***	***Time***
Welcome by host	Heijndermanns	09.00
Brief Introductions	All	09.10
Approval of Minutes of 1st Experts Meeting	All	
Verification of Actions	Bates	
Subtask 1 – Deployment Infrastructure Detailed workplan and organisation of subtask	Rijssenbeek	10.00
Subtask 2 – Support and Co-operation Detailed workplan and organisation of subtask	Arter	
Discussion and agreement on Workplan for Subtasks 1 and 2	All	
Subtask 3 – Techno-economic aspects Provisional workplan and organisation of subtask	Harada	
Discussion and agreement on Workplan for Subtasks 3	All	
Target Countries	Bates	
Summary of the Photovoltaic Consultative Group Meeting	McNelis	
Further review/discussion of World Bank Quap-PV Manuals	All	
Close		*18.00*
Dinner		*19.30 (TBC)*

Agenda – Wednesday 9th February	***Discussion Leader***	***Time***
Collaboration with World Bank	McNelis	09.00
Presentation of IEA PVPS and Task IX	McNelis	
Open Discussion		
World Bank SHS Projects: Experiences and Lessons Learned 1993-2000'.	Martinot	To be confirmed
Open Discussion		
Recommended Practice for Training Programmes	Fitzgerald	
Discussion		
Financing PV from Carbon Credit Mechanisms	Mendis (AED)	
Discussion		
Visit to BP Solarex Manufacturing Facility		*Depart 13.30*

Lunch will be held between 13.00 and 14.00 on both days.

Representatives of the World Bank and IFC have been invited to attend the session on Wednesday.

４． 作業部会

４．１ 第１回 作業部会

・議事録

・資料 ＰＶ ＧＡＰの現況説明図（ＪＥＭＡ資料）

４．２ 第２回 作業部会

・議事録

４．３ 第３回 作業部会

・議事録

・資料 Target Country Identification Matrix (Fm. OA) ＆ 集約版

第１回　ＩＥＡ Task Ⅸ 作業部会　議事録

１．開催月日：平成１１年１０月５日（火）　１３：３０～１７：００

２．開催場所：㈲ クリエイティブルーム・コバヤシ　会議室

３．出席者：　京セラ㈱　佐倉ソーラーセンター　本多　潤一

（敬称略）　シャープ㈱　ソーラーシステム事業部　鳥喰　貞次

昭和シェル石油㈱ 新ｴﾈﾙｷﾞｰ部 太陽電池事業部門　桜井　勝

㈶日本エネルギー経済研究所 国際協力ﾌﾟﾛｼﾞｪｸﾄ部　谷　隆之

吉野コンサルタント事務所　吉野　量夫

太陽光発電懇話会　原田　恒久

４．配布資料

1)ＩＥＡ／ＰＶＰＳ Task Ⅸ

2)ＰＶＧＡＰの現況説明図

５．議事内容：

5-1：経過説明

事務局からＮＥＤＯと太陽光発電懇話会との契約が平成１１年９月２９日に締結されたとの報告がなされた。

続いて"平成１１年度　実施計画書"の概要説明並びに"ＩＥＡ Task Ⅸ 作業部会"の正式発足とメンバーの紹介が行われ、併せて太陽光発電懇話会の事業推進体制における位置付け説明が行われた。

5-2：推進体制について

事務局から活動を推進するための体制について諮り、次の体制が決定した。

部会主　査：谷 氏（日本エネルギー経済研究所）

副主査：吉野 氏（吉野コンサルタント事務所）

5-3：Task Ⅸ（開発途上国との協力による太陽光発電技術の展開）について

主査からＩＥＡ／ＰＶＰＳ Task Ⅸ の活動趣旨並びにＯＡから提示されているWark Planにつき説明がなされた。

5-4：キックオフ会議のＡgenda とその対応策について

主査からキックオフ会議は平成11年10月14～16日（オランダ:ﾕﾄﾚﾋﾄ）に開催される事の紹介があり、参加にあたって日本側の見解と対応を諮った。

その結果

- Task Ⅸ の狙いの確認及びＳub Task 10､20､30の詰めが第一とされた。
- 引続いてＰrovisional Ａgenda に則って対応方針を検討し、日本としてもSub Task 10､20､30には相応に関わることにすることを確認した。

尚　日本がＳub Task のなかでどれかのリーダーを受けざるを得ないとすれば、Ｓub Task 30である事とした。

・ＰＶＧＡＰについての対応は日本電機工業会（ＪＥＭＡ）が日本の窓口として活動している状況に鑑み、これ迄のＪＥＭＡの意向に沿った発言とする事を確認した。

・キックオフ会議には主査（谷 氏）と事務局（原田）が出席することとした。

5-5：その他

・今後の活動

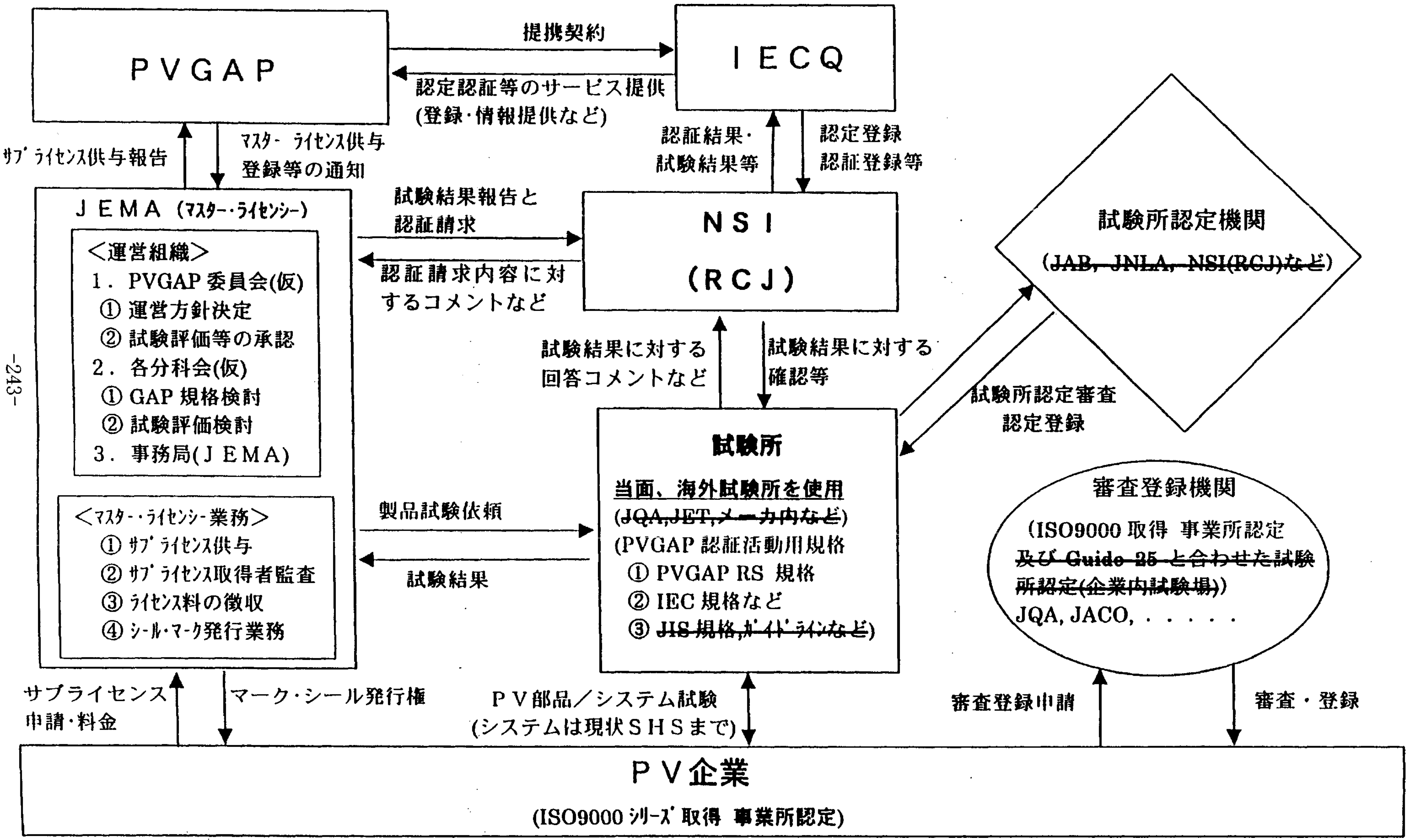
キックオフ会議の結果によってはメンバーの増強または当該専門家への呼び掛けも行うこととした。

・次回の会議予定

キックオフ会議の結果にもよるが、成るべく早い機会に開催することとした。

以上

<日本における<u>当面の</u> PVGAP 活動体制>：試験所として海外の登録試験所を用い、その試験結果に基づいて RCJ を通じて IECQ による認証を受ける。



May 27, 1999
技術部 亀田

「PVGAP における様々なギャップ」（取り扱いご注意！，少々独断と偏見が含まれているのであくまで参考資料です。）
～対発展途上国ビジネスの推進（マーケット対応の問題）～　※矢印の意味：GAP に対する関与の強さ=矢印の太さ。灰色はややﾈｶﾞﾃｨﾌﾞ。

欧米は必ずしもメーカとのｺﾝｾﾝｻｽﾍﾞｰｽで進んでいない。一部有力メーカの疑問の声もある。（TC82 事務局関連企業 S 社）

欧州・米国 PV メーカー（EPIA，SEIA）
- 欧州・米国ともにコンサルタント＆ベンチャーPV 企業が中心に活躍
- 市場は、国内より国外

IEC
- PVGAP は、TC の作業（規格作成）の遅延解消となるかも(ITA)？
- しかし、認証制度として IECQ は PV にマッチしてる？（TC82 議長）

協調関係を結んで作業も取りこんじゃおうか？

日本の PV メーカ（JEMA）
- 日本はｺﾝｾﾝｻｽﾍﾞｰｽで進めている。
- 本当にこの制度、発展途上国のためになるの？？？（これが原点）
- 日本の市場はほとんど国内。
- 日本には日本の市場にあった品質ｼｽﾃﾑが必要だなぁ。 GAP や IECQ は少々帯に短し、襷に長しか？
- 日本で現状試験が出来ない。

先進国製ﾓｼﾞｭｰﾙに問題などない。問題は....

PVGAP
太陽光発電システム
（発展途上国向け数百 W 独立型）
暫定規格＋認証制度
やります。
市場　お金

IEC/TC82（事務局は米国）
- WG のメンバーは欧米を中心にｺﾝｻﾙﾀﾝﾄ&ﾍﾞﾝﾁｬｰ PV 関係者が多い。
- ボランティアベースの作業。これまでの審議の遅れは否めない（特にシステム）。
- GAP との並行作業による弊害懸念
- 求心力の低下。

発展途上国（ｲﾝﾄﾞﾈｼｱ，中国，南ｱﾌﾘｶ，ｱﾙｾﾞﾝﾁﾝ，（インド））：少なくとも熱烈歓迎していない
- WTO 加盟問題と同じで、またまた高くつくものを押し付ける欧米のいじめだ。
- どうしてすでに君たちが作ったシステムがあるのに新たに作るの？？？
- 我々は我々のレベルに合ったもの作りをするし、十分できる自信がある。
- でも、作ったものを買ってもらいたいし.......

UNDP，各国政府：
- バンクがやるのなら..........

IECQ らしいクールな対応で

World Bank（仕掛人）
- 発展途上国のｽﾀﾝﾄﾞｱﾛｰﾝ･ｼｽﾃﾑの品質が劣悪ではせっかく投資した意味がない。
- 品質ｼｽﾃﾑが必要だ。誰かやって！
- お金は出すよ！

IECQ（国際的な電子部品認証制度）
～Only one standard～
- IECQ 以外の PV に向いた世界的認証制度はないはずだ。
- 大いに使ってもらえば宣伝にもなるしね。
- でも、あくまでも IECQ は IECQ、発展途上国版 IECQ とかいうのはないから誤解のないようにね！！

第２回　ＩＥＡ Task Ⅸ 作業部会　議事録

１．開催月日：平成１１年１１月１２日（金）　１３：３０～１７：００

２．開催場所：太陽光発電懇話会　８０４号　会議室

３．出席者：　京セラ㈱　佐倉ソーラーセンター　本多　潤一
（敬称略）　シャープ㈱　ソーラーシステム事業部　鳥喰　貞次
㈶日本エネルギー経済研究所 国際協力プロジェクト部　谷　隆之
吉野コンサルタント事務所　吉野　量夫
ＮＥＤＯ太陽技術開発室　脇　栄一
太陽光発電懇話会　原田　恒久

４．配布資料　1)ＩＥＡ／ＰＶＰＳ Task Ⅸ キックオフミーティグ報告
2)Work Ｐlan for Ｓub－Ｔask 30(Draft)
3)Ｓtand－Ａlone　Ａpplications TASK Ⅸ

５．議事内容

５-1：経過説明（谷　主査／原田）

５-2：Task Ⅸ　キックオフミーティグ報告と決定事項

資料1)に基づきキックオフミーティグ(10/14~16 ｵﾗﾝﾀﾞ:ﾕﾄﾚﾋﾄ) の報告が行われた。
要点は次の通り。

- ＯＡ(IT POWER:B.McNelis)による Task Ⅸ のワークプランの概説
- 出席者の自己紹介と各国の海外協力方針及び実績報告
- Ｓubtask10,20,30個々の活動方針とリーダーの選任
  Ｓubtask10 (Deployment infrastructur：Netherland)
  Ｓubtask20 (Support & Co-operation　：Switzerland)
  Ｓubtask30 (Technical & Economic Aspects of PV in Developing Countries)
  (Japan-encoraged & is considering)
- 作業推進概略予定
  ワークプランを1999/12/31迄に固める
  第２回　専門家会議は2000/Feb（モロッコ）を予定
  第３回　専門家会議は2000/Oct（インドネシア）を予定
- 14th PVPS Meeting of the Exec.Committee(19-20/Oct Oslo) にてTask Ⅸの報告、承認を頂く。

５-3：14th PVPS Meeting of the Exec.Committee 報告（NEDO　脇 氏）

ＯＡ(IT POWER:B.McNelis)からTask Ⅸキックオフ会議の報告がなされた。
しかし　ＵＫの支援が確定していない事もあってか、スポンサー企業名の紹介があり、ＩＥＡ／ＰＶＰＳ活動のあり方について論議されたが、基本合意された。

5 -4 : 今後の推進計画（案）の検討

部会長からWork Plan for Sub－Task 30(Draft) に基づき予想される作業について説明がなされ、検討を行った。

- Task Ⅸ の作業に深い関わりのあるTask Ⅲの調査結果資料の内容検討も行った。
  その結果
- Task Ⅸ の全体計画並びにTask Ⅰとの関連も念頭にして具体化検討する方が効果的であるとの見解となり、早急に基本となるWork Plan の確認をする事となった。
- その結果にもよるが、日本としてもSub Task10、20、30には相応に関わって行くことを確認した。

5 -5 : 次回の会議予定

国内作業部会は第２回　海外専門家会議（2000/Feb）に対応して開催する。

以上

第３回　ＩＥＡ Task Ⅸ 作業部会　議事録

１．開催月日：平成１２年１月１９日（水）　１３：３０～１７：００

２．開催場所：太陽光発電懇話会　８０４号　会議室

３．出席者： （敬称略）	京セラ㈱　佐倉ソーラーセンター	本多　潤一
	シャープ㈱　ソーラーシステム事業部	鳥喰　貞次
	昭和シェル石油㈱　新エネルギー部	長谷川　隆
	吉野コンサルタント事務所	吉野　量夫
	ＮＥＤＯ太陽技術開発室	脇　栄一
	太陽光発電懇話会	原田　恒久（事務局）

４．配布資料　1)第２回　ＩＥＡ Task Ⅸ 作業部会　議事録（案）
2)Work Ｐlan for Ｓub－Ｔask 30(Draft)
3)Ｔarget Ｃountry Ｉdentification Ｍatrix
4)第２回　海外専門家会議の予定について
5)NEDO“平成11年度　ＩＥＡ／ＰＶ対策部会”報告

５．議事内容

5-1：第２回　ＩＥＡ Task Ⅸ 作業部会　議事録（案）の確認
事務局より確認が行われ承認された。

5-2：Work Ｐlan for Ｓub－Ｔask 30の検討
－Ｓubtask30 (Technical & Economic Aspects of PV in Developing Countries)
前回の検討結果に基づく（改定）Work Ｐlan の詳細検討を行った。
各　Ｓub Task 30の各Ａctivity 共２０００／初頭から着手し、Ａctivity 毎の予定は下記の通りとして、ＯＡに回答する事とした。
- Ａctivity 31(Stand-alone PV)の予定は２００２／中期を一区切りとする。
- Ａctivity 32(Village & hybrid PV) の予定は２００３／中期を一区切りとする。
- Ａctivity 33(Grid connected PV) の予定は２００４／中期を一区切りとする。

5-3：Ｔarget Ｃountry Identification についての検討
ＯＡから提示されたＴarget Ｃountry Ｉdentification Ｍatrix 表に基づく案の詳細検討を行い、下記の修正（案）にてＮＥＤＯ及びＪＩＣＡにご了解を頂いた後、谷リーダーの意見も確認し、ＯＡに回答する事とした（集約表参照）
修正の要点：
- 業務経験のある対象国の見直し及び対象国での経験の内訳(机上調査か研究) の調整。
- PVに対する当該政府のポリシーいついて対象国及び評点の確認と見直し。

確認した評点基準：

1．資金借入をしても地方電化を推進したい国（日本も仕込んで行きたい）
2．当該国はPV導入に熱心（日本として積極的に進めるには？）
3．当該国の一部がPV導入に熱心しかし国レベルでのコンセンサスは？
4．当該国にPV導入に熱心な非政府組織（民間・大学）あり。
5．当該国にポテンシャシティはあるが未だ教育が必要。

5-4：第2回　海外専門家会議について（2/8~9 USA ﾜｼﾝﾄﾝDC ）

開催時期に谷リーダーが海外出張につき対応策を検討し、下記の通り確認した。

・専門家会議出席者は・サブリーダーの吉野 氏　・事務局　原田。
　尚　NEDOからも２名がオブザーバーとして出席予定との連絡があった。
・会議にて日本のＳubtask30（暫定）リーダーの交替を申入れる事を確認
・会議の結論に沿った作業には国内部会メンバーは積極協力する事を確認。

5-5：NEDO“平成11年度　ＩＥＡ／ＰＶ対策部会”報告

資料に基づき出席した事務局から全体的な報告並びにＳubtask30キックオフ会議の報告内容についての説明がなされた。

5-6：次回の会議予定

国内作業部会は第２回　海外専門家会議に対応して開催する予定。

以上

Target Country Identification Matrix

Country	In which of the countries below does your organization have in-country work experience?	In which of the countries have you undertaken desktop studies or research?	In which countries are you aware of planned, on-going or completed bilateral aid programmes from your country or elsewhere either in PV, with a PV component or with some other renewable energy component? Please also indicate whether or not the programme(s) were successful in your opinion.
Argentina			
Bolivia		X	JICA Project is on going
Brazil			
China	X		NEDO Project is on going (Technical Collaboration)
Guatemala			
Honduras			
Indonesia	X	X	JICA Project is planned
India			
Kenya			
Mexico			
Morocco	X	X	JICA Master plan of rural electrification for a district had been done
Philippines		X	
Sri Lanka			

South Africa			
Syria	X		JICA Technical Cooperation project is on going
Thailand	X	X	NEDO Project had been done (Technical Collaboration)
Vietnam		X	NEDO Project is on going (Technical Collaboration)
Zimbabwe	X	X	JICA Technical Cooperation project had been done
Nepal	X		NEDO Project had been done (Technical Collaboration)
Laos	X	X	JICA Technical Cooperation project is on going
Mongolia	X		NEDO Project had been done (Technical Collaboration) JICA Technical Cooperation project is on going
Senegal	X		JICA Technical Cooperation project is on going
Malaysia	X		JICA Project is planned
Botswana			JICA Project is planned
Island Countries:			
Cook Islands			
French Polynesia			
Tuvalu			
Kiribati	X		JICA Technical Cooperation project had been done

Contries in Bold are added.

Country	For which of the following countries do you have access to high quality data (that would be available to Task IX) on the status of the PV market - applications, installed capacity, active companies etc?	To which of the following countries would you be able to undertake a mission if this were necessary? (This may include countries you would visit as part of other projects etc and that you would be able to devote some time gathering information for Task 9)
Argentina		
Bolivia	(x)	
Brazil		
China	X	(X)
Guatemala		
Honduras		
Indonesia	(X)	
India		
Kenya		
Mexico		
Morocco		
Philippines	(X)	
Sri Lanka		
South Africa		
Syria	X	(X)
Thailand	(X)	

Vietnam	(X)	
Zimbabwe	X	(X)
Nepal		
Laos	(X)	
Mongolia	(X)	
Senegal	X	X
Malaysia	(X)	
Botswana	(X)	
Island Countries:		
Cook Islands		
French Polynesia	(X)	
Tuvalu	(X)	
Kiribati	X	(X)

X: Available (X): may be possible

Country	How would you judge government policy to be in terms of supporting PV? (Please score on a scale of 1 to 5 with 1 being very favourable, 5 being unfavourable).	Which countries would you or your funding organisation like to see included as a Task IX target country?	For information, the following countries were included in the Task III Survey Report
Argentina	2		
Bolivia	3		
Brazil	2		Y
China	1	X	
Guatemala	3		
Honduras	3		
Indonesia	2	X	Y
India	2		Y
Kenya	4		Y
Mexico			Y
Morocco	2	X	Y
Philippines	3	X	Y
Sri Lanka	2		
South Africa	1	X	Y
Syria	3		
Thailand	1	X	Y

Vietnam	3	X	Y
Zimbabwe	3		
Nepal	4		
Laos	3	X	
Mongolia	1	X	
Senegal	3		
Malaysia	3		
Botswana	2		
Island Countries:			
Cook Islands			Y
French Polynesia			Y
Tuvalu	5		Y
Kiribati	2	X	

Target Country Identification Matrix

GG:iea92005

Country	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Latin America								
Argentina						2		
Bolivia		X	JICA on going	(X)		3		
Brazil						2		Y
Guatemala						3		
Honduras						3		
Mexico								Y
Asia								
China	X		NEDO on going	X	(X)	1	X	
Indonesia	X	X	JICA completed NEDO completed JICA planning	(X)		2	X	Y
India						2		Y
Laos**	X	X	JICA on going	(X)		3	X	
Malaysia	X		NEDO completed JICA planning	(X)		3		
Mongolia**	X		NEDO completed JICA on going	(X)		1	X	
Nepal**	X		NEDO completed			4		
Philippines		X		(X)		3	X	Y
Sri Lanka						2		
Thailand	X	X	NEDO completed NEDO on going	(X)		1	X	Y
Vietnam		X	NEDO on going	(X)		3	X	Y
Islands Countries								
Cook Island						?		Y
French Polynesia				(X)		?		Y
Kiribati	X		JICA completed	X	(X)	2	X	
Tuvalu				(X)		5		Y
Middle East								
Syria	X		JICA on going	X	(X)	3		
Africa								
Botswana**			JICA planning	(X)		2		
Kenya						4		Y
Morocco	X	X	JICA completed*			2	X	Y
Senegal**	X		JICA on going	X	X	3		
South Africa						1	X	Y
Zimbabwe**	X	X	JICA completed	X	(X)	3		

* Master plan only
** Countries are added to the list
X: available (X): may be possible

(1) In which of the countries does your organization have in-country work experience ?
(2) In which of the countries have you undertaken desktop studies or research ?
(3) In which countries are you aware of planned, on-going or completed bilateral aid programmes from your country or elsewhere either in PV, with a PV component or with some other renewable energy component ?
Please also indicate whether or not the programme(s) were successful in your opinion.
(4) For which of the following countries do you have access to high quality data (that would be available to Task IX) on the status of the PV market-applications, installed capacity, active companies etc ?
(5) To which of the following countries would you be able to undertake a mission if this were necessary ?
(This may include countries you would visit as part of other projects etc. and that you would be able to devote some time gathering information for Task IX.)
(6) How would you judge government policy to be in terms of supporting PV ? (Please score on a scale of 1 to 5 with 1 being very favourable, 5 being unfavourable).
(7) Which countries would you or your funding organization like to see included as a Task IX target country ?
(8) For information, the following countries were included in the Task III Survey Report

5．関連資料

1）Ｔａｓｋ III
Stand-Alone Applications (1996)
2）ＰＶ ＧＡＰ (1999) QUALITY MANAGEMENT IN ＰＶ (TRAINING MANUAL)

Foreword

The International Energy Agency (IEA), founded in November 1974, is an autonomous body within the framework of the Organisation for Economic Co-operation and Development (OECD) which carries out a comprehensive programme of energy co-operation among its 24 member countries. The European Commission also participates in the work of the Agency.

The IEA Photovoltaic Power Systems (PVPS) Programme is one of the collaborative R&D agreements established within the IEA and, since 1993, its Participants have been conducting a variety of joint projects in the applications of photovoltaic conversion of solar energy into electricity.

The overall programme is headed by an Executive Committee composed of one representative from each participating country, while the management of individual research projects (Tasks) is the responsibility of Operating Agents. Currently seven tasks have been established. The twenty-one members of the PVPS Programme are:

Australia (AUS), Austria (AUT), Canada (CAN), Denmark (DNK), European Commission, Finland (FIN), France (FRA), Germany (DEU), Israel (ISR), Italy (ITA), Japan (JPN), Korea (KOR), Mexico (MEX), Netherlands (NLD), Norway (NOR), Portugal (PRT), Spain (ESP), Sweden (SWE), Switzerland (CHE), United Kingdom (GBR), United States (USA).

This International Technical Report has been prepared under the supervision of PVPS Task III by:

Jonathan Bates and Alison Wilshaw
IT Power Ltd, United Kingdom (GBR)

in co-operation with experts of the following countries: Australia, Canada, Finland, France, Germany, Italy, Japan, Korea, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland.

The report expresses, as nearly as possible, a consensus of opinion of the Task III experts on the subjects dealt with.

SHORT ABSTRACT AND KEYWORDS

The International Energy Agency (IEA) is an autonomous body within the Organisation for Economic Co-operation and Development (OECD) formed to encourage co-operative ventures among the 24 member nations. The Agency's efforts include efforts into the research, development and demonstration of new energy technologies.

The Implementing Agreement on Photovoltaic Power Systems was initiated to assist in the development of the world photovoltaic market. The agreement is divided into seven tasks, of which Task III deals with Photovoltaic Power Systems in Stand-alone and Island Applications. Within this Task, applications in developing countries are considered of special interest.

In an effort to accelerate the implementation of stand-alone and island photovoltaic power systems in developing countries, it was realised that a number of steps needed to be taken. Firstly, an understanding of the current state of the photovoltaic industry in developing countries needed to be formulated. Secondly, the barriers to the increased use of photovoltaic power systems needed to be identified. Thirdly, methods of addressing the identified barriers needed to be determined.

To develop an industry baseline, the Task III Experts each completed a survey on a selected developing country. The information provided was collated with data drawn from other sources and a report produced, comparing social and geographic, economic and political, and industrial parameters.

By comparing the successes that different policies and project approaches have engendered, as well as drawing information from other sources, the market barriers preventing the wide-spread implementation of photovoltaic power systems were identified.

Keywords: developing countries, stand-alone PV, survey, renewable energy programmes, rural electrification.

ACKNOWLEDGEMENT

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4. PV Programme Experiences and Policy Issues
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Figure 7: Installed PV power per capita in the surveyed countries

Executive Summary

This report is a summary of photovoltaic programmes and applications in selected developing countries as of the end of 1996. The information in the report is based partly on questionnaires completed by the various national experts appointed to Task III and partly on research by the report authors.

The report aims to provide a basic understanding of the state of the photovoltaic market in developing regions of the world at the end of 1996, and to highlight the perceived market barriers to the accelerated implementation of photovoltaic power systems. The countries surveyed are: Brazil, The Cook Islands, The Dominican Republic, Ethiopia, French Polynesia, Ghana, India, Indonesia, Kenya, Malaysia, Mongolia, Morocco, Namibia, The Philippines, Senegal, South Africa, Tanzania, Thailand, Tuvalu, Uganda and Vietnam.

Economic and political aspects

The report details the key demographic and geographic data for reach of the countries in the survey. These data varied very widely between the countries surveyed indicating the wide disparity of conditions in the various countries: land areas ranged from that of Brazil, encompassing 8 460 000 km^2 to Tuvalu, occupying 26 km^2. Population densities ranged from less than 2 people per square kilometre in Mongolia to 380 people per square kilometre in Tuvalu. Literacy rates ranged from an estimated 100 % in French Polynesia to 24 % in Ethiopia. Urban populations ranged from an estimated 79 % in Brazil to 12 % in the Cook Islands.

Key economic data were also presented in the report as these need to be considered when assessing the state of a given market. Poverty levels, as given by the population on an income of less than 1 USD per day, ranged from a high of 69.3 % in Uganda to less than 2 % in Morocco and Thailand. Consumer price indices ranged from over 640 % in Brazil (this figure has reduced significantly since 1996) to 1.5 % in French Polynesia. GDP per capita in the surveyed countries ranged from 103 USD in Ethiopia to 7 554 USD in French Polynesia.

Electrification status

Data on the status of current electricity generating capacity and production was collected and these are summarised in

Table 1. From the Table the wide range in electricity generating capacity and generation can be seen., with per capita electricity generation ranging from 4 916 kWh in South Africa (which was a net exporter of electricity) to 22 kWh in Ethiopia.

Table 1: Estimated electrical capacity and generation[1] and population without access to electricity.

Country	Electricity Generation Capacity 1995 (GW)	Electricity Generation 1995 (GWh)	Electricity Generation per capita (kWh/capita)	Unelectrified population (%)[2]
Brazil	63.77	275 000	1 711	12
Cook Islands[3]	0.014	21	420	NA
Dominican Republic	2.28	6 500	813	NA
Ethiopia	0.33	1 300	22	90
French Polynesia	0.075	275	1 250	12
Ghana	1.8	6 200	344	60
India	81.2	415 000	439	68
Indonesia	11.6	61 200	311	70
Kenya	0.73	3 700	137	90
Malaysia	8	45 500	2 167	19
Mongolia	1.25	NA	NA	60
Morocco	2.4	12 000	444	75
Namibia	0.406	994	925	90
Philippines		29 700	413	45
Senegal	0.215	900	100	75
South Africa	46	187 000	4 916	33
Tanzania	0.405	1 800	60	96
Thailand	10	80 100	1 335	27
Tuvalu	0.0026	3	306	NA
Uganda	0.2	610	31	95
Vietnam		14 400	192	80

Of the surveyed countries, Brazil, India and South Africa had operational nuclear reactors, although they were not reliant to any great degree upon nuclear power. Brazil and Uganda both relies upon hydropower for more than 90 % of electricity generation, while Mongolia, Senegal, South Africa, Ghana and Morocco relied on traditional thermal generation for over 90 %. Of the remaining countries, Indonesia, Malaysia, and the Dominican Republic were heavily reliant upon thermal generation while Ethiopia and Kenya were reliant upon hydropower.

1 World Development Indicators 1998, The World Bank.
2 UK Department of International Development unless stated
3 World Factbook 1997 (http://www.odci.goc/cia/publications/factbook/country.html)

Estimations of the population in each country without access to electricity services were obtained and these ranged from as high as 96 % in Namibia to 12 % in each of Brazil and French Polynesia.

PV programme experiences and policy issues

All of the countries included in the survey had had some experience with stand-alone photovoltaic power systems. For many of the countries, this was largely been for social / health / educational applications, often funded by international agencies and installed as demonstration or pilot programmes. However, a number of countries had developed a commercial PV industry independently of large scale aid projects. Particularly important from this perspective were the industries in Kenya, the Dominican Republic and Namibia.

The installed PV power as of the end of 1996 is shown for each of the surveyed countries in Table 3. It is estimated that the total PV power installed in the surveyed countries was in the region of 53 MWp with over half of this installed in India.

Table 3: Estimated installed PV power at the end of 1996 in the surveyed countries.

Country	PV power installed at the end of 1996 (kW_p)	Country	PV power installed at the end of 1996 (kW_p)
Brazil	2 000	Morocco	1 000
Cook Islands	NA	Namibia	800
Dominican Republic	225	Philippines	133
Ethiopia	NA	Senegal	800
French Polynesia	NA	South Africa	5 500
Ghana	350	Tanzania	NA
India	35 000	Thailand	2 500
Indonesia	1 800	Tuvalu	50
Kenya	2 000	Uganda	150
Malaysia	640	Vietnam	100
Mongolia	80	**TOTAL**	53 078

The countries with the highest total peak power installed at the end of 1996 were Brazil, Kenya, India, South Africa and Thailand, which accounted for 47 MWp. The cumulative installed V power per capita ranged from a high of 5.05 Wp in Tuvalu and 0.4 Wp in Namibia to 1.85 mWp in the Philippines and 1.33 mWp in Vietnam. It is interesting to note that the governments of those countries with the highest PV installed per capita were actively supportive of PV and, with the exception of Senegal, had an active private sector PV industry. In Morocco, Senegal and Tuvalu, large PV programmes funded by bilateral agencies had been implemented and these had been generally successful in ensuring continued government support. In Namibia and Thailand the PV industry had developed mainly through the active support of the national governments and in the absence of large aid programmes.

PV had been used for a variety of applications in the surveyed countries. In India, PV had been used in many applications including water pumping, street lighting systems, solar home systems and solar lanterns as well as large scale (>100 kWp) PV power plants and telecommunications. PV in South Africa had been largely used in solar home systems, water pumping, electrification of schools and clinics as well as in professional applications such as telecommunications. In Thailand, PV had been installed for village battery charging stations, schools and clinics and water pumping applications. In Brazil, the first PV applications were for telecommunication relay stations but since 1992, PV had been used in solar home systems, schools and water pumping. In Kenya, PV had been largely used for solar home systems and solar lanterns, almost entirely in the private sector.

Many countries had plans with regard to the electrification of rural areas. A number of countries had policies and targets for rural electrification that explicitly included reference to the use of PV and/or other renewable energy sources. A summary of existing programmes on rural electrification and PV and the status of import duties and tariffs in the surveyed countries is given in the main report.

Many of the surveyed countries had developed and implemented coherent plans focused on encouraging the growth of the photovoltaic industry. The various programmes were not comparable, as the size of the populations being served were very different and the goals of the programmes quite different. Indonesia was attempting to develop a rural infrastructure for both supplying electrification and supplying credit on a massive scale, while Tuvalu and French Polynesia, with small populations, were attempting to achieve electrification with PV almost entirely as a demonstration project. The Malaysian government, in contrast, was leaving the development of the industry almost entirely to the private sector in the belief that PV should only be implemented on an economically justifiable basis.

In countries with limited governmental interest in promoting PV systems on a wide scale, private sector interest and internationally funded Aid projects can support industrial activity to some degree. Kenya had a thriving private sector photovoltaic industry, although it was supported by Aid projects throughout the region and its success was largely due entirely to the private sector. The Dominican Republic had also developed a successful private sector industry despite confusing government policies and tariffs, although the industry suffered from some difficulties in the development of customer finance mechanisms. The PV industry in Namibia had also developed independently of large scale aid programmes, although there had been government support for the technology.

Domestic PV industries

Many of the survey countries lacked the industrial base and trained technicians required to produce all of the components of a photovoltaic power system. However, the production of PV modules from cells bought on the international market or manufactured by parent companies overseas took place in a number of countries including South Africa, Thailand and Vietnam. There were three companies in India involved in the manufacture of PV cells, as well as module manufacture. Facilities for module manufacture did exist in Brazil but these were no longer in production.

Most of the countries had the ability to produce some, if not all, of the components for a stand-alone PV system. These typically included charge controllers, batteries, DC lamps, wiring etc. Most of the batteries that were manufactured were automotive batteries rather than the more expensive solar batteries.

Demonstration programmes had encouraged the creation of photovoltaic firms for assembling and installing components in all of the countries surveyed; however, many of these firms were dormant between projects, as the local market volume was too low to sustain employment.

Financing Options

One of the common features among the survey countries was the lack of finance available for the purchase of PV systems, either through cash sales or through affordable credit. This was especially problematic in rural areas, where the population was often reliant upon subsistence agriculture and informal employment. As this demographic group represented the largest market for stand-alone photovoltaic power systems, the problem of finance needs to be addressed in order to develop the potential market.

In general, many of early demonstration projects were not implemented with any intention of recovering costs, and many public sector projects follow this tradition. Electrification of medical clinics and schools was usually performed on a grant basis, and only recently had solar pumping projects begun to attempt cost recovery. Cost recovery was seen as both inducing a sense of ownership on the part of the people paying for the system and providing funds to sustain the project beyond initial installation.

Three main methods of developing the necessary infrastructure were being used in the survey nations: strengthening local lending bodies, expanding state owned enterprises, and encouraging private sector development. The majority of the projects covered by the surveys relied upon funding from Non-Governmental Organisations (NGOs) and bilateral grants.

Attempts to either strengthen traditional lending mechanisms or introduce culturally sympathetic mechanisms among the local population had achieved a level of success. With the assistance of NGOs, revolving credit schemes and local credit co-operatives were both used frequently as a means of distributing available funds to the consumers. The advantages of these schemes included the strengthening of social ties within the community and the minimal administration costs.

The success of PV in both Namibia and Kenya was largely a result of private sector demand in the absence of any large scale donor funded electrification programmes. There were no specific financing schemes in either country for solar home systems, although hire purchase schemes finance as many as 2 000 solar home systems per year in Kenya. It was estimated that as many as 50 000 solar home systems had been sold on a commercial basis in Kenya and 2 000 in Namibia, with a further 2 000 systems sold for installation in schools, clinics, community farms and shops. The hire purchase schemes were generally over 12 or 24 month period and interest levels could be as high as 40 %.

More recently the concept of the Energy Service Company or ESCO, has been pioneered in South Africa. These companies can be a PV manufacturer, a local electricity utilities, who own and maintain the PV system and charge either a flat monthly rate or according to the energy consumed.

1. Introduction

The International Energy Agency (IEA) formed an agreement in 1993 with the intention of accelerating the implementation of photovoltaic systems through improvements in cost effectiveness and the opening of new markets. This agreement, the Photovoltaic Power Systems Programme, was originally divided into 6 Task areas, each dealing with a different aspect of photovoltaic power systems (PVPS):

- Task I: Exchange and dissemination of information on photovoltaic power systems.
- Task II: Operational performance and design of photovoltaic power systems and subsystems.
- Task III: Use of photovoltaic power systems in stand-alone and island applications.
- Task V: Design and grid interconnection of building integrated and other dispersed photovoltaic systems.
- Task VI: Design and operation of modular photovoltaic plants for large scale power generation.
- Task VII: Photovoltaics in the built environment.
- Task VIII: Very large-scale photovoltaic power generation systems in remote areas.
- Task XI: Deployment of photovoltaic technologies: co-operation with developing countries.

1.1 Task III Objectives

Task III is subdivided into three groups, each focusing upon one issue intended to demonstrate the "added value" which international co-operation can bring to the photovoltaic market, specifically with regard to stand-alone and island systems. Group A, under which this report falls, is focused upon the implementation of stand-alone PV programmes. As such, it includes the application of PV in developing countries, and has involved collaborating with institutes in developing countries and international organisations to encourage the widespread use of stand-alone PV systems.

1.2 Survey Objectives

This report is, in part, based on questionnaires completed by Task III IEA PVPS experts from participating countries concerning the state of the photovoltaic industry in a particular country. The surveys were intended to provide a basic understanding of the current state of the photovoltaic market in developing regions of the world, and to highlight the perceived market barriers to the accelerated implementation of photovoltaic power systems. Where the data provided by the questionnaires was insufficient, further research was undertaken by the authors.

The survey focused upon past renewable energy programmes: how many there have been; how they were perceived by officials and consumers; what the local and national government policy issues have been; and how the programmes have affected the technical, financial and institutional infrastructure of the country. By investigating these issues, it was anticipated that an overview of the ability of each country to implement and support sustainable PV programmes would be derived. This report is the result of this activity.

1.3 Participation and Data

The following countries have been examined: fourteen by Task III participants in the survey and a further seven countries surveyed by IT Power Ltd. The countries are detailed in Table 4.

Table 4: Countries surveyed by Task III experts and IT Power

Countries surveyed by Task III experts.	ISO Country Code	Countries surveyed by IT Power.	ISO Country Code
Brazil	BRA	Dominican Republic	DOM
Cook Islands	COK	Ghana	GHA
Ethiopia	ETH	Kenya	KEN
French Polynesia	PYF	Philippines	PHL
India	IND	South Africa	ZAF
Indonesia	IDN	Uganda	UGA
Malaysia	MYS	Vietnam	VNM
Mongolia	MNG		
Morocco	MAR		
Namibia	NAM		
Senegal	SEN		
Tanzania	TZA		
Thailand	THA		
Tuvalu	TUV		

The selection of countries surveyed was made by the individual Task III experts, with each National expert providing data on a selected country. In order to try and provide a more balanced selection, seven additional countries were surveyed by IT Power. Additional data from the surveyed countries were also provided by the authors. Countries were selected on the basis of the state of the PV market. The report has a bias towards Asia and Africa and, apart from Brazil, has not really addressed Central and South America.

The economic data for this report and the Country Reports have been sourced from the World Bank, World Development Indicators 1998. The data in this publication is mostly for 1996.

The percentage of the population without access to electricity, or unelectrified was difficult to ascertain as it was dependent upon the exact definition of access. In this report the population without access to electricity has been taken to be the percentage of the population without an electricity connection. It is important to distinguish this from the definitions that relate to the percentage of population or country covered by the electricity distribution system.

It was very difficult to obtain data for the population that did not have electricity supply as national statistics do not tend to include this information. As far as possible data supplied by the UK Department for International Development has been used although data was not available for the Cook Islands, Dominican Republic, French Polynesia, Ghana, Mongolia, Morocco, Senegal or Tuvalu from this source.

1.4 Survey Limitations

The survey was based initially on questionnaires distributed to the Task III National Experts. The questionnaire was designed to provide information on the status of the PV market in each country. The information was often based on the individual experts' knowledge of a particular country.

The PV market globally is in a state of unprecedented expansion, with global shipments of PV modules from IEA member countries in the region of 100 MWp in 1998[4]. The situation in many of the countries surveyed is in a continual state of change and this report provides an overview of the status of PV in these countries as of the end of 1996.

[4] IEA PVPS Report 1-06: 1998: *Trends in PV Power Applications in selected IEA countries between 1992 and 1996.*

2. Economic and Political Aspects

The key demographic and geographic data varied very widely between the countries surveyed. Table 5 shows approximate land area, population figures, population densities and population growth rates from the surveyed countries as well as percentage urban population and literacy rates.

The figures indicate the large disparities amongst the surveyed nations: country areas ranged from that of Brazil, encompassing 8 460 000 km^2 to Tuvalu, occupying 26 km^2. Population densities ranged from less than 2 people per square kilometre in Mongolia to 380 people per square kilometre in Tuvalu. Literacy rates ranged from an estimated 100 % in French Polynesia to 24 % in Ethiopia. Urban populations ranged from an estimated 79 % in Brazil to 12 % in the Cook Islands.

Table 5: Population details of surveyed countries[5]

Country	Population ($x10^3$)	Land area (km^2)	Population density (inhabs per km^2)	Population growth rate (1980-96)	Urban population (1996)	Literacy (%)
BRA	161 000	8 460 000	19.0	1.8 %	79 %	83
COK	20[6]	240[6]	83.3	1.08 % (1995)[6]	NA	80[7]
DOM	8 000	48 000	166.7	2.1 %	63 %	83
ETH	58 000	1 100 000	52.7	2.7 %	16 %	24
PYF	233[3]	3 660[6]	64.7	1.89 % (1995)[6]	NA	100[7]
GHA	18 000	228 000	78.9	3.1 %	36 %	60
IND	945 000	3 287 000	287.5	2.0 %	27 %	52
IDN	197 000	1 812 000	108.7	1.8 %	36 %	77
KEN	27 000	569 000	47.5	3.1 %	30 %	69
MYS	21 000	329 000	63.8	2.5 %	54 %	78
MNG	3 000	1 570 000	1.9	2.6 %	61 %	83
MAR	27 000	446 000	60.5	2.1 %	53 %	35
NAM	2 000	823 000	2.4	2.7 %	37 %	38
PHL	72 000	298 000	241.6	2.5 %	55 %	95[6]
SEN	9 000	193 000	46.6	2.7 %	44 %	38
ZAF	38 000	1 220 000	31.1	2.0 %	50 %	76
TZA	30 000	884 000	33.9	3.1 %	25 %	46
THA	60 000	511 000	117.4	1.6 %	20 %	94
TUV	10[6]	26[6]	380.8	1.45 % (1995)[6]	NA	NA
UGA	20 000	200 000	100.0	3.5 %	13 %	48
VNM	75 000	325 000	230.8	2.1 %	19 %	94[6]

Figures regarding population density must however be taken on the understanding that they varied greatly within a country. For instance, the

5 World Development Indicators 1998, The World Bank.
6 World Factbook 1997 (http://www.odci.goc/cia/publications/factbook/country.html)
7 Task III Expert

population of Brazil was clustered mainly along the Atlantic coastal plane, such that the population density in these areas was far higher than the statistics indicate, whereas the interior was very sparsely populated. This has had an influence on the development of these countries in that they have concentrated on providing services to the urban populations rather than meeting the needs of the isolated rural population.

Statistics for French Polynesia, The Cook Islands as well as Tuvalu, were also interesting in that although the population densities were not especially low, the population was scattered on a number of small isolated islands making central electricity generation impractical. The small and dispersed nature of the population makes countries such as these prime candidates when considering renewable energy programmes. Indonesia, the Philippines, and to a lesser extent Malaysia, suffer from the same population dispersion, but have much larger populations.

The traditional Mongolian lifestyle of nomadic animal husbandry, with seasonal migrations determined by the growing seasons, meant that the basic population density figure is unlikely to be statistically significant. This lifestyle also makes it difficult to develop a centralised power distribution system to supply the large rural population.

The higher population growth rates, such as those seen in Ethiopia, Ghana, Kenya, Namibia, Senegal, Tanzania and Uganda, were often linked with poorer countries. With limited economic capacity to provide funding for infrastructure development, these countries - together with Morocco, and South Africa - had large areas of scattered villages engaged in subsistence agriculture.

Thailand and Malaysia, both Pacific Rim nations, have a very definite split between urban and rural populations. Urban areas tend to be westernised and technically advanced, while the rural areas maintain traditional lifestyles. The rapidity with which development has occurred in the urban areas has left much of the rest of the country lagging behind, as resources have been focused upon maintaining growth in industrialised areas.

The economic indicators of Gross Domestic Product (GDP), growth rate and inflation rate are given in Table 6, along with estimates of the population with an income less than 1 USD per day and the consumer price index.

Table 6: Economic indicators of countries surveyed[8]

Country	GDP 1996 (MUSD)	GDP per capita (USD)	GDP growth rate 1990-96	Consumer Price Index 1990-96	Population below 1 USD/day[9]
Brazil	749 000	4 652	2.9 %	643.9 %	23.6 % (95)
Cook Islands	57 (1993)[10, 11]	2 850 (1993)[10,11]	8.7 % (1995)[11]	5.8 % (1994)[11]	NA
Dominican Republic	13 200	1 646	4.7 %	10.9 %	19.9 % (89)
Ethiopia	5 990	103	3.9 %	8.9 %	46 % (82)
French Polynesia	1 760 (1993)[10,11]	7 554 (1995)[10,11]	NA	1.5 % (1994)[11]	NA
Ghana	6 340	352	4.4 %	29.8 %	NA
India	356 000	377	5.8 %	9.9 %	52.5 % (92)
Indonesia	226 000	1 146	7.7 %	8.8 %	11.8 % (95)
Kenya	9 220	342	1.9 %	23.5 %	50.2 % (92)
Malaysia	99 213	4 724	8.7 %	4.2 %	5.6 % (89)
Mongolia	972	324	3 %[11]	53 % (1996)[11]	NA
Morocco	36 800	1 364	2.1 %	5.5 %	<2 % (91)
Namibia	3 230	1 615	4.1 %	11.2 %	NA
Philippines	83 800	1 164	2.9 %	9.5 %	28.6 % (91)
Senegal	5 160	573	1.8 %	7.6 %	54.0 % (94)
South Africa	126 000	3 324	1.2 %	10.4 %	23.7 % (93)
Tanzania	5 840	195	3.2 %	26.8 %	10.5 % (93)
Thailand	185 000	3 084	8.3 %	4.8 %	<2 % (92)
Tuvalu	7.8 (1995)[10,11]	788 (1995)[10,11]	NA	2.9 % (1989)[11]	NA
Uganda	6 120	306	7.2 %	16.9 %	69.3 % (90)
Vietnam	23 300	311	8.5 %	6.0 %[7]	NA

As can be seen from the figures in Table 2, the economic development of the surveyed countries, as measured by GDP, varied widely. Due to the wide variations in population, the overall productivity of the countries is less indicative of the relative wealth of the citizens than the value of per capita GDP. However, GDP per capita figures can be misleading, as in many of the countries there is a large disparity between the relative wealth of the poorest sections of society and the richest.

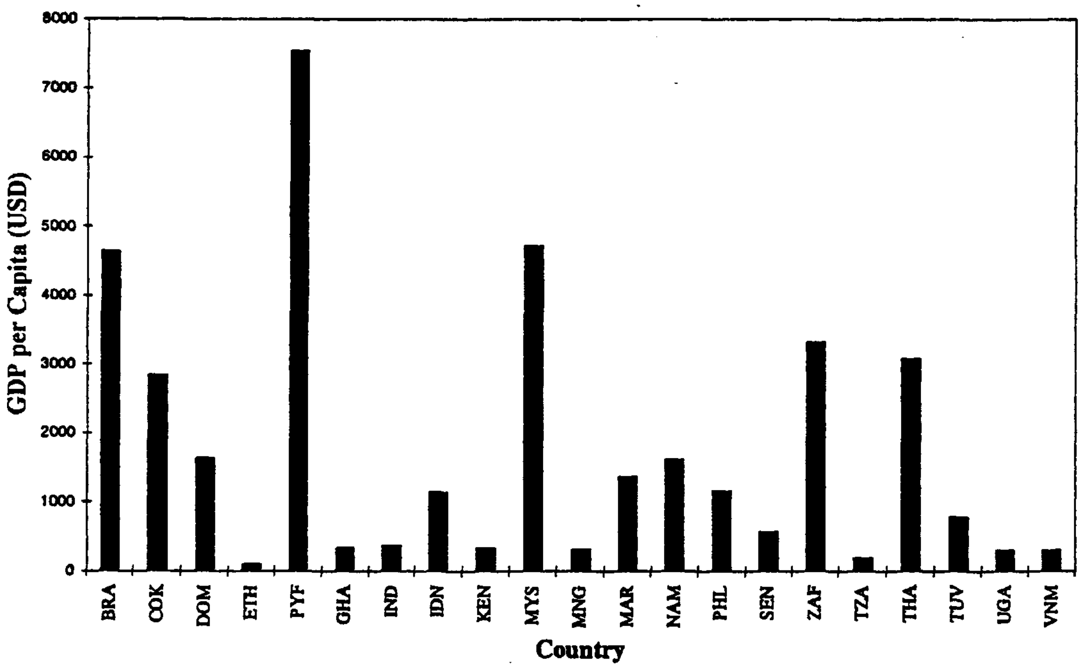
8 World Development Indicators 1998, The World Bank.
9 Year of data in brackets
10 Purchasing power parity
11 World Factbook 1997 (http://www.odci.goc/cia/publications/factbook/country.html)

The population on an income of less than 1 USD per day ranged from a high of 69.3 % in Uganda to less than 2 % in Morocco and Thailand. Consumer price indices ranged from over 640 % in Brazil (this figure has reduced significantly since 1996) to 1.5 % in French Polynesia. The economic indicators for French Polynesia must be interpreted in the light of the fact that in 1996 nearly a third of the nation's GDP was transfer payments from the French government.

It was difficult to obtain data on the economic development of Mongolia, as it was still in transition after a period of centrally planned economic activity under a communist government. As the economy was liberalised and state owned enterprises privatised, statistics were overcome by events.

GDP per capita figures are shown graphically in Figure 1. GDP per capita in the surveyed countries ranged from 103 USD in Ethiopia to 7 554 USD in French Polynesia.

Figure 1: GDP per capita in the surveyed countries.



3. Electrification Status

Table 7 provides the estimated electricity generation capacity, annual electricity generation, per capita generation figures and transmission losses for the survey nations. Again, the per capita estimations must be taken in the light of the fact that there were a wide disparity of living conditions, as highlighted in Section 2 of this report.

Table 7: Estimated electrical capacity, production and transmission losses[12]

Country	Electricity Generation Capacity 1995 (GW)	Electricity Generation 1995 (GWh)	Electricity Generation per capita (kWh/capita)	Transmission & distribution losses 1995 (%)
Brazil	63.77	275 000	1 711	17
Cook Islands[13]	0.014	21	420	NA
Dominican Republic	2.28	6 500	813	25
Ethiopia	0.33	1 300	22	3
French Polynesia[13]	0.075	275	1 250	NA
Ghana	1.8	6 200	344	4
India	81.2	415 000	439	18
Indonesia	11.6	61 200	311	12
Kenya	0.73	3 700	137	16
Malaysia	8	45 500	2 167	10
Mongolia	1.25	NA	NA	NA
Morocco	2.4	12 000	444	4
Namibia	0.406	994	925	NA
Philippines		29 700	413	16
Senegal	0.215	900	100	13
South Africa	46	187 000	4 916	6
Tanzania	0.405	1 800	60	13
Thailand	10	80 100	1 335	8
Tuvalu[13]	0.0026	3	306	NA
Uganda	0.2	610	31	NA
Vietnam		14 400	192	22

South Africa had an excess of generating capacity and exported electricity to its neighbours. The country had instituted an ambitious plan to connect more users

12 World Development Indicators 1998, The World Bank.
13 World Factbook 1997 (http://www.odci.goc/cia/publications/factbook/country.html)

to the national distribution grid. This plan is unlikely to extend out into the rural areas, due to the high costs involved in large scale grid extension and the large population in urban areas without access to electricity, and so should not be seen as competing with stand-alone photovoltaic applications.

Brazil, India and South Africa had operational nuclear reactors, although they were not reliant to any great degree upon nuclear power. The ability to operate and maintain nuclear power stations indicated the ability to produce highly trained technicians and engineers.

Brazil and Uganda both relies upon hydropower for more than 90 % of electricity generation, while Mongolia, Senegal, South Africa, Ghana and Morocco relied on traditional thermal generation for over 90 %. Of the remaining countries, Indonesia, Malaysia, and the Dominican Republic were heavily reliant upon thermal generation while Ethiopia and Kenya were reliant upon hydropower. Details of the breakdown of electricity generation are given in Figure 2[14].

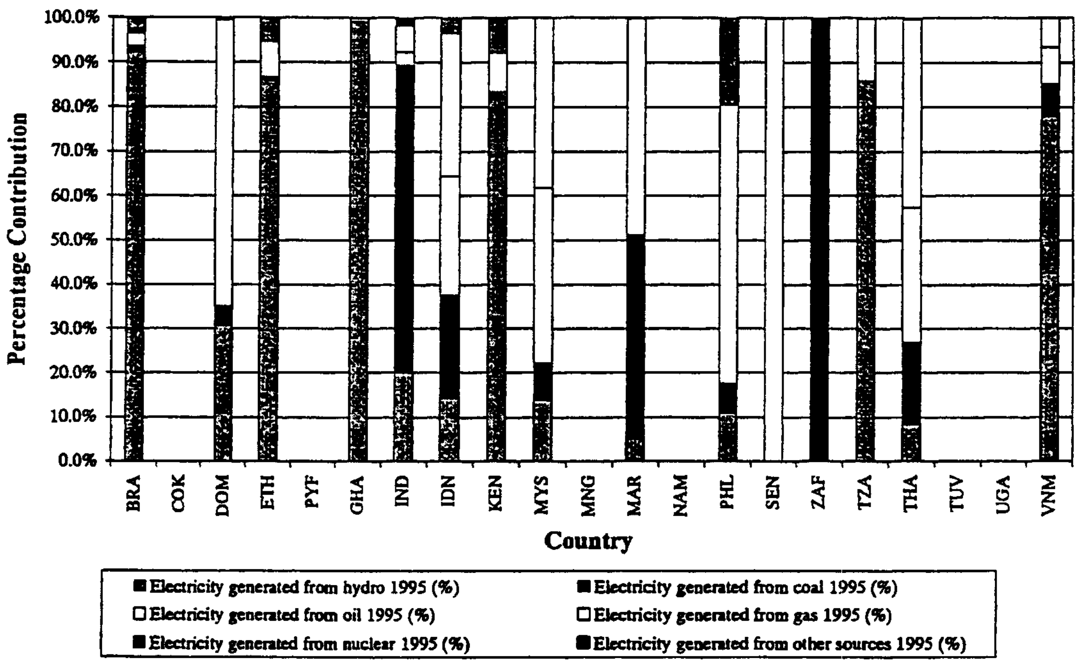


Figure 2: Electricity generation breakdown by source.

Recent difficulties in Malaysia's financial markets have cast doubts on the large scale hydropower scheme, the Bukan dam project, which had been expected to power Malaysia's continued drive toward economic development. It is likely that even with the increased generating capacity provided by the project, the outlying

14 World Development Indicators, World Bank 1998.

islands of Malaysia would still not be electrified, due to the expense involved in extending grid power across large water masses.

A reasonable correlation between per capita electricity production and GDP per capita can be seen from Figure 3. The data point for the high electricity production per capita is for South Africa, which exports electricity to neighbouring countries. The data point for the high GDP per capita is for French Polynesia which receives significant amounts of French bilateral aid.

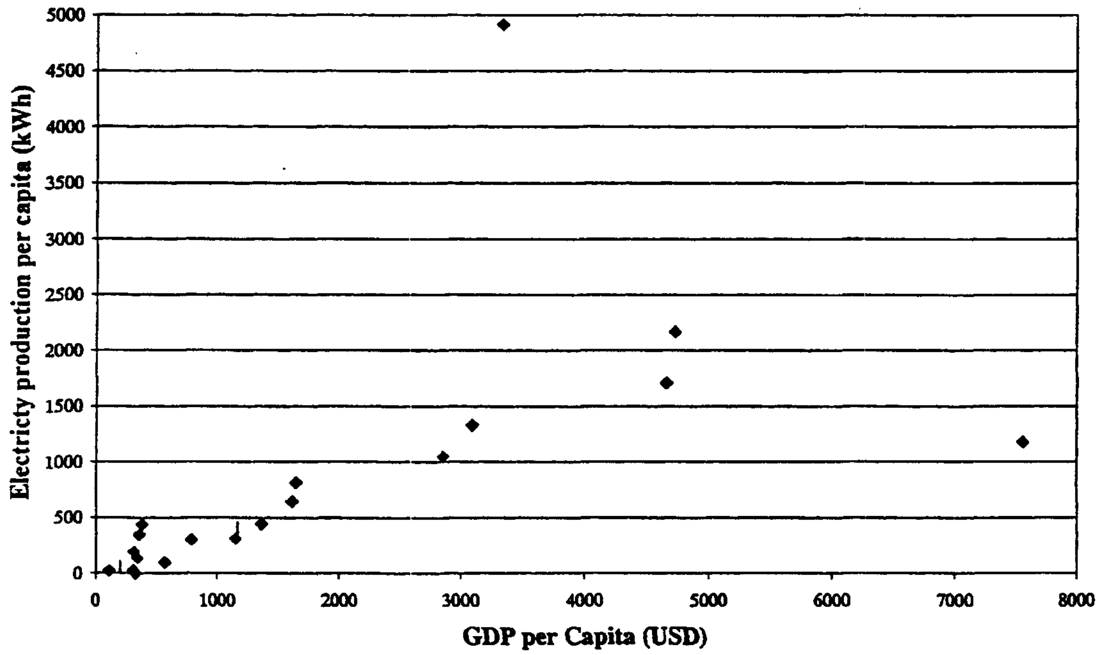


Figure 3: Electricity production per capita versus GDP per capita (1995)

In an effort to develop a better understanding of the circumstances in the rural areas, estimates of the percentage of the population without access to electricity were collated. The figures provided were compared with the estimated labour force and estimated percentage of the labour force engaged in agriculture. Figures are shown in Table 8.

Table 8: Extent of rural electrification compared with rural employment

Country	Labour Force[15] (1996)'000s	Agriculture[15] (%)	Unelectrified (%)[16]
Brazil	72 000	23	12
Cook Islands	6	NA	NA
Dominican Republic	3 000	25	NA
Ethiopia	26 000	86	90
French Polynesia	76	15	12[17]
Ghana	8 000	59	60[17]
India	418 000	64	68
Indonesia	91 000	55	70
Kenya	13 000	80	90
Malaysia	8 000	27	19
Mongolia	1 000	32	60[17]
Morocco	11 000	45	75[17]
Namibia	1 000	49	90
Philippines	30 000	45	45
Senegal	4 000	77	75[17]
South Africa	15 000	14	33
Tanzania	16 000	84	96
Thailand	30 000	40	27
Tuvalu	NA	NA	NA
Uganda	10 000	84	95
Vietnam	38 000	71	80

From Table 8, it can be seen that a large proportion of the workforce in many of the countries was involved in agriculture.

Specific statistics were rarely quoted for the Pacific Islands, however it is known that the primary occupation in Tuvalu and the Cook Islands was fishing, and the economy of French Polynesia was undergoing restructuring since the removal of the French government as a major employer.

The correlation between the population engaged in agriculture and lacking access to electricity appeared to be clear, as can be seen from Figure 4. It can be assumed that the rural population made up the majority of both statistics.

15 World Development Indicators, World Bank, 1998
16 UK Department of International Development unless stated
17 Task III Expert

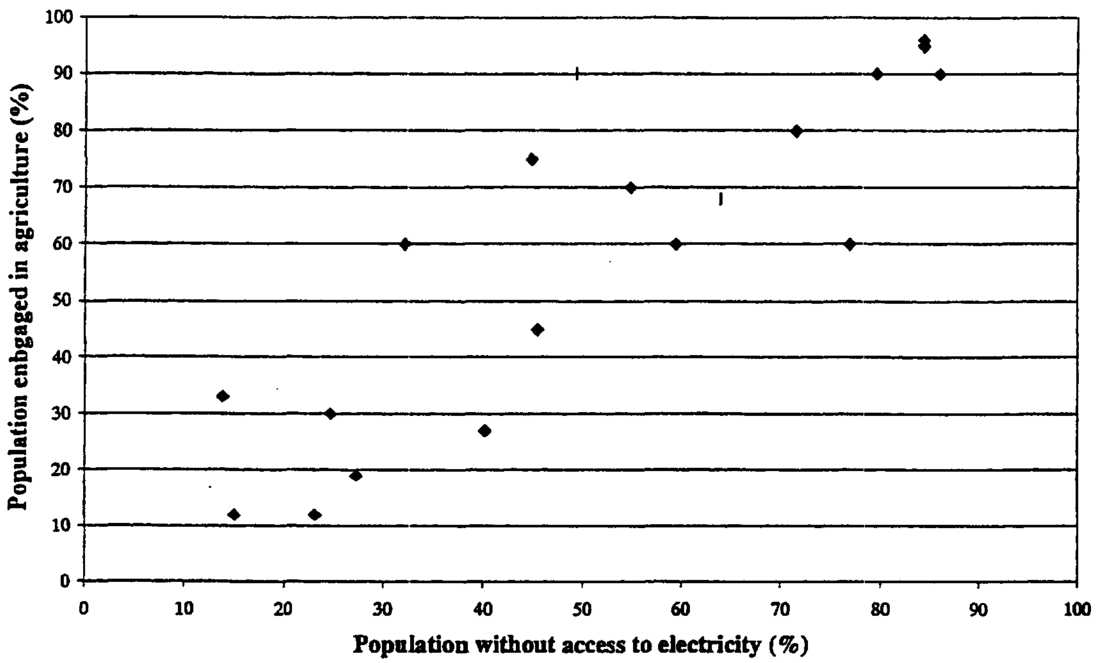


Figure 4: Population without electricity versus population in agriculture

There was also a correlation between the unelectrified population and GDP per capita as can be seen from Figure 5 demonstrating that the poorer countries were more likely to have larger, unelectrified populations working in agriculture.

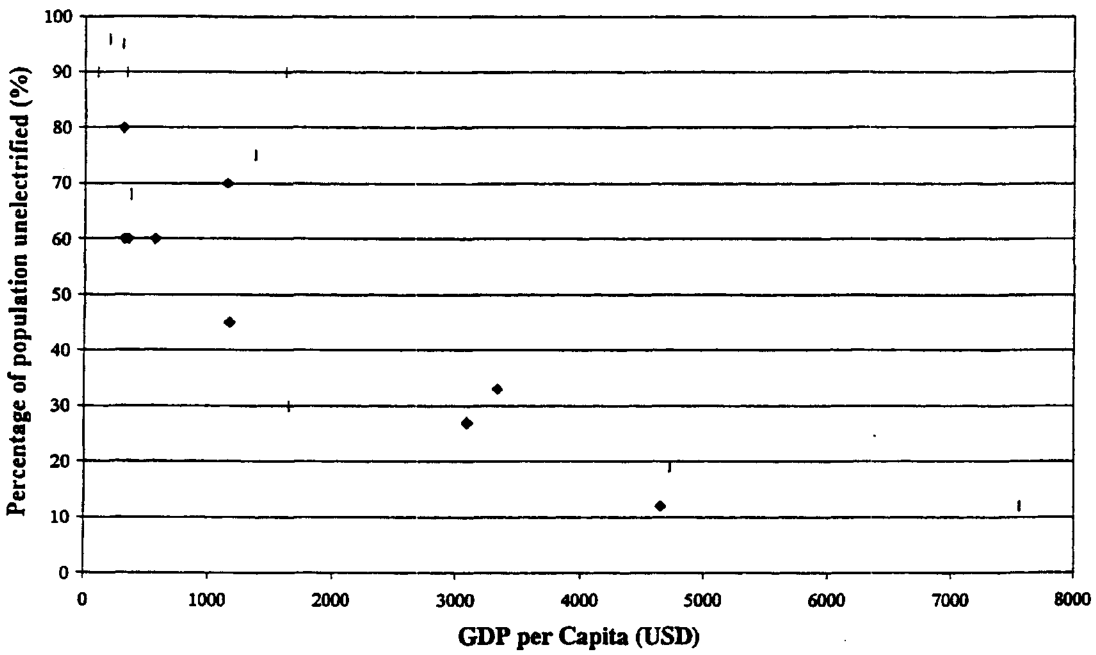


Figure 5: Population without electricity versus GDP per capita.

Furthermore, from Figure 6 a loose correlation between the unelectrified population and the urban population was apparent, providing further evidence that unelectrified populations tended to be those in rural areas.

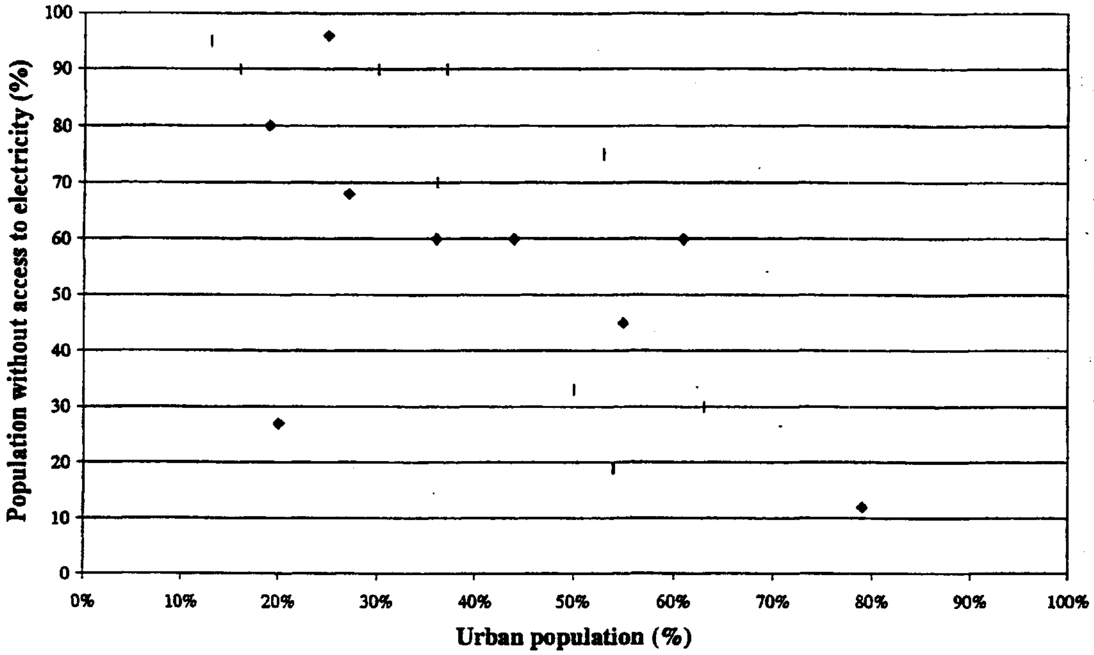


Figure 6: Unelectrified population versus urban population.

4. PV Programme Experiences and Policy Issues

4.1 PV Applications and Installed Power

All of the countries included in the survey had had some experience with stand-alone photovoltaic power systems. For many of the countries, this was largely been for social / health / educational applications, often funded by international agencies and installed as demonstration or pilot programmes. However, a number of countries had developed a commercial PV industry independently of large scale aid projects. Particularly important from this perspective were the industries in Kenya, the Dominican Republic and Namibia.

The installed PV power as of the end of 1996 is shown for each of the surveyed countries in Table 9. It was estimated that the total PV power installed in the surveyed countries is in the region of 53 MWp with over half of this installed in India. Figure 7 shows the installed power per capita. For reasons of scale, the data for Tuvalu has not been included in the Figure as it equates to 5.05 Wp/capita.

Table 9: Estimated installed PV power at the end of 1996 in the surveyed countries.

Country	PV Power installed at the end of 1996 (kW_p)	Country	PV Power installed at the end of 1996 (kW_p)
Brazil	2 000	Morocco	1 000
Cook Islands	NA	Namibia	800
Dominican Republic	225	Philippines	133
Ethiopia	NA	Senegal	800
French Polynesia	NA	South Africa	5 500
Ghana	350	Tanzania	NA
India	35 000	Thailand	2 500
Indonesia	1 800	Tuvalu	50
Kenya	2 000	Uganda	150
Malaysia	640	Vietnam	100
Mongolia	80	**TOTAL**	53 078

The countries with the highest total peak power installed at the end of 1996 were Brazil, Kenya, India, South Africa and Thailand, which accounted for 47 MWp.

In India, PV had been used in many applications including water pumping, street lighting systems, solar home systems and solar lanterns as well as large scale

(>100 kWp) PV power plants and telecommunications. PV in South Africa had been largely used in solar home systems, water pumping, electrification of schools and clinics as well as in professional applications such as telecommunications. In Thailand, PV had been installed for village battery charging stations, schools and clinics and water pumping applications. In Brazil, the first PV applications were for telecommunication relay stations but since 1992, PV had been used in solar home systems, schools and water pumping. In Kenya, PV had been largely used for solar home systems and solar lanterns, almost entirely in the private sector.

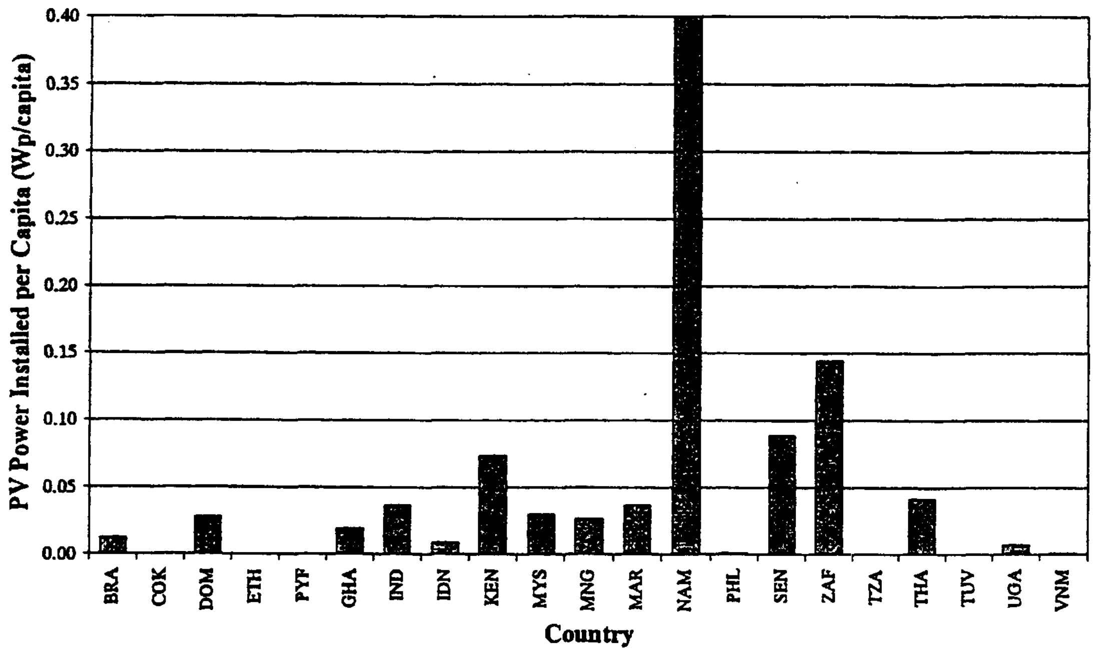


Figure 7: Installed PV power per capita in the surveyed countries

From Figure 7 it can be seen that the countries with the highest per capita figures were Namibia, South Africa, Tuvalu, Kenya, Senegal and Morocco. It is interesting to note that the governments of these countries were actively supportive of PV and, with the exception of Senegal, had an active private sector PV industry. In Morocco, Senegal and Tuvalu, large PV programmes funded by bilateral agencies had been implemented and these had been generally successful in ensuring continued government support. In Namibia and Thailand the PV industry had developed mainly through the active support of the national governments and in the absence of large aid programmes.

Table 10 shows the uses of stand-alone photovoltaic power systems in the survey countries. It must be noted that as information was often difficult to obtain there may be examples of particular applications that are not listed for a particular country. Every effort was made to ensure the accuracy and completeness of the data although there were inevitably areas where data were lacking.

Table 10: PV applications in the surveyed countries

Country	Domestic	Schools	Clinics	Water	Telecoms	Other
Brazil	✓	✓	✓	✓	✓	agriculture
Cook Islands	✓		✓		✓	
Dominican Republic	✓					agriculture
Ethiopia			✓	✓	✓	PV radios
French Polynesia	✓					Pearl farms, hotels
Ghana	✓				✓	battery charging centres
India	✓	✓	✓	✓	✓	industrial, agriculture, larger scale plants
Indonesia	✓		✓	✓		public lighting, hybrid mini-grids
Kenya	✓		✓	✓		industrial, agricultural
Malaysia	✓	✓	✓	✓	✓	military, large scale plants for village power
Mongolia	✓				✓	
Morocco	✓	✓		✓		battery charging stations, mosques
Namibia	✓	✓	✓	✓	✓	shops, farms, railway stations, navigational buoys, TV relay stations
Philippines	✓	✓	✓	✓		village grid and battery charging stations, hotels, community centre lighting
Senegal	✓		✓	✓		village battery charging stations
South Africa	✓	✓	✓	✓	✓	Navigational buoys
Tanzania	✓		✓	✓	✓	
Thailand	✓	✓	✓	✓		PV-hybrid mini-grids, industrial, village battery, charging stations
Tuvalu	✓				✓	
Uganda	✓		✓	✓	✓	
Vietnam	✓		✓		✓	Navigational aids, height indicators, community centres, village battery charging stations, street lighting

The use of PV water pumping and other agricultural applications use had been piloted widely, as this was seen as a primary market for systems. The private sector purchase of systems for agricultural use was limited by the expense involved. Even as a community co-operative venture, the capital accumulated from subsistence agriculture was generally not enough to provide the down-payments necessary for developing a photovoltaic powered irrigation system.

Other agricultural applications, such as solar-powered electric fences were also being piloted, especially in areas of Brazil where animal husbandry was widely practised.

In the Pacific islands of French Polynesia and the Cook Islands, economic activity based upon photovoltaic electrification included pearl farming and 'eco-hotels', catering to environmentally conscious tourists.

Domestic lighting appeared to be the primary use of photovoltaic systems purchased in the private sector, mainly because these systems were the least expensive. Three different types of system were commonly used: a small (~50 Wp) solar home system providing power for three of four lights and a radio; a solar lantern, providing a small (5 Wp to 10 Wp) module and a single light; or a co-operative venture in which a battery charging station was set up and each member either rented or was given a light and battery, which was returned to the charging house for recharge.

In urban areas, which were relatively affluent but had an unstable power distribution system, such as the Dominican Republic, photovoltaic power systems were used for back up power supplies.

The immediate effects of photovoltaic projects, as with other power supply projects, focussed upon either economic or social benefits. Projects providing power to remote health clinics and schools addressed social problems, which may lead to secondary economic improvements in productivity. Solar pumping projects providing increased irrigation water addressed the necessity of increasing productivity to break the population free from subsistence agriculture.

One of the most important social aspects of stand-alone photovoltaic power systems in areas without access to electricity was the provision of lighting. Private sector purchases focussed upon domestic lighting followed by radios and televisions, all of can provide immediate social benefits as well as secondary economic benefits. These immediate improvements in quality of life and status were often seen as more important than the possible long term increases in productivity available with systems aimed at small enterprises.

Electrification programmes based upon the use of photovoltaic systems have begun to focus upon providing domestic electricity in response to this demand. Solar Home Systems (SHS), designed to meet domestic lighting requirements are becoming the typical stand-alone system.

An alternative to SHS is the installation of a village battery charging stations, renting out batteries and lights. These systems were reported as having been quite successful, both in ease of cost recovery and in satisfaction by the end users.

4.2 Policy Issues

Many countries had plans with regard to the electrification of rural areas. A number of countries had policies and targets for rural electrification that explicitly included reference to the use of PV and/or other renewable energy sources. A summary of existing programmes on rural electrification and PV and the status of import duties and tariffs in the surveyed countries is given in Table 12.

An important policy issue affecting the implementation of photovoltaic power systems was the imposition of import duties and tariffs charged on photovoltaic components. The decision to charge import duties on system components was often based upon a need to collect revenue, as well as to protect any home industries for these products.

Many of the countries had developed and implemented coherent plans focused on encouraging the growth of the photovoltaic industry. The various programmes were not comparable, as the size of the populations being served were very different and the goals of the programmes quite different. Indonesia was attempting to develop a rural infrastructure for both supplying electrification and supplying credit on a massive scale, while Tuvalu and French Polynesia, with small populations, were attempting to achieve electrification with PV almost entirely as a demonstration project. The Malaysian government, in contrast, was leaving the development of the industry almost entirely to the private sector in the belief that PV should only be implemented on an economically justifiable basis.

In countries with limited governmental interest in promoting PV systems on a wide scale, private sector interest and internationally funded Aid projects can support industrial activity to some degree. Kenya had a thriving private sector photovoltaic industry, although it was supported by Aid projects throughout the region and its success was largely due entirely to the private sector. The Dominican Republic had also developed a successful private sector industry despite confusing government policies and tariffs, although the industry suffered from some difficulties in the development of customer finance mechanisms. The PV industry in Namibia had also developed independently of large scale aid programmes, although there had been government support for the technology.

Table 12: Existing policies, initiatives and tariffs for PV components

Country	Policies and Initiatives	Tariffs on PV
Brazil	The Ministry of Energy & Mines had an ongoing project, PRODEEM, to install demonstration PV systems in every state in Brazil.	VAT and import duties - under review.
Cook Islands	Involved in energy discussions with other countries in the area in an effort to capitalise upon any opportunity to increase the electrification of the islands.	No.
Dominican Republic	Negligible policy making in support of solar energy, although PV modules counted as electricity generation equipment and were free of import duties. Left to private sector.	No duties on PV modules, 100 % import duty on batteries.
Ethiopia	Indications were that the government was supportive of solar power systems, but lacked the resources to implement them.	NA.
French Polynesia	Private sector expected to sustain the local PV industry.	NA.
Ghana	Committed to electrify the whole country by the year 2020. This commitment was being realised within the framework of a National Electrification Programme, initiated in 1980. PV was included as part of NEP.	NEP projects attractedno duties; private project attract 15 % VAT.
India	The Government of India was committed to renewable energy development. The Ministry of Non Conventional Energy Sources was responsible for the specific policy, legislation and support programmes for renewable energy, with the aim of achieving a 6 % contribution to power generation from renewable sources by 2002. Numerous programmes were planned and ongoing, including the construction of high capacity power plants to electrify entire regions, small scale domestic lighting / power production, credit provision to encourage market development, and subsidy schemes. In 1998, the GEF/IFC "Photovoltaic Market Transformation Initiative" programme was launched.	Yes.
Indonesia	Government had made rural electrification a priority and the Suharto government gave considerable support to photovoltaic applications. In 1997, the GOI set a target for 50 MWp of PV by 2005 to install 1 million SHSs nationwide. World Bank and GEF funding was secured for 200 000 homes (10 MWp) in West Java, Lampung and South Sulawesi.	Equipment not manufactured locally were exempt from import taxes and duties.

Country	Policies and Initiatives	Tariffs on PV
Kenya	Rural Electrification Master Plan should re-stimulate rural electrification activities. It was anticipated the plan will give specific attention to PV. In 1998, the GEF/IFC "Photovoltaic Market Transformation Initiative" programme was launched.	Yes.
Malaysia	Supportive of PV for rural electrification providing it was economic. Ministry of Rural Development established a rural community initiative encompassing the Sabah, Sarawak and Peninsular Malaysia Provinces in 1996. The 34 MUSD programme will run for 5 years in 2 phases to improve rural village services.	NA.
Mongolia	PV systems are seen by the Mongolian government as providing a possible method of providing electricity for nomadic herders.	NA.
Morocco	Government was committed to electrifying most of the remainder of the country (1.6 million households) by 2010, and had indicated that approximately 5 % of those households should be electrified using off-grid solar and wind technologies. In 1998, the GEF/IFC "Photovoltaic Market Transformation Initiative" programme was launched.	Import duty on modules, 2.5 %, BOS: 25 %; inverters: 17.5 %. VAT levied on all components at 20 %.
Namibia	By 1996, a basic infrastructure for rural electrification in the north and east of the country had been completed. The current focus was on the south of the country. The Ministry of Mines and Energy had given photovoltaic applications high priority for rural electrification.	NA
Philippines	The government aimed to achieve 100 % electrification of all villages by 2010 and connect all potential customers by 2018. BP Solar Australia had been contracted to design, supply and install 1 003 PV systems to provide electricity to 387 villages electrifying over 1 million people in one of the biggest solar projects world-wide.	Equipment not manufactured locally is exempt from import taxes and duties.
Senegal	Government was actively promoting the use of renewable energy resources and equipment for all PV systems was exempt from VAT and import duties.	PV equipment exempt from all import duties and sales taxes.

Country	Policies and Initiatives	Tariffs on PV
South Africa	The National Electrification Forum aimed to increase dwellings connected to the grid from 45 % to 67 % by 2000 and to 79 % by 2012. REFSA established and charged with developing PV SHS programme. Subsidy of 1 500 ZAR per system for approved pilot projects. ESKOM committed to manage the electrification of 16 400 schools that will not be connected to the grid under the RDP. 4 000 health clinics had been targeted for PV electrification.	NA.
Tanzania	Rural electrification did not seem to be a high priority. All PV programmes had been aid programmes.	NA.
Thailand	There was no distinct rural energy plan, but rural energy issues had a high priority under the rural development component of the National Economic and Social Development Plan	Yes.
Tuvalu	After initial scepticism about the use of PV systems, the government was enthusiastic about their use. Three programmes had been initiated, installing over 300 more systems and funded by the E.U. and French bilateral aid	NA.
Uganda	The NRSE (New & Renewable Sources of Energy) within the Department of Energy in the Ministry of Natural Resources activities included facilitating the development of renewable sources of energy and this had ensured government involvement. Funding had been secured for a 1.76 MUSD GEF funded PV for Rural Electrification Project. The project aimed to install 2 000 SHS and solar lanterns in rural communities.	No import duties levied but sales tax of 17 % imposed in 1995.
Vietnam	The Government had already played a major role in establishing PV industry and energy policy. The National Program for New and Renewable Sources of Energy (NRSE) was established by a government initiative to improve living conditions in rural areas. The World Bank and DANIDA had recently provided funding for a Rural Electrification Masterplan to identify regions to be supplied by the grid, and those which would be supplied by a variety of other energy sources, including micro-hydro and PV.	No import duties levied on PV related materials and equipment.

5. Domestic PV Industries

Many of the survey countries lacked the industrial base and trained technicians required to produce all of the components of a photovoltaic power system. However, the production of PV modules from cells bought on the international market or manufactured by parent companies overseas took place in a number of countries including South Africa, Thailand and Vietnam. There were three companies in India involved in the manufacture of PV cells, as well as module manufacture. Facilities for module manufacture did exist in Brazil but these were no longer in production.

Table 14 displays the production capability of PV system components in the countries surveyed.

Most of the countries had the ability to produce some, if not all, of the components for a stand-alone PV system. These typically included charge controllers, batteries, DC lamps, wiring etc. Most of the batteries that were manufactured were automotive batteries rather than the more expensive solar batteries.

Demonstration programmes had encouraged the creation of photovoltaic firms for assembling and installing components in all of the countries surveyed; however, many of these firms were dormant between projects, as the local market volume was too low to sustain employment. Those countries that were known to have private sector firms providing photovoltaic power systems on a continual basis were Brazil, Dominican Republic, French Polynesia, India, Indonesia, Kenya, South Africa, and Thailand.

Table 14: In-country manufacture of components

Country	BOS Components	Module Manufacture	Comments
Brazil	✓	✗	Cell & module manufacturer ceased production. Established market for professional systems. At least 2 national commercial distributors of PV systems.
Cook Islands	✗	✗	All components imported from French Polynesia.
Dominican Republic	✓	✗	PV modules imported and a mixture of imported and locally manufactured BOS components used. PV industry reliant solely on private sector.
Ethiopia	✗	✗	No system components manufactured. University of Addis Ababa involved in PV technology and applications research.
French Polynesia	✓	✗	PV industry capable of manufacturing all components except modules.
Ghana	✓	✗	Estimated 13 companies working with PV. University of Science and Technology manufacturers BOS components.
India	✓	✓	Several companies involved in manufacture of PV cells and modules (production in 1997/8 estimated at 8.2 MWp) and numerous companies involved in design and installation of systems.
Indonesia	✓	✗	Most international PV manufacturers have either subsidiaries or local dealerships. Most BOS components manufactured locally.
Kenya	✓	✗	Estimated 50 000 SHS installed on a commercial basis. As many as 15 module distributors and a further 20 companies involved in BOS component manufacture.
Malaysia	✓	✗	Most components imported.

Country	BOS Components	Module Manufacture	Comments
Mongolia	✓	✗	Institute of Physics and Technology had manufactured cells from imported wafers and assembled modules on a laboratory scale. 1 commercial company involved in PV for telecommunications sector.
Morocco	✓	✓	As many as 30 organisations involved in manufacture, systems design and installation. 6 modules distributors and one local module manufacturer using cells purchased on international market.
Namibia	✓	✗	Most BOS components manufactured locally or imported from South Africa. Modules sourced from South Africa or direct from manufacturer.
Philippines	✓	✗	Modules and charge controllers imported. Other BOS components manufactured locally. At least 15 suppliers dealing in PV, supplying modules from most international manufacturers.
Senegal	✓	✗	Most PV components imported, although automotive batteries manufactured locally.
South Africa	✓	✓	All components manufactured in country. Most major international module manufacturers have dealerships in south Africa.
Tanzania	✗	✗	Perhaps 9 firms involved in system installation. All components imported and systems are purchased privately.
Thailand	✓	✓	Joint ventures in PV module assembly have been established and module production capacity estimated at 1 MWp.
Tuvalu	✗	✗	All components imported from French Polynesia.
Uganda	✗	✗	System components imported and assembled locally. Estimated nine companies involved in PV installation.
Vietnam	✓	✓	Five companies involved in design and installation of PV systems. three dealers of international companies. BOS components also manufactured locally. Two companies involved in small scale PV module manufacture.

6. Financing Options

One of the common features among the survey countries was the lack of finance available for the purchase of PV systems, either through cash sales or through affordable credit. This was especially problematic in rural areas, where the population was often reliant upon subsistence agriculture and informal employment. As this demographic group represented the largest market for stand-alone photovoltaic power systems, the problem of finance needs to be addressed in order to develop the potential market.

In general, many of early demonstration projects were not implemented with any intention of recovering costs, and many public sector projects follow this tradition. Electrification of medical clinics and schools was usually performed on a grant basis, and only recently had solar pumping projects begun to attempt cost recovery. Cost recovery was seen as both inducing a sense of ownership on the part of the people paying for the system and providing funds to sustain the project beyond initial installation.

Cost recovery had become especially important as national budgets in the developed world tighten and aid funding was stretched tighter; by achieving full cost recovery for capital costs as well as operation and maintenance costs, the same initial funds can be reinvested in subsequent installations. An effective cost recovery system requires administrative infrastructure to disburse and collect funds and keep records of transactions.

Three main methods of developing the necessary infrastructure were being used in the survey nations: strengthening local lending bodies, expanding state owned enterprises, and encouraging private sector development. As shown in Table 16,Table 16 the majority of the projects covered by the surveys relied upon funding from Non-Governmental Organisations (NGOs) and bilateral grants.

Attempts to either strengthen traditional lending mechanisms or introduce culturally sympathetic mechanisms among the local population had achieved a level of success. With the assistance of NGOs, revolving credit schemes and local credit co-operatives were both used frequently as a means of distributing available funds to the consumers. The advantages of these schemes included the strengthening of social ties within the community and the minimal administration costs.

Official encouragement of private enterprise to provide credit at the local level for photovoltaic power systems was an option that was promoted in a number of countries. In Indonesia, providing local dealers with access to finance to provide credit to consumers was incorporated as part of the World Bank /GEF programme.

Table 16: Sources of project funding

Country	Local co-operative	Government	Aid Agencies and NGOs	Bank/Private	Utilities
Brazil	✓		✓	✓	✓
Cook Islands			✓		
Dominican Republic	✓		✓	✓	
Ethiopia			✓		
French Polynesia		✓	✓	✓	
Ghana	✓		✓		
India	✓	✓	✓	✓	
Indonesia	✓	✓	✓	✓	
Kenya			✓	✓	
Malaysia				✓	
Mongolia		✓	✓		
Morocco		✓	✓	✓	
Namibia				✓	
Philippines	✓	✓	✓	✓	
Senegal	✓		✓	✓	
South Africa	✓	✓	✓		✓
Tanzania			✓		
Thailand		✓			
Tuvalu	✓		✓		
Uganda			✓	✓	
Vietnam	✓	✓	✓	✓	

Despite the firm commitment of the previous Indonesian government to the use of PV for rural electrification, implementation was still hampered by a lack of financing mechanisms. While the central government believed that the overall economic growth of the country was dependent upon electrification, the immediate ability of the population to pay for system installation was limited. The limited resources of the end-users required appropriate credit arrangements in order to achieve full cost recovery. With a large population to provide for, this time delay in cost recovery resulted in credit funds being prohibitively expensive to set up and offered little return on the investment. For the original pilot scheme, the SHS project averaged a cost recovery of approximately 60 %, and it was not expected that follow on projects would achieve 100 % cost recovery.

The rather slow response in private sector investment in Indonesia is indicative of the problems encountered during attempts to instigate economic development in low income areas. Although the initial solar project in Indonesia was set up using aid funding with a low down-payment and a 10-year, zero interest financing scheme, procuring photovoltaic systems on a private basis required a large down-payment, 2-3 year financing, and ~18 % interest. Clearly the purchase of photovoltaic systems in the private sector was limited to either those with a large disposable income, or those whose income would be significantly enhanced by the addition of electrification.

The success of photovoltaic systems in Tuvalu can be partially attributed to the small population and the relatively large amount of development aid from which it had benefited. Tuvalu had managed to successfully develop an operating photovoltaic electrification scheme. As in Indonesia, the island nature of the country does not lend itself to centralised power distribution grids. In this scenario, photovoltaic systems can be expected to provide the most cost effective method of providing electricity to a widely dispersed population, and the success of an electrification project rests upon the provision of financing mechanisms which can be afforded by the local population. In Tuvalu, the initial down-payment and monthly payments were kept low by not actually selling the photovoltaic systems to the end-users, who pay a flat rate for the systems depending on the size to the Tuvalu Solar Electric Company. While this increased the possible client base to include those households with very low income, the co-operative itself was only able to cover short term operating costs; it has been unable to purchase new units to increase the electrification of the population, nor to purchase replacements as units fail.

The success of PV in both Namibia and Kenya was largely a result of private sector demand in the absence of any large scale donor funded electrification programmes. There were no specific financing schemes in either country for solar home systems, although hire purchase schemes finance as many as 2 000 solar home systems per year in Kenya. It was estimated that as many as 50 000 solar home systems had been sold on a commercial basis in Kenya and 2 000 in Namibia, with a further 2 000 systems sold for installation in schools, clinics, community farms and shops. The hire purchase schemes were generally over 12 or 24 month period and interest levels could be as high as 40 %.

More recently the concept of the Energy Service Company or ESCO, has been pioneered in South Africa. These companies can be a PV manufacturer, a local electricity utilities, who own and maintain the PV system and charge either a flat monthly rate or according to the energy consumed.

7. Conclusions

In many of the countries surveyed there was a substantial rural population not connected to the electricity distribution network, either because they lived in areas not covered by the distribution system or because they were unable to afford the price of a connection. This problem was often compounded by the fact that electricity utilities in some of the countries discouraged domestic connections in rural areas due to the low levels of electricity consumption associated with these populations.

Many of the surveyed countries had already experience of stand-alone PV systems for remote service applications such as telecommunications, railway signal and switching devices, television relay stations, and coastal navigation devices. This market was largely a commercial market and operated without the need for direct subsidies. Solar Home Systems (SHS), vaccine refrigerators, school electrification, public street lighting, water pumping and desalination plants can all be considered to bring significant social benefits and represent a huge potential market for the PV industry. Many of the countries in this survey had experience with one or more of these applications, although they were often funded through multi-lateral or bilateral aid programmes.

The technical capability of photovoltaics as a means of rural electrification was demonstrated through the successful implementation of programmes in many of the countries. It must be noted that many of the early programmes suffered from technical problems associated with poor system design and inadequate component specification. The importance of ensuring that the institutional capability to ensure that systems were operated properly and adequately maintained has also been highlighted.

Of the countries surveyed, only India had the facilities to manufacture PV cells where three companies were manufacturing PV cells and others were manufacturing modules from cells bought on the international market or supplied by parent companies. The production of PV modules from cells bought on the international market or manufactured by parent companies overseas also took place in South Africa, Thailand and Vietnam. Facilities for module manufacture did exist in Brazil but these were no longer in production. Most of the other countries had the capability to manufacture some or all of the balance of systems components. Many of the international companies had also established dealerships in the many of the countries.

The key barrier to the accelerated implementation of stand-alone photovoltaic power systems is highlighted in each of the surveyed nations as being the high capital cost of PV systems and the lack of available and affordable finance. The people most able to benefit from the appropriate implementation of PV are those often most unable to be able to afford the high capital costs associated with PV systems, i.e., the rural poor.

The issue of financing of photovoltaic systems was an issue to be resolved in each of the 20 countries surveyed. This was perhaps inevitable due to the low income levels of much of the population in these countries. However, the problems were not insurmountable and some of the countries had approached the problem of finance with some degree of success. Indonesia, India and Tuvalu each had some success at providing finance to end users. The Dominican Republic, Kenya and Namibia had also had considerable success in providing PV systems on a market basis in the absence of any government subsidies.

Attempts were also being made by various NGOs to develop finance mechanisms within the developing countries in the form of revolving funds and local co-operatives. As a large portion of the potential market for PV was engaged in subsistence agriculture and had only a small disposable income, the start-up of the credit schemes capitalised by external funds was often an appropriate solution. It was also important to ensure continual cost recovery in order sustain the project. Consumers, once educated to the advantages of photovoltaic systems and provided with affordable credit schemes, appeared willing to invest in domestic lighting and entertainment systems. It was important that payment levels were kept to a level that are affordable by the end users. Expenditure on alternative forms of lighting, such as kerosene lamps and candles can be diverted to pay off loans for a solar home system. For every 20 hours of operation of a kerosene lamp, 1 litre of kerosene is required.

Other barriers have been identified as a lack of awareness of the potential of PV as a technology for rural electrification; lack of quality control of system installation and design; difficulties in setting up and maintaining distribution networks over large, sparsely populated areas, lack of provision for maintenance and a lack of end user training.

Country Reports

Brazil
Cook Islands
Dominican Republic
Ethiopia
French Polynesia
Ghana
India
Indonesia
Kenya
Malaysia
Mongolia
Morocco
Namibia
The Philippines
Senegal
South Africa
Uganda
Tanzania
Thailand
Tuvalu
Vietnam

Brazil

Land Area	274 000 000 km^2
Population	161 million
Population Density	19 inhabs per km^2
GDP per capita	4 652 USD
Urban Population	79 %
Labour Force	72 million
Population Growth Rate (1980-1996)	1.8 %
Literacy Rate	83 %.

General Data			
Insolation	4.9 $kWh.m^{-2}.day^{-1}$	Latitude	10°S
Population unelectrified	12 %	Terrain	Mostly flat rolling lowlands in North; some plains, hills, mountains and narrow coastal belt.

PV Data	
PV power installed	2.0 MWp (1995)
Technical potential	126 MWp (based on 50 Wp SHS for 65 % of households currently without electricity, assuming 5 people per household.)
PV programmes committed	The Ministry of Energy & Mines has an ongoing project, PRODEEM, to install demonstration PV systems in every state in Brazil.
Government policy	Proposed 14 specific programmes, with target for PV of 50 MWp by 2005
Utility programmes & strategies	Privatisation of the utilities has resulted in little effort being made to extend the national grid beyond the coastal plain, leaving the majority of the interior without supply. The Ministry of Energy and Mines, responsible for rural electrification, has historically relied upon diesel generators feeding 'mini-grids' requiring an annual subsidy of 250 MUSD.
Market sophistication	Advanced
Technical development	All BOS components are manufactured. Modules were manufactured..
Pricing structure	Support available from PRODEEM project. Financing available from the RE programme which provides at preferential rates Various revolving funds and other loan schemes planned or in operation. SHS can also be rented for 13.5 USD/month
Testing & Standards	The Brazil Standards Organisation adopted IEC standards for PV cells and modules. The experience from the systems installed by the NREL/CEPEL project has been used for 'good practice' guidelines. CEPEL has a PV Working Group to address PV commercialisation.

1 Economic and Political Aspects

Between 1945 and 1980, the Brazilian economy expanded very rapidly and a large and diversified industry was developed. Brazil's development during this time was traditionally based on import substitution industrialisation (ISI) and was helped by protectionist policies. In the 1980s ISI faltered: such protectionist policies made the economy inward-looking and inefficient and as a consequence investment collapsed, leading to hyperinflation. Between 1986 and 1991 there were five unsuccessful attempts to stabilise the economy and the name of the Brazilian currency was changed four times.

Trade liberalisation began in 1990 and within four years practically all non-tariff barriers were removed and import tariffs were slashed. The result was an extraordinary rise in labour productivity. Productivity growth per year between 1990 and 1995 was estimated at 6-7 % compared with approximately 1.4 % per year between 1986 and 1990.

A major shift in economic policy occurred in 1993 when a stabilisation programme largely based on market forces was launched. The rate of inflation dropped from 50 % per month in June 1994 to about 2 % per month in the fourth quarter of 1994

In 1996 Brazil had a Gross Domestic Product of 749 BUSD, 14 % of which was supplied by agriculture, and grew at a rate of approximately 5 %. Economic activity was largely located in three south eastern states, which accounted for about 60 % of Brazil's GDP.

2 Grid Electrification Status

Electrical capacity was estimated at 63.8 GW, with annual production of 242 TWh. Over 90 % of the electrical capacity was derived from hydro-electric schemes, with the remainder supplied largely by thermal generating plants. Brazil had a nuclear generating capacity, but was not reliant upon nuclear power. There were more than 20 utilities serving the states and these were in the process of being privatised. Whilst under state control, the grid was being systematically extended into rural areas. Privatisation of the utilities has resulted in little effort being made to extend the national grid beyond the heavily populated coastal plain, leaving the majority of the interior without supply. The Ministry of Energy and Mines, responsible for rural electrification, has historically relied upon diesel generators feeding 'mini-grids' which required an annual subsidy of 250 MUSD. This subsidy was provided by the National Fuel Consumption Account, which drews tariffs from the electricity produced by the large hydro-electric infrastructure. Improving the economic viability of these mini-grids was of particular concern to the newly privatised utilities.

Regional and state distribution concerns were being privatised as were individual generation plants and new generating capacity was being promoted through the private sector. Brazil's grid was connected to those of neighbouring countries, which may be expected to provide further sources of power in the future.

The unelectrified population was variously reported to be in the range 20-35 million people. The majority of these were in the north east of the country where 40 % of the population in the 9 Northern states were said to be without electricity.

3 PV Programme Experiences and Policy Issues

Photovoltaic systems were initially installed in remote areas to power telecommunications relay stations approximately 10 years ago, and had proven successful in this application. This 'service application' continued to be a growth area for photovoltaic power systems, with reports estimating a requirement for up to 7 MWp capacity as the telecommunications industry expanded.

The US Department of Energy through NREL, collaborated with CEPEL and the state-owned utilities from 1992-1995 in a 2-phase project to install over 1 000 stand-alone PV systems in rural areas on a demonstration basis. The project was the largest and most significant PV project in Brazil to date, but was criticised for undermining the indigenous PV industry. The stated objectives were to enhance the movement of PV hardware from the US to Brazil (supplied by Siemens, Solarex and USSC) and establish in-country training and expertise of technical personnel. The US-DoE donated the PV modules, batteries and charge controllers from US suppliers (approximately 50 % of the project cost). All other BOS were procured by the state utilities who were also responsible for installation and maintenance. The projects were far from financially viable, since the SHS users were asked to pay only 1 USD per month - the equivalent of a grid-connection charge with minimum consumption. All sites were further than 7 km from the grid.

The Eldorado-Sun project followed the same pattern as the NREL project, installing 60 kWp of PV systems in Pernambuco state, completed in 1996. Over 400 schools were each provided with a 100 Wp system. The PV modules were provided by Siemens Solar (Germany) funded by GTZ, while the utility CEPEL provided the BOS components and carried out installation.

The Ministry of Energy & Mines had an ongoing project, PRODEEM (run by CEPEL) to install demonstration PV systems in every state in Brazil. The programme was integrated into existing state programmes and was being implemented in five phases. Under Phase 1, 32.5 kWp of community lighting and water-pumping schemes had been installed using imported US equipment by 1995 with a target of 200 kWp. Phase 2 contracts had been awarded for 500 kWp, and Stage 3 was due to start in 1997. Within the PRODEEM programme, the state of Minas Gerais aimed to electrify 100 schools in 1997, with a further 1 000 planned for 1998. The state had announced targets of electrifying 20 000 consumers by 1998, and the state of Bahia had identified 172 localities for implementing SHS and water-pumping projects, plus 280 farms for PV irrigation.

Two major markets for photovoltaic power systems were emerging in Brazil, the upgrading of existing systems and the provision of new systems. As the electrical utilities were privatised it was becoming necessary to improve the efficiency of the diesel powered 'mini-grids'. These systems were originally intended as short term solutions to power requirements during the expansion of the national grid, which has been halted; with the future of the subsidised fuel in doubt, there was a perceived need to introduce substitute generating technology. In addition, the westward expansion in the agricultural industry requires power for irrigation systems and electric fencing, both of which were mature applications for photovoltaic power systems.

Government initiatives on PV were started in earnest in April 1994 when the Ministries of Energy & Mines and Science & Technology produced the Belo Horizonte Statement laying down 53 directives for the development of solar and wind energy in Brazil. A Permanent Forum for Renewable Energy was established in October 1994 to oversee the directives, including a mix of government and non-government organisations. The Permanent Forum staged a conference in Brasilia in June 1995 which enlarged upon the Belo Horizonte Statement with the Brasilia Statement. This proposed 14 specific programmes, with execution guidelines, aimed at achieving targets for renewable energy. The target for PV was set at 50 MWp by 2005.

Import duty on PV modules was around 15%, and VAT also 15%, but the removal of both taxes for renewable energy systems was under review.

4 Domestic PV Industry

Heliodinamica had been the only Brazilian PV cell and module manufacturer since the early 1980s, using locally-produced silicon, however the company was for sale having experienced financial difficulties. Demonstration programmes implemented by international funding agencies, which utilised imported modules, exacerbated these difficulties. The company had a production capacity of 1.8 MWp per year and had reportedly supplied over 5 MWp of modules for the home market (largely professional systems) and export. Heliodinamaca's modules were comparatively expensive (10 USD/Wp) and in the end could not compete with US imports, despite national tax incentives.

There were also at least two national-level commercial distributors operating in Brazil as well as numerous farming co-operatives and NGOs working in the rural areas who would facilitate the implementation and support of PV systems to local communities.

The expertise for the large scale implementation of PV systems in Brazil was readily available due to the large and established market for 'professional' PV systems in Brazil. Telecommunications companies were reported to be currently implementing 7 MWp of PV projects.

5 Financing Options

The two main impediments to the increased implementation of photovoltaic power systems were identified as the lack of financial resources and the expectation that the government would cover the capital costs of generating equipment and charge consumer tariffs based upon monthly consumption - estimated in many rural areas at 1 USD per month.

Government support for PV projects was available from the PRODEEM project in conjunction with the Community Solidarity Programme, plus the Small Farmer

Support Programme (PAPP). Financing assistance was reported to be available from the renewable energy programme (PROERN) of the Banco de Nordeste do Brazil and the Northeast Constitutional Fund of the Northeast Development Bank (BNB), which provided 12-year financing at preferential rates

An attempt was made to recover costs by Electrobras by charging the end-users a minimal fee, corresponding to the cost of a rural connection to the national grid and assuming minimal consumption; additional funds were received from USAID and GTZ. Expansion of the programme was dependent upon continued support from international donors, as the fees collected did not cover the cost of the installations. Various banks had stated their willingness in principle to provide loan schemes for PV on a commercial basis although there was a lack of intermediary organisations, trusted by potential users, which can negotiate the loans with the banks.

A Belgium NGO SOS-PG had been working with the Association of Small Farmers (APAEB) in Bahia to establish a revolving fund to provide PV electric fencing to local farmers - 15 systems were demonstrated initially, with the aim of installing a further 75.

The University of Sao Paulo has collaborated with the University of Madrid, with development agency support, to set up a revolving fund managed by a rural co-operative in Sao Paulo state. SHS could be bought with an advance of 90 USD followed by monthly payments of 5 USD. Also in Sao Paulo state, the local privatised utility CESP had set up a scheme whereby users can rent a SHS for 13.50 USD per month, aimed at amortising the systems over 20 years.

The Solar Electric Light Fund (SELF) were setting up a small credit scheme for 50 SHS in NE Brazil, with grant funding. The intention was for a full cost-recovery scheme charging 18 % interest on the loan. Discussions were underway to set up SELCO-Brazil as a profit-making PV finance organisation.

A pilot project in remote regions of Pernambuco installed 350, 100 Wp SHS, in 1994 and another scheme in Ceara covered 400 homes (50 Wp) and 14 schools. Responsibility for the installation, maintenance and evaluation after three years lay with the respective state utilities who charged the users 1 USD per month.

Cook Islands

Land Area	240 km^2
Population	20 000
GDP per capita (1993)	3 000 USD (ppp)
Population Density	83 inhabs per km^2
Urban Population	Not Available
Labour Force	6 600
Population Growth Rate (1997 est.)	1.08 %
Literacy Rate	80 %

General Data			
Insolation	$kWh.m^{-2}.day^{-1}$	Latitude	21 S
Population unelectrified	NA	Terrain	Low coral atolls in north, volcanic hilly islands in South

PV Data	
PV power installed	Unknown
Technical potential	NA
PV programmes committed	Unknown
Government policy	Involved in energy discussions with other countries in the area in an effort to capitalise upon any opportunity to increase the electrification of the islands
Utility programmes & strategies	The Cook Island Electric Company has been supportive of renewable energy sources
Market sophistication	Medium
Technical development	None
Pricing structure	No specific financing available
Testing & Standards	Unknown

1 Economic and Political Aspects

The Cook Islands' economic development was hindered by the isolation of the country from foreign markets, lack of natural resources, periodic devastation from natural disasters, and inadequate infrastructure. Agriculture provides the economic base with major exports made up of copra and citrus fruit. Manufacturing activities were limited to a fruit-processing plant and several clothing factories. Trade deficits were made up for by remittances from emigrants and by foreign aid, largely from New Zealand. In 1996, the government declared bankruptcy, citing a 120 MUSD public debt. Efforts to exploit tourism potential and expanding the mining and fishing industries had not been sufficient to deal with the financial crisis. In an effort to stem further erosion of the economic situation, the government reduced public service salaries by 50 %, condensed the number of government ministries from 52 to 22, reduced the number of civil servants by more than half, began selling government assets, and closed all overseas diplomatic posts except for the one in New Zealand.

The Cook Islands are a small island chain in the Pacific generally included with French Polynesia for statistical purposes. The labour force is estimated at 6 600, with 29 % engaged in agriculture and 27 % in governmental positions.

The Gross Domestic Product of the Cook Islands was estimated to be 57 MUSD (ppp) in 1993 with no figures available on growth rates. The most recent estimates of inflation available, from 1994, indicated a 5.8 % annual increase. With exports in the range of 3.9 MUSD and imports estimated at 67 MUSD, the economy was dependent upon remits from migrants working abroad and bilateral aid from international sources.

2 Grid Electrification Status

Although the population density of the Cook Islands was comparatively high at 83 persons per km^2, it must be noted that the population was spread thinly over separate islands, making a single centralised power supply impractical.

The Cook Islands Electric Company was the sole electricity provider for the islands, with 7.5 MW capacity and annual production estimated at 20 GWh; due to the island nature of the country, electricity was available in a limited area and to only a small portion of the population. While lacking in resources, the Cook Islands' Government had been proactively involved in energy discussions with other countries in the area in an effort to capitalise upon any opportunity to increase the electrification of the islands. A single individual appeared to have greatly influenced the Cook Island's approach, participating heavily in regional energy conferences and lobbying the government to commit to renewable energy.

3 PV Programme Experiences and Policy Issues

The Cook Island Electric Company had been supportive of renewable energy sources, and had maintained ties with French Polynesia, which had a significant photovoltaic industry, able to produce all components with the exception of photovoltaic modules. As early as 1980 a programme was instituted to install Arco modules, which was followed in 1982 by a demonstration project funded by France.

During this time there were some technical difficulties encountered with photovoltaic power systems throughout the greater French Polynesia area.

In 1990 another project was instituted, again funded with Bilateral Aid from France, to electrify the islands using photovoltaic systems. The programme was managed jointly by the Cook Islands' Government and the South Pacific Institute of Renewable Energy (SPIRE), an organisation based in Tahiti in French Polynesia. The systems were installed by a private photovoltaic company, SolerEnergy, and were intended to be maintained by local technicians. Users were charged a monthly fee of 30 USD in order to recover costs.

4 Domestic PV Industry

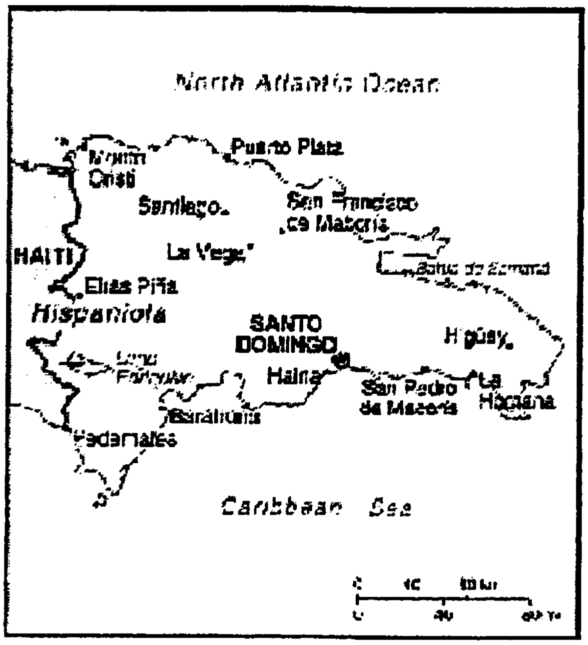
The Cook Islands did not have a supporting industry, and was unlikely to develop one and was therefore dependent upon imports from French Polynesia, which had an industry able to support photovoltaic power systems. However, due to the cessation of the French nuclear testing programme, the economy of French Polynesia was in question; historically, the testing programme had accounted for approximately 30 % of GDP. Industry collapse in French Polynesia would have implications on the photovoltaic electrification programmes in surrounding countries.

5 Financing Options

The Cook Islands electrification scheme was extremely ambitious in that attempts were being made to meet all of the energy requirements of the population using photovoltaic systems. Projects in developing countries usually focus upon providing power to schools, medical clinics and perhaps community centres, but the end-user expectations in the Cook Islands appeared to be that the programme would provide each household with enough power for domestic lighting, radios, televisions and refrigerators. While this indicated great demand for systems, the local government lacked the resources to provide the necessary financial mechanisms to enable consumers to purchase the products.

The limited economy of the Cook Islands was the major stumbling block to increased development, as it was unable to sustain the large capital costs associated with the electrification of island chains. Without the input of funds, components, and technical assistance from external sources, the expansion of PV systems will be limited.

Dominican Republic



Land Area	48 000 km^2
Population	8 million
Population Density	166 inhabs per km^2
GDP per capita	1 646 USD
Urban Population	63 %
Labour Force	3 million
Population Growth Rate (1980-1996)	2.1 %
Literacy Rate	83 %.

General Data			
Insolation	5.4 kWh.m^{-2}.day^{-1}	Latitude	19°N
Population unelectrified	30 %	Terrain	Rugged highlands and mountains with fertile valleys interspersed.

PV Data	
PV power installed	4 500 SHS
Technical potential	16 MWp (based on 50 Wp SHS for 65 % of households currently without electricity, assuming 5 people per household.)
PV programmes committed	Unknown
Government policy	Negligible policy making in support of solar energy, although PV modules counted as electricity generation equipment and are free of import duties
Utility programmes & strategies	Utility has little money to invest in rural electrification.
Market sophistication	Advanced
Technical development	High
Pricing structure	There are currently four revolving funds active in the Dominican Republic.
Testing & Standards	Unknown

1. Economic and Political Aspects

The latter half of the 1980s and early 1990s saw a deterioration in economic conditions in the Dominican Republic, with diminished growth and increased instability. There was a marked drop in private sector investment, which was replaced to some extent by the public sector. An economic reform programme was introduced in 1990 (the New Economic Policy - NEP) which made some major progress towards stability. Despite some measures (interest rate liberalisation, elimination of sectoral credit allocations, and a lowering of reserve requirements), the financial condition of the banking sector remained precarious, exacerbated by weak central authority supervision and handling of bank failures. A Financial Sector Reform Programme (FSRP) was initiated in 1995 to restore solvency and stability in the financial sector and improve its efficiency in the mobilisation and allocation of resources.

The GDP of the Dominican Republic was estimated to be 13 200 MUSD in 1996, with a growth rate between 1990 and 1996 of 4.7 %, the consumer price index averaged 10.9 % in the same period. It was estimated in 1996 that 25 % of the labour force was engaged in agriculture and unemployment was 16.7 %.

2. Grid Electrification Status

Electricity generating capacity was estimated at 2.3 GW, of which 30 % was hydro power and 65 % oil fired generation: annual generation was estimated at 6 500 GWh. Per capita electricity production was estimated at 813 kWh The generation and distribution industries were dominated by the vertically integrated, state owned utility, Corporacion Dominicana de Electricidad (CDE). The government was considering privatisation of CDE following financial difficulties that resulted in frequent power outages. With CDE struggling to maintain its existing network and reduce black outs and system losses (estimated at 25 %), it was unlikely to invest in rural electrification programmes. However, the government had approved plans for the construction of two new power stations with a combined capacity of 250 MW.

Nearly 30 % of the population had no access to electricity (approx. 2.2 million people) and CDE had little money to invest in rural electrification. Rural areas were therefore unlikely to receive connection to the national grid in the near future, and urban areas were poorly served because of the poor state of the national grid.

3. PV Programme Experiences and Policy Issues

Despite government indifference, the private sector in PV was thriving, with over 4 500 SHS sold since 1985. The private sector activity was developed through aid-sponsored programmes and had been maintained through consumer demand in both rural and urban areas. It was estimated that more than 1 % of rural households had SHS installed, meaning the rural community was more aware of PV than in most countries.

The government had demonstrated a low awareness of, and negligible policy making in support of, solar energy. However, PV modules were counted as electricity generation equipment and were therefore free of import duties. There was a 100 % duty on batteries to protect indigenous suppliers and manufacturers.

4. Domestic PV Industry

PV businesses used imported PV modules and a mixture of imported and locally manufactured BOS components to assemble systems. Major failures of amorphous silicon modules had led to a rejection of this technology. In order to improve system reliability, the quality of locally manufactured batteries needed to be improved or duties removed from imported batteries. Charge controllers and light fixtures were also manufactured locally.

5. Financing Options

The private sector market in the Dominican Republic was limited only by the lack of end-user finance. Financing schemes had been unsubsidised (though supported by training and promotion) and similar to schemes available for other consumer durables.

There were four revolving funds active in the Dominican Republic which were managed by NGOs. The funds were pioneered by Enersol/ADESOL in 1984. There had been other unsuccessful revolving funds set up, but these were dormant. Experience has shown that NGOs, rather than community associations, are best placed to run the funds. The NGOs also performed a role as intermediaries between the equipment suppliers and the customers, feeding back technical problems noted from their monthly visits to collect payment. Major seed funding contributions had also been made by the Catholic Relief Services (CRS) and the GEF small grants program, as well as many other smaller sources.

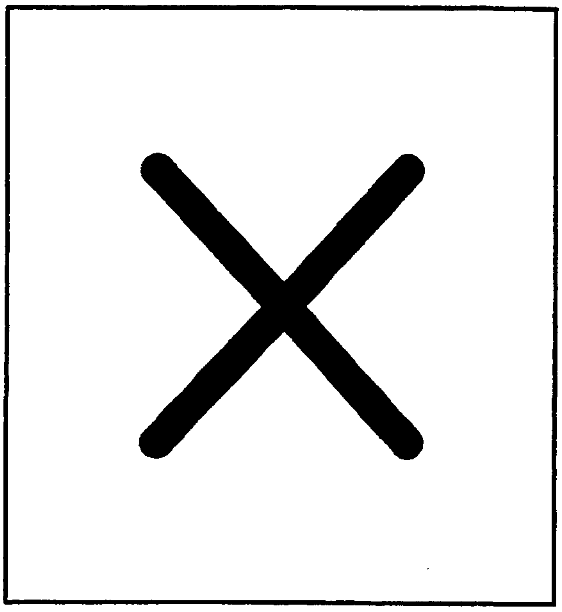
Typical terms were a 25 % down-payment, followed by monthly payments for 12-36 months at 18-22 % interest. For a 700 USD system this equated to roughly 30 USD per month. The 25 % down payment was noted as a significant barrier to many potential customers. Of the 1 850 systems installed up to 1994 by PV businesses affiliated to ADESOL, only 225 (12 %) were on a credit basis, the remainder were cash purchases. The number of credit purchases was limited by the size of the funds, not lack of demand. Many of the cash purchases were funded by relatives abroad.

Enersol had more recently concentrated its efforts on leasing schemes, with an 'Energy Service Company' (ESCO) retaining ownership of a SHS. The ESCO collected a monthly 'energy service' fee, and was responsible for maintenance. Leasing schemes were more capital intensive and difficult to run, but have the potential to open up a larger market due to lower monthly repayment fees.

Enersol collaborated with Soluz Inc. (USA) to form Soluz Dominicana in 1994 to act as an ESCO. 750 systems had been leased in Paerto Plata: the smallest system was 20Wp, available at 5 USD per month. Soluz Inc. were now seeking 575 000 USD from various sources to expand to 2 000 leased systems. The longer-term target was to lease 30 000 systems over 7 years, requiring an investment of 8 MUSD.

The market for SHS could be greatly expanded if additional working capital was available to seed revolving funds, for NGOs to expand their resources, for institutional strengthening of PV businesses and for training programmes.

Ethiopia



Land Area	1 100 000 km^2
Population	58 million
GDP per capita	103 USD
Population Density	52.7 inhabs per km^2
Urban Population	16 %
Labour Force	26 million
Population Growth Rate (1980-1996)	2.7 %
Literacy Rate	24 %

General Data			
Insolation	4.75 kWh.m^{-2}.day^{-1}	Latitude	8°N
Population unelectrified	90 %	Terrain	High plateau with central mountain range divided by Great Rift Valley

PV Data	
PV power installed	
Technical potential	339 MWp (based on 50 Wp SHS for 65 % of households currently without electricity, assuming 5 people per household.)
PV programmes committed	Unknown
Government policy	Indications are that the government is supportive of solar power systems, but lacks the resources to implement them.
Utility programmes & strategies	Utility is supportive of attempts to provide electricity in rural areas through renewable energy or photovoltaic systems, but lacks the funds to operate a programme independently.
Market sophistication	Low
Technical development	None
Pricing structure	Aid projects only – system users not charged.
Testing & Standards	Unknown

1 *Economic and Political Aspects*

At the time of writing, Ethiopia was recovering from a long standing civil war, which was finally resolved with the independence of Eritrea, resulting in the loss of Ethiopia's coastal access.

An estimated 16 % of the population of Ethiopia lived in urban areas, while 80 % of the 26 million strong labour force was engaged in agriculture. The education conditions were very poor, with female enrolment in primary school among the lowest in the world and much of the population having no formal education at all.

Economic figures were difficult to obtain, as the country was just beginning to recover from the two droughts in the 1980s and the civil war. Gross Domestic Product in 1996 was estimated to be 5 990 MUSD growing at a rate of 3.9 %, and average inflation of 8.9 % between 1990 and 1996. It was estimated that agriculture, largely coffee, accounted for more than half of GDP, and provided over 90 % of exports. Import and export figures were estimated to be 423 MUSD and 1 150 MUSD respectively.

2 *Grid Electrification Status*

Electrification was limited to the urban areas, with installed capacity of 330 MW and annual production of approximately 1 300 GWh with annual electricity production per capita of 22 kWh. Hydro-electric schemes generated 80 % of the electricity, with the remaining 20 % provided by traditional thermal generators. A single national electricity authority was responsible for the provision of electricity and was supportive of attempts to provide electricity in rural areas through renewable energy or photovoltaic systems, but lacked the funds to operate a programme independently. In addition, each ministry was responsible for the provision of electricity for its own uses: the ministry of agriculture was responsible for programmes which provided irrigation water, the telecommunications authority was responsible for providing electricity to telecommunications relay stations, etc. Overall, indications were that the government was supportive of solar power systems, but lacked the resources to implement them.

3 *PV Programme Experiences and Policy Issues*

Four main photovoltaic programmes had been implemented in Ethiopia: Vaccination Refrigeration, Solar Radios, Solar Pumping, and Telecommunications. Each was managed by the respective government ministry, with funds provided by a number of sources, including UNICEF, UNHCR, World Food Programme, USAID, SIDA, NORAD, Oxfam, Save the Children, World Vision, Concern, Goal, Jesuit Refugee Service, NCA, and EECMY. With four programmes being managed separately by four ministries with funds from 14 different Aid Agencies, the particulars of each project were difficult to summarise. In general the projects attempted to train local technicians to install and maintain the systems. The systems were regarded as government property and the end-users were not charged for the installation or use.

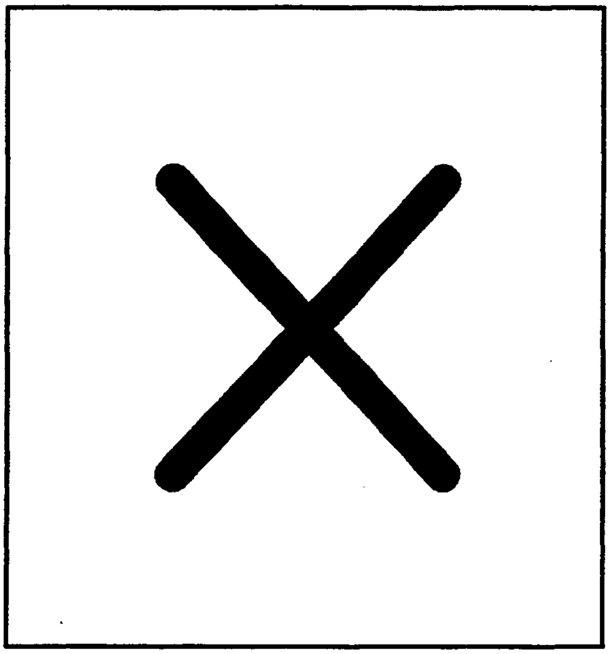
4 *Domestic PV Industry*

There were no system components manufactured in Ethiopia, nor were they readily available for purchase in the private sector. Attempts were being made at the University of Addis Ababa to develop photovoltaic technology and applications in order to facilitate the electrification of the nation, but the research is lagged far behind the technology that was commercially available outside Ethiopia. While the government considered that having photovoltaic manufacturing capability and a commercial photovoltaic market would be beneficial, the resources and infrastructure were not available to develop the industry.

5 *Financing Options*

As all systems to date had been provided free of charge, there had not been a cost recovery mechanism developed. It should be noted that while there was a danger that the local population would be unwilling to pay for photovoltaic power systems in the future because past systems have been funded using Aid grants, the community service applications which these systems provided would not otherwise be available.

French Polynesia



Land Area	3 660 km^2
Population	233 500
GDP per capita	8000 USD (ppp)
Population Density	59.5 inhabs per km^2
Urban Population	NA
Labour Force	119 000
Population Growth Rate (1980-1996)	1.89 %
Literacy Rate	98 %

General Data			
Insolation	$kWh.m^{-2}.day^{-1}$	Latitude	15°S
Population unelectrified	12 %	Terrain	Mixture of rugged, high islands and low coral reefs

PV Data	
PV power installed	NA
Technical potential	180 kWp (based on 50 Wp SHS for 65 % of households currently without electricity, assuming 5 people per household.)
PV programmes committed	
Government policy	
Utility programmes & strategies	The electricity utility, Electricité de Tahiti, had opposed the PV electrification of the outlying islands, to the point of installing national grid connections to islands that have had photovoltaic systems installed.
Market sophistication	
Technical development	High - capable of producing all system components except PV modules.
Pricing structure	No specific finance for PV systems
Testing & Standards	Member of international standards organisations through France.

1 Economic and Political Aspects

French Polynesia is a grouping of small island chains located in the South Pacific with a total land area of 3 660 km^2. In 1996 the population was estimated at 233 500, with a growth rate of 1.89 %. Of this, the labour force was estimated at 119 000, the majority of whom worked in tourism-related jobs. Traditionally a high percentage of the population worked in defence related jobs stemming from the French nuclear testing programme; however, this was ended in 1996, and French Polynesia now has an estimated 15 % unemployment. While the literacy rate was officially listed as 98 %, the history of the Polynesian islands has left the country with a disparate collection of native languages.

The Gross Domestic Product (PPP), estimated at 3 600 MUSD, with a growth rate of 2 %, was based almost entirely upon tourism and French subsidies. Inflation was estimated at 1.5 % annually. With exports estimated at 88.9 MUSD and imports estimated at 765 MUSD, the trade deficit was severe. Black pearls accounted for over half of the national exports, but provided little employment and did not require an industrial base. However, the country was heavily subsidised by France; around 1250 MUSD in 1995. After the decision to cease testing nuclear devices in the area this funding was promised for further ten years after which it will end.

2 Grid Electrification Status

The wide spread of the island chains had resulted in uneven development among the population. Papeete, the capital, had a high standard of living, while many of the outlying islands were without electricity and had very limited economic activity.

The installed electrical capacity was estimated at 75 MW, with annual production of 320 GWh; nearly all consumed on the main island. The electrical utility firm, Electricité de Tahiti, had opposed the PV electrification of the outlying islands, to the point of installing national grid connections to islands that had had photovoltaic systems installed.

3 PV Programme Experience and Policy Issues

Solar power systems were introduced in French Polynesia in 1978 through a demonstration programme, funded by the French Government, the E.U. and private consumers and led by GIE Soler. The project was intended to both spur economic activity in the renewable energy field, as well as induce the island populations to remain on the islands by improving the standard of living and providing electricity for local commercial activities. The photovoltaic systems were designed by the South Pacific Institute for Renewable Energy (SPIRE) in conjunction with GIE Soler, and included development of high efficiency appliances. There were a number of technical difficulties during the initial phases of the project, as well as the opposition of the local utility.

The programme was funded through the French Polynesian Ministry of Energy and subsidised by the E.U, ADEME, and CEA. Half of the systems were installed to private consumers, with a 20 % subsidy and 7 % interest on the loan; this required monthly payments of between 15 USD and 20 USD. The rest of the systems were installed to provide collective electrification to islands as a whole, and difficulties have been experienced with cost recovery. The overall programme was managed by SPIRE, with GIE Soler providing installation and maintenance technicians.

4 Domestic PV Industry

By the end of the electrification programme in 1990, French Polynesia had developed a photovoltaic industry capable of producing all of the necessary system components with the exception of the PV modules themselves. This had led to the export of components to the Cook Islands and Tuvalu, which had also implemented photovoltaic electrification programmes.

5 Financing Options

It was anticipated that the island electrification would continue, with expectations that the private local market would be able to sustain the local photovoltaic manufacturing industry. It was difficult to make projections concerning the economy of French Polynesia, as the end of the French nuclear testing programme could present economic difficulties. It is likely that the survival of photovoltaic market will depend upon the ability of black pearl farms and tourist hotels to both afford the systems and expand rapidly enough to sustain the business; additional orders may also be received from other countries in the area, but the electrification of both the Cook Islands and Tuvalu were entirely dependent upon continued international aid.

Ghana

Land Area	239 000 km^2
Population	18 million
Population Density	78.9 inhabs per km^2
Urban Population	36 %
Labour Force	3.7 million
Population Growth Rate (1980-1996)	3.1 %
Literacy Rate	60 %

General Data			
Insolation	4.9 $kWh.m^{-2}.day^{-1}$	Latitude	8°N
Population unelectrified	60 %	Terrain	Mostly low plains with dissected plateau in south central area

PV Data	
PV power installed	350 kWp (1992)
Technical potential	70 MWp (based on 50 Wp SHS for 65 % of households currently without electricity, assuming 5 people per household.)
PV programmes committed	Solar lighting systems in rural areas fall under the NEP and were therefore duty free. The Spanish Government was to provide a mixed credit loan facility to the Ministry of Mines and Energy for solar electrification.
Government policy	Committed to electrify the whole country by the year 2020. This commitment was being realised within the framework of a National Electrification Programme, initiated in 1980. PV was included as part of NEP.
Utility programmes & strategies	None of the two utilities were known to have been involved with PV to any significant extent but the Northern Electricity Department of VRA was due to play the role of an implementing agency in UNDP/GEF solar electrification project in Northern Ghana.
Market sophistication	Medium
Technical development	In country manufacture of charge controllers and a number of other BOS components including batteries and lamps.
Pricing structure	Little credit available for purchasing PV systems privately, the government was taking positive steps to encourage their use through the NEP
Testing & Standards	Unknown

1 Economic and Political Aspects

The economy of Ghana was almost entirely dependent upon cocoa production, leaving the country reliant upon climactic conditions. Agriculture provided 45% of the Gross Domestic Product (GDP) and employed 55 % of the workforce. GDP was estimated at 6 340 MUSD and grew at an average annual rate of 4.4 % between 1990 and 1996. The consumer price index over the same period was estimated at 29.8 %.

2 Grid Electrification Status

The electricity generation capacity in Ghana was estimated to be 1180 MW in 1995 , almost all of which was generated by the Akosombo hydropower station on Lake Volta. Annual electricity production in 1995 was estimated at 6.2 TWh, with per capita production of 344 kWh.

There were two main power utilities in the country. The Volta River Authority (VRA) was responsible for generation and transmission throughout the country and for distribution in the 4 northernmost regions. The Electricity Corporation of Ghana (ECG) was responsible for distribution in the remaining 6 regions, in southern Ghana. None of these utilities had had any significant previous involvement with PV but the Northern Electricity Department of VRA was due to play the role of an implementing agency in UNDP/GEF solar electrification project in Northern Ghana.

Almost all of Ghana's electricity is generated from the 912 MW Akosombo Hydropower Station on Lake Volta and the smaller downstream Kpong Dam. Only a tiny fraction was generated by the thermal power (coal, oil, gas) stations. In 1994, low water levels resulted in one-sixth of the country's industries losing one production day per week. An economic growth rate of 5 % brought about a 10 % to 15 % increase in electricity consumption.

A District Capitals Electrification Programme was initiated to connect all district capitals (including those that had diesel plants) to the national grid by the end of 1994. Of 110 district capitals, 74 (67 %) were connected to the national grid by the target date - work on the remaining capitals was expected to be completed by 1997.

The Government had also made a commitment to extend the reach of electricity to all corners of the country by the year 2020. This commitment was being realised within the framework of a National Electrification Programme, which was initiated in 1980. The estimated percentage of the total population with connections to the electricity supply in Ghana had grown from about 12 % in 1989 to about 40 % in 1996 although approximately 10 million people still did not have access to electricity. The high-voltage electricity grid passed through every region of the country and all regional capitals had access to grid electricity. Electricity consumption growth rates exceeded 10 % since the onset of the NEP; the demand for electricity had outstripped the grid supply capacity and Ghana had now become a net importer of electricity from Côte d'Ivoire. Other options, such as PV were being used as part of this programme to reach the rural areas.

3 PV Programme Experiences and Policy Issues

Solar lighting systems in rural areas were becoming more prevalent, especially since they fell under the NEP and were therefore duty free. Although there was little credit available for purchasing systems privately, the government was taking positive steps to encourage their use.

As of January 1991 there were 335 solar PV installations in Ghana with a total estimated power rating of about 160 kWp. By October 1992 these figures had more than doubled with the number of installations reaching 700 units and an estimated power rating of over 350 kWp. Most of these applications had been in telecommunications which accounted for more than 80 % of systems: of these, 40 % were owned or operated by the Ghana Railway Corporation and the Ghana Education Service.

A recent UNDP/GEF project approved 3.1 MUSD for PV developments in 13 villages. The project proposed to establish a regional operations and maintenance centre in the East Mamprusi District and 3 renewable energy information centres. Three system types were to be deployed in the project: local micro-mini grid systems powered by PV/diesel hybrid units for the larger villages, battery charging centres and stand-alone communal facilities for commercial/collective use; and home PV lighting systems for households in the smaller villages.

The Canadian Aid Agency, CIDA, had provided 1 MCAD for a Renewable Energy for Rural Development Project at University of Science and Technology (UST). The project saw the establishment of three Solar Service Centres (SSC), which provided battery charging services and also sold complete home lighting systems. Co-operatives had been formed in the towns to manage the SSCs to paying local operating costs, such as labour and rent, out of income from the SSCs. The technicians in charge of SSCs had also undergone training at the DME.

The Off-Grid Solar Electrification Project was being administered by the Ministry of Mines and Energy with internally generated financial resources. The project was part of a broader scheme to promote PV electricity in Ghana. The specific objectives included the preparation of an action and work programme for future integration of solar PV electricity into the National Electrification Programme; to establish a local manufacturing capacity in solar technology (charge controllers and inverters) and to establish standards for PV equipment and components as well as design and installation.

The Spanish Government was to provide a mixed credit loan facility to the Ministry of Mines and Energy for solar electrification. The loan was to be used to purchase solar equipment rural electrification, from the Spanish manufacturer - ISOFOTON which planned to integrate the PV technology backwards by establishing a local facility to produce solar panels, charge regulators, lights etc. Provision was made in the project for training and technology transfer to Ghanaian institutions from both the public and private sectors.

The use PV for rural electrification formed part of the National Electrification Programme (NEP). Therefore, all PV systems imported into the country either by

Government or its agencies, or by private companies for NEP projects, attracted no import duties or taxes. For private project and systems, customs duty of 10 % was imposed on all imported finished solar products. Sales tax (or Value Added Tax) was about 15 %. No import duty and sales tax was charged on raw materials and parts for the production of solar products locally.

4 Domestic PV Industry

There were approximately thirteen companies working with photovoltaic systems in Ghana, although a large number of these had worked on a single programme and had not worked in the field since. The single most important player in the photovoltaic industry in Ghana was the Mechanical Engineering Department, UST. The UST manufactured charge controllers and a number of other BOS components including batteries and lamps. Other companies were also involved in the production of charge controllers.

5 Financing Options

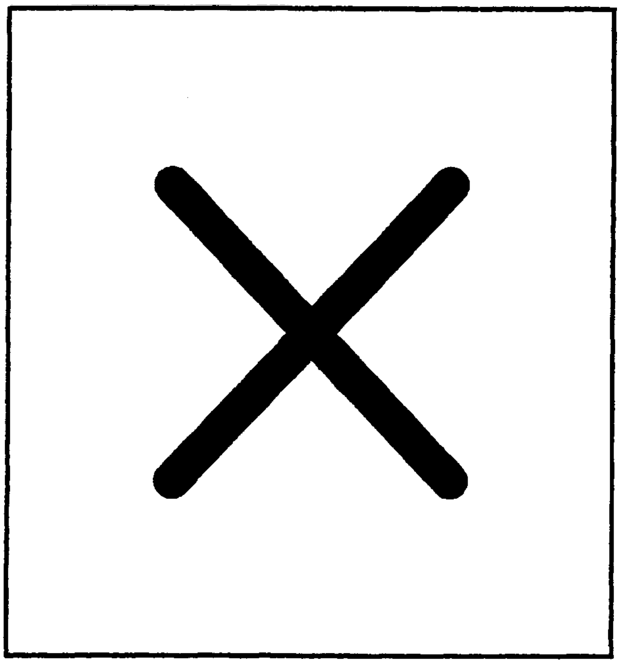
There were no primary lenders or independent financial intermediaries for PV projects in Ghana. PV dealers in the country attributed poor sales to the high initial cost of solar systems and the lack of credit facilities for potential buyers.

Two organisations were known to provide some form of financing, as part of specific projects, for PV systems. The MOME was administering two PV financing schemes as part of its PV Battery Charging Projects in the Upper West Region and in the Greater Accra Region. In both projects the MOME provided interested households with 2 lamps (one 18 W fluorescent tube and one 6 W incandescent bulb), a battery and a regulator; the cost of wiring the house was borne by the occupants. The beneficiaries were required to pay an initial deposit of 18 USD. Take up rates were extremely low possibly due to the costs of wiring etc. The Department of Mechanical Engineering, UST also operated a loan facility as part of its CIDA-funded PV project.

In addition to supporting research and component fabrication at universities and utilising photovoltaic systems as part of the NEP, the government of Ghana was also working in conjunction with the Spanish government to establish a local facility to produce photovoltaic components. The prices (FOB) for the solar equipment, which was to be supplied by ISOFOTON, were 14 USD per Wp for the Home Lighting Systems and 21 USD per Wp for Institutional and Community Lighting Systems. Villages interested in home lighting systems under this facility would be required to pay 30 % of total cost as an initial deposit and spread the remaining 70 % over 10 years, at an interest rate of 2 %. Institutional and community systems would be treated differently, in which case repayment of the total cost would be spread over a period of 8 years, at an interest rate of 6 %.

For most rural and many urban households informal sources provided the bulk of financing supported by extensive systems of rotating savings, savings collectors, and community or social group support funds. Through the 1980s the central bank, with responsibility for rural finance, supported the development of rural banks, but inefficiency and dominance by powerful local interests undermined the effectiveness of many of them until a reform programme was initiated in 1989. At the same time there was a rapid expansion in the number of NGO programmes providing credit, though frequently undermined by a continued presence of, particularly religious, charities offering concessional or gratis funds. Several programmes, however, sought to introduce variants of the Grameen model with NGO support for group formation and awareness raising. Several NGOs concentrated on support for women entrepreneurs (women traditional run the marketing and many other systems in West Africa), including Women's World Banking and an association of professional women. Mass organisations, linked to the Party, especially for women, remained strong and dominated many Government sponsored programmes, benefiting from their high political profile and widespread grassroots organisation.

India



Land Area	2 970 000 km^2
Population	945 million
GDP per capita	USD
Population Density	317.9 inhab per km^2
Urban Population	27 %
Labour Force	408 million
Population Growth Rate (1980-1996)	2.0 %
Literacy Rate	52 %

General Data			
Insolation	5.6 kWh.m^{-2}.day^{-1}	Latitude	20°N
Population unelectrified	68 %	Terrain	Upland plateau in South; flat to rolling plain along Ganges; deserts in West; Himalayas in North

PV Data	
PV power installed	35 MWp
Technical potential	4200 MWp (based on 50 Wp SHS for 65 % of households currently without electricity, assuming 5 people per household.)
PV programmes committed	Numerous programmes were planned and ongoing, including the construction of high capacity power plants to electrify entire regions, small scale domestic lighting / power production, credit provision to encourage market development, and subsidy schemes. In 1998, the GEF/IFC "Photovoltaic Market Transformation Initiative" programme was launched.
Government policy	The Government of India was committed to renewable energy development. The Ministry of Non Conventional Energy Sources was responsible for the specific policy, legislation and support programmes for renewable energy, with the overall aim to achieve a 6 % contribution to power generation from renewable sources by 2002
Utility programmes	Unknown
Market sophistication	Advanced
Technical development	Advanced – full cell, module and BOS manufacturing capability
Pricing structure	A number of banks and non-banking financial companies handle lines of credit and leasing for IREDA's SPV Market Development Programme
Testing & Standards	Unknown

1 Economic and Political Aspects

India had the largest population among the focus countries with an estimated 925 million increasing at a growth rate of 1.8 %. The population was largely rural, with an estimated 23 % living in urban areas. The labour force was estimated at 315 million, with 65 % engaged in rural agriculture. The educational system was poor in rural areas, especially among women; the overall literacy rate was estimated at 52 %.

In 1996 India's Gross Domestic product was estimated at 1.25 TUSD, growing at 5 % to 7 % per year. Agriculture accounts for 34 % of GDP. Since the early 1990s, economic reforms and liberalisation had improved the economic outlook considerably, although inflation was estimated at 10 % per year. India's exports were estimated at 24.4 BUSD, with imports estimated at 25.5 BUSD.

2 Grid Electrification Status

With installed electrical capacity of 81.2 GW and annual generation of 314 TWh, India produced around 439 kWh per capita. Attempts to electrify the country were continuing with nearly every type of energy source under consideration, although India remained reliant upon thermal generation for 71 % of production, followed by 27 % from hydro-electric dams. A further 2 % was generated by 6 nuclear reactors, with 4 more planned. With the majority of the population not serviced, the infrastructure required to meet projected demands will require a substantial investment.

The shortfall between peak electricity demand and supply in India was estimated to be equivalent to 14 000 MW of generating capacity. With the public sector generators and the state-owned electricity distributors unable to meet this shortfall, the Government was beginning to respond to the economic pressure for major tariff reforms and restructuring of the industry to attract new investment.

Independent power producers (IPPs) were actively encouraged to participate, and reductions in subsidies on diesel fuel and petroleum products had recently be legislated. However, with electricity consumption per capita predicted to double over following five years, the shortfall in electricity supply can be expected to increase over the next 10 years.

The positive implications of the electricity supply situation for the PV industry were substantial for the private sector and foreign participation which has been limited to date.

3 PV Programme Experiences and Policy Issues

The Government of India was committed to renewable energy development. The Ministry of Non Conventional Energy Sources (MNES), established in 1991, generated and administered specific policy, legislation and support programmes for renewable energy, with the overall aim of achieving a 6 % contribution to power generation from renewable sources by 2002.

MNES had been providing an impetus to the development and utilisation of new and renewable sources of energy. Awareness promotion, information dissemination, development of standards, operation of test facilities and international co-operation were among the objectives of the Ministry. The responsibility for implementing several vital programmes in solar energy utilisation hadbeen assigned to MNES's financial and promotional arm, the Indian Renewable Energy Development Agency Limited (IREDA).

IREDA's mission was to stimulate, promote, support and accelerate an efficient, environmentally sustainable infrastructure for effective exploitation of New and Renewable Sources of Energy (NRSE) for productive purposes. IREDA operated a revolving fund to develop and promote commercially viable NRSE technologies in the country. Within the initial 9 years of operation, up to 31st March 1996, IREDA had pledged resources to 728 Renewable Energy Projects which amounted to over 328 MUSD.

Government PV purchasing and subsidy programmes had played a significant role in supporting the development of the photovoltaics industry. There were substantial incentives offered by the Indian government for the promotion of renewable energy technologies, including subsidies in the form of financial support and cost-sharing, a wide range of fiscal incentives, and concessional finance.

Government policy and incentives specifically for PV were:

- Government departments'/agencies' own internal programme for "Integration of Renewable Energy" - as illustrated by the Department of Telecommunications' PV powered Rural Automatic Telecommunications Exchanges, etc. which drive the bulk of PV systems sales.
- the socially oriented programmes implemented through nodal agencies and NGOs to install free domestic and street lighting.
- the market oriented programmes administered through the Indian Renewable Energy Agency - IREDA, which utilised donor funds, including the World Bank's 43 MUSD PV Market Development Programme, and other smaller donor schemes. IREDA programmes had extended long-term credit of around 9 MUSD to support 30 projects for installation of solar lanterns, PV pumps and small-scale PV power plants.
- Central and Local Government fiscal and financial incentives, including 100 % capital depreciation, sales tax exemption in certain states and reduced customs and excise duties on PV systems materials and components.
- Incentives for grid connected PV systems, tax holidays on income from PV power sales, low charges for feeding power to the utility grid and favourable buy-back rates.

The installed PV capacity to date is summarised in the following table:

PV system type	Description	Approx. number / kWp
Water pumping	One of the earliest applications tried in India. Initial programme installed 800 small (350 Wp) surface water pumps, subsequent programme expanded by a further 1 000 pumps of higher capacity (600 – 900 Wp). In addition, over 100 deep well pumping systems were installed as part of the National Water Mission to supply drinking water to villages	~2 000
Street lighting systems	Usually comprise two pole-mounted PV modules, charge controller and battery encased at ground level, energy efficient light. Installed by state electricity boards and state renewable energy agencies	30 000
Solar Home Systems	Comprise one PV module, charge controller and battery inside the house, sufficient to power a few energy efficient lights, possibly a small TV	15 000
Community Centre Systems	Also used in Adult Education Centres and Clinics. Standard packages supplied by manufacturers	1 000
Solar Lanterns	Self-contained unit comprising small (10 Wp) module with a (7 W) lantern which houses the battery and electronic control. Programme of supply to villagers currently under expansion	>5 000
PV Power Plants	Small power plants in the range of 2 – 10 kWp had been installed in around 100 villages. Power plants of 100 kWp were also installed in two Uttar Pradesh villages. India's first grid-connected power plant was a 5 kWp system installed in Hyderabad. The feasibility of large grid-connected power plants was under investigation.	~500 kWp
Telecoms.	TV transmitters powered by PV had been in use since 1985. Around 100 low power transmitters had been installed in remote areas. The Department of Telecommunications had procured and installed around 25 000 PV powered radio telephones for rural areas.	> 25 000

Government sponsored programmes were an important component of the 9th Five Year Plan (1997 - 2002). However, further applications for financing under the present IREDA World Bank scheme would not be accepted after March 1998, unless an extension was granted. It was likely that alternative funds would be secured enabling IREDA to perform a modified role in supporting PV.

Numerous future programmes had been developed and were ongoing, including the construction of high capacity power plants to electrify entire regions, small scale domestic lighting / power production, credit provision to encourage market development, and subsidy schemes to assist the impoverished / socially disadvantaged.

The photovoltaic market in India was hampered somewhat by the magnitude of the undertaking. Elements within the Government of India recognised the importance of providing electrical power and the increases in productivity that could be gained through electrification. However, the resources that will be needed to be allocated in order to achieve full electrification are massive.

In 1998, the GEF/IFC "Photovoltaic Market Transformation Initiative" (PVMTI) programme was launched. As part of the programme, 15 MUSD of concessional financing was available for PV support. It should be considered that the PVMTI support will greatly increase the development of the PV industry in India.

Several crucial barriers to implementation of PV in India were identified in the project preparation phase of PVMTI. These are summarised below:

- the unacceptably high incidence of system failure in the field - attributed to a mix of inadequate product specification, quality of installation, and technical competence;
- inadequate marketing, distribution, customer support and after-sales service; attributable to lack of commercial and marketing skills and inadequate levels of investment in appropriate infrastructures;
- dependence on end-user subsidy and too high an incidence of discredited customer credit schemes.

4 Domestic PV Industry

One of the significant features of the PV status in India is that there were several private sector industries competing in the areas of PV system manufacturing including design, assembly, installation and commissioning of systems. There were additionally over 50 small entrepreneurs largely undertaking supply and installation of PV systems and executing contracts.

Most of the PV shipment in the country was through the institutional market route, meaning that PV manufacturers were selling their products to various government organisations and other institutional sectors such as state modal agencies who were distributing these systems directly to beneficiaries. The consumer market in India was marginal; PVMTI could prove beneficial in supporting its development.

Twelve companies accounted for the bulk of output and module capacity, with two state owned (Central Electronics Ltd and Bharat Heavy Electricals Ltd) and four private sector organisations producing over 1 MWp each in 1996. RES and Udhaya Semiconductors were significant indigenous manufacturers, with TATA BP Solar, XL Telecon, Pentafour and Webel the leading organisations with foreign joint venture partnerships. Several companies were experiencing financial difficulties due to over-expansion.

India was able to produce all BOS components, as well as possessing the manufacturing technology for PV module productions. Efficiency and quality of modules varied widely but the larger producers consistently deliver acceptable quality equivalent to international norms. Module prices in India were between 25 % and 30 % above international prices.

In addition to single-crystal silicon modules, MNES had supported research into amorphous silicon production. A pilot plant for amorphous silicon modules was established by Bharat Heavy Electricals Ltd (BHEL) at Gwal Pahari in 1992.

The PV module manufacturing industry imported 100 % of its demand for low iron glass, EVA and Tedlar, and 80 % and 50 % of its demand for wafers and cells. The recent sharp increase in demand for wafers in the US and Japan resulted in a short-term scarcity of raw materials.

In response to the current crisis, a number of systems houses had, or planned to set up small scale module production (< 0.5 MWp), to service their own demand. This backward integration on such a small scale may not remain viable when the market starts to demand improved quality and pricing.

The larger private sector manufacturers made their own inverters, and relied on internal sourcing of charge controllers. The balance relied on imports or a small number of local suppliers. A number of international brand-name battery suppliers manufactured locally, and a solar battery line was also planned by one manufacturer. Power conditioning systems for grid inter-connected power generation were entirely imported.

Around 30 systems houses were involved in the lantern and street lighting programmes, 16 organisations in water pumping and over 15 in solar lighting. Most were small-scale serving a niche local market, with only TATA BP and RES of any significant size.

Only Tata BP Solar, RES Photovoltaics and Udhaya Semiconductors, all manufacturers, had created dealership networks of any significance - as the demand had not encouraged such structures. Only one large organisation with an established dealership network across India was known to be investing in market development and only on a small scale.

Based on appraisals conducted under the IREDA programmes, incidence of systems failure - through poor installation or incorrect or inappropriate BOS specification - was high, at over 30 %.

5 *Financing Options*

Decentralised electrification of rural areas was considered more cost effective then developing more large power stations and extending the national grid, and the benefits of electrifying the rural areas were considered necessary to the continued development of the nation. The benefits as seen by the Indian government included: increased awareness, support to weaker sections of society, improved healthcare, improved education, and income generation through farming, fisheries, handlooms, and village craftsmen. In addition, providing electricity to a greater portion of the population will increase the market for electrical goods, providing follow on economic benefits.

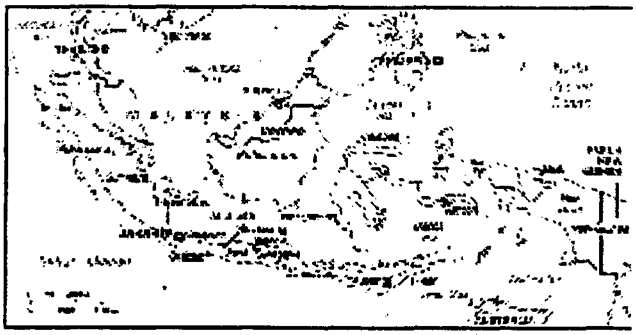
The World Bank had mobilised a line of credit of 195 MUSD for the "India: Renewable Resources Development project", which envisaged installation of a capacity of 187.5 MW in three renewable energy sectors, of which PV accounted for 43 MUSD of the funds.

A number of banks and non-banking financial companies handled lines of credit and leasing for IREDA's SPV Market Development Programme

Those projects which used World Bank funding utilise a revolving fund, while other projects had provided 50 % subsidies or interest rate subsidies. In general, at least some form of cost recovery was used, usually with collection conducted by local intermediaries. IREDA was the institution that monitored the financial transactions and was the final collector of payments.

Over five years from 1998, PVMTI was expected to invest 15 MUSD at a preferred leverage of 3:1, increasing the annual PV market size from 10 MWp/year in 1997 to 28 MWp per annum.

Indonesia



Land Area	1 812 000 km^2
Population	197 million
Population Density	108.7 inhab per km^2
Urban Population	36 %
Labour Force	91 million
Population Growth Rate (1980-1996)	1.8 %
Literacy Rate	77 %

General Data			
Insolation	$kWh.m^{-2}.day^{-1}$	Latitude	5°S
Population unelectrified	70 %	Terrain	Mostly coastal lowlands, larger islands have interior mountains

PV Data	
PV power installed	1.8 MWp
Technical potential	900 MWp (based on 50 Wp SHS for 65 % of households currently without electricity, assuming 5 people per household)
PV programmes committed	1997 programme to install 1 million SHSs nationwide. World Bank and GEF funding was secured for 200 000 homes (10 MWp) in West Java, Lampung and South Sulawesi.
Government policy	Government had made rural electrification a priority and Suharto government gave considerable support to photovoltaic applications. In 1997, the GOI set a target for 50 MWp of PV by 2005.
Utility programmes & strategies	Specific utility involvement unknown.
Market sophistication	Advanced
Technical development	Weaknesses in the Indonesian industry were in the production of high quality batteries and photovoltaic modules, both of which were being addressed
Pricing structure	As part of World Bank/GEF project dealers should receive five year loans at market rates through the commercial banks (refinanced by Bank Indonesia from donor funds). Dealers should set their own terms for clients. Also large potential for cash sales.
Testing & Standards	The Bureau for the Assessment and Application of Technology is responsible for UPT-LSDE, a government laboratory with extensive facilities was responsible for the testing and demonstration of PV technology. Presence of international companies should ensure modules tested to international standards.

1 Economic and Political Aspects

Indonesia is one of the major island groups of Asia, encompassing 1.8 million km^2, and is the fourth most populous country in the world. The 1996 population was estimated at 197 million, with a growth rate of 1.8 %. A fall in the birth rate from 5.6 % in the late 1960s, to 2.9 % in 1996, offset the significant decline in the mortality rate over the same period.

Although the literacy rate was estimated at 77 %, there were a wide variety of languages and dialects, making estimates of literacy difficult to quantify. The proportion of people living in urban areas increased from 22.4 % in 1980 to 36 % in 1996. The urban population had grown at a rate of around 5.4 % a year, compared to a rural population growth of just 0.8 %. A total of 50 million people – 55 % of all those employed - worked in the agricultural sector.

Before the Asian economic crisis of 1998, which had a major impact on both the political and economic environment of Indonesia, the country was known as one of the 'Tiger Economies' of Asia. In 1996, Gross Domestic Product was estimated at 226 BUSD with an annual growth rate of 7.7 % and inflation of 8.8 % between 1990 and 1996. This growth was led by the Indonesian government, which invested heavily in developing infrastructure to support industrial activity - especially in the 'high-tech' sector - and encouraged private sector commercialism. Although Indonesia retained elements of central planning - notably five year plans - it had started to deregulate key areas of the economy.

Prior to 1998, Indonesia had a balanced economy, with output split almost evenly between the three main sectors. Exports were dominated by semi-processed and manufactured goods, following the collapse of gas prices (which was Indonesia's main source of wealth) in the 1980s.

Industry had been the main driver of economic growth. In 1996, it had expanded its share of GDP from 8 % in 1965 to around 24 %. However, in more recent years utilities were the fastest growing sector, averaging annual growth rates of 14 % since 1985.

2 Grid Electrification Status

The Ministry of Mines and Energy was responsible for the national electrical supply, operating through two offices, the Bureau for Planning (BAPPENAS), and the Directorate General of Electricity and Energy Development (DGEED). However, many of the other offices had active involvement in previous PV programmes, depending upon the sector, for example health, industry and R&D.

A single state owned utility, Perusahaan Umum Negara (PLN), provided electrification on the national scale, with an installed generating capacity of 11.6 GW and annual production of 61.2 TWh, the majority of which was provided for industrial loads. As the population was spread across a large number of islands, central infrastructure was only feasible on those islands that had large populations and were supporting economic activity. PLN had historically relied upon hydro-electric and diesel generators to power 'mini-grids' for rural electrification. With 63 % of the rural population estimated to consume under 30 kWh per month, many of the more remote areas were considered uneconomic for operation by PLN, and electricity was provided by small private sources, usually village co-operatives known as 'KUDs'.

Although the government had made rural electrification a priority, the fragmented geography of the archipelago created particular problems for extension of the grid. For this reason many rural population centres were served by isolated diesel mini-grids, with capacities of 20 kW to several megawatts. However, in the smallest and most dispersed communities, these isolated grids were not viable and PV could be an economical option.

The Bureau for the Assessment and Application of Technology (BPPT), under the Ministry of Research and Technology was responsible for the management of all state-initiated PV projects. BPPT was responsible for UPT-LSDE, a government laboratory with extensive facilities for the testing and demonstration of PV technology.

The Ministry of Co-operatives was involved in project implementation due to the high involvement of village co-operatives (KUDs) in SHS projects. It had developed selection criteria for the KUDs involved in previous PV projects and provided the interface between the KUD network and GOI.

Energy production per capita in 1994 was 281 kWh and total national production was 53 414 GWh. The residential share of electricity consumption had fluctuated widely since 1986, with the share in 1993/94 being over 30 %. The industrial share grew strongly up to 1991, and was around 50 % in 1994. In 1995, Perusahaan Umum Negara's (PLN), the state owned electricity company, capacity was 14 370 MW (55 % of the total) and non-PLN capacity was 11 693 (45 % of the total). Of the 124.6 million rural population, 34 % were supplied by PLN for light, 4 % were supplied by non-PLN sources and 62 % used kerosene. Demand for electricity grew at 11.8 % per annum between 1985 and 1995: in 1996 demand was reportedly growing at about 15 % per annum.

There had been a rapid increase in the number of households with access to electricity, increasing from 14 % in 1985 to just under 40 % in 1995. An alternative indicator for rural electrification was the village electrification rate (a village is regarded as electrified if more than twenty households are connected to the electricity supply). There were about 62 000 villages in Indonesia, of which 57.5 % were electrified in 1995. However, there were wide regional variations: Java had the highest ratio at 78 %, whilst Kalimantan had a rate of only 28 %.

3 PV Programme Experiences and Policy Issues

The previous Indonesian government gave considerable support to photovoltaic applications, because President Suharto considered the electrification of the country to be a priority for maintaining economic growth and believed that photovoltaics offered one of the most cost effective methods. It was not known what direction the new government would take regarding the implementation of PV for rural electrification.

By the end of 1996, government sponsored solar PV projects and private initiatives had resulted in the installation of over 1 MWp of PV capacity in rural areas. PV systems were first demonstrated in Indonesia in 1979 through a water pumping project carried out by the German Aid agency GTZ, with the assistance of the Indonesian government.

The first rural electrification was of Sukatani village, Java, where 85 SHS, 7 public systems and 15 street lights were installed in 1989. This was funded by the Dutch aid agency DGIS, and involved the BPPT, the Ministry of Co-operatives, the local government and the international and local branch of PV manufacturer, R&S (now Shell Solar).

The success of the Sukatani project led to a rural electrification scheme in the village of Lebak, in which a further 500 systems were installed; these systems typically had a 45 Wp module, sufficient to power two 6 W lights.

The above pilot programmes were followed by the Presidential Aid Programme, BANPRES, with interest-free credit provided for 3 000 SHS. These were successfully installed and, although cost-recovery was poor, some additional credit schemes had been started through the revolving fund.

Since 1993 the Department of Health had driven the installation of 270 medical clinics with PV lighting and refrigerators, requiring around 75 000 PV modules. Eight hybrid mini-grids had also been installed in eastern Indonesia, on Nusa Penida. The hybrid generators were developed by IPC / Westinghouse and used a meter prepayment system, which aimed to match customer consumption with ability to pay. Additional major projects included the GTZ Eldorado Sun, a project funded by the German Aid agency GTZ to develop solar pumping projects on four islands, and a project funded by the Australian Aid agency AusAid to install 36 400 SHS of 50 Wp each.

In 1997, the World Bank and the Global Environment Facility (GEF) were in the process of launching a programme to assist the Government of Indonesia (GOI) to provide 200 000 Solar Home Systems to households in West Java, South Sulawesi and Lampung, Sumatra.

All solar equipment was exempt from import tax and duties, providing similar products were not manufactured in Indonesia.

4 *Domestic PV Industry*

All of the major international photovoltaic power system manufacturers, such as BP Solar, Kyocera, Shell Solar, Siemens and Solarex had either a subsidiary or local distributor in Indonesia, an indication that Indonesia's policies encouraging both the implementation of photovoltaics and the use of the local labour force in the manufacture of photovoltaic power system components were successful.

While the use of high import tariffs to protect local industry could lead to stagnation in the market and poor quality, high cost goods, the Indonesian market remained competitive through collaboration with international firms. The two main weaknesses in the Indonesian industry were the absence of the production of high quality batteries and photovoltaic modules, both of which were being addressed. A local battery manufacturer was working in conjunction with BPPT to develop high quality batteries, and attempts were being made to acquire the 'clean' manufacturing technology necessary for silicon cell production.

The BPPT had invested considerably in the development of its Test Laboratory, UPT-LSDE, located near to Jakarta in Serpong. This facility was set up in 1979 and was equipped with over 7 kWp of PV test array, which could be configured to provide output voltages of 12 V to 240 V. It had several laboratories for testing electronic control devices and a computer-based data acquisition system, as well as PV pumping and battery test facilities.

BPPT had closely monitored the standards and performance of the existing SHS projects installed. It was partially responsible for developing the specification of the BANPRES SHS, together with the private PV industry involved.

Further assistance in testing and training was being sought as part of the proposed WB/GEF project. This would enable UPT-LSDE to carry out certified approval of each solar home system to be installed by the dealer networks. The criteria were that each 50 Wp or larger system should power at least three fluorescent lights (@ 200 lumens) and a black and white TV for 4 hrs/day or more, assuming average insolation.

5 Financing Options

The Lebak and Sukatani projects were sold to the villagers through the co-operatives (KUD) by means of an interest free loan. Average investment was around 400 USD. The villagers made a downpayment of 5 % followed by monthly payments of around 3 USD for a period of 10 years. This was used to cover maintenance and repairs, with the remaining money used to establish a revolving fund for further projects.

The Indonesian government identified the lack of appropriate financing as the single greatest impediment to increased use of photovoltaic systems for rural electrification. The Presidential Aid Programme (BANPRES), opened personally by President Suharto in 1991, was aimed at providing interest free loans through village level KUDs in 13 provinces. Although the programme led to the purchase of around 3 300 systems, it was considered a promotional programme because of the poor cost recovery record. Purchasers were required to make an initial payment of 5 % of the 400 USD cost, followed by payments of approximately 3 USD per month for ten years.

However, in 1993 it was estimated that BANPRES fee collection was in arrears by 40 %, attributed to seasonal incomes, short term cash crises and inadequate income levels to meet payment obligations. Failure to disconnect, particularly of the village elite, also encouraged non-payment. Consumers expressed the need to make the down payment by instalments over several months. The monthly fee was equivalent to the monthly connection fee on the grid, although it has been noted that other SHS projects with substantially higher fees had equal or better payment records. Demand was considered relatively price inelastic so higher cost recovery and shorter terms could perhaps have been acceptable. A major problem was the need to replace batteries, the high cost of which often resulted in the purchase of inferior technology.

Subsequent projects had targeted end-users that were able to pay for the systems on a consumer financing basis. Three major local dealers - Pt. Sudimara, Pt. Kyocindo and Pt. Walet - offered short term credit (3 years) at around 18 % interest with a 30 % downpayment. Typical monthly fees of around 8 USD were required.

In 1995 Sudimara reported system sales at 400 USD plus 10 % VAT. Around 10 % to 15 % of sales were cash. Credit terms were 140 USD downpayment and 40 monthly payments of 10 USD interest at 1.5 % a month. These were being sold through regional service centres (approximately one per 10 000 to 20 000 families) in three provinces.

One of the major PV manufacturers had also recognised the private sector opportunities and taken an aggressive approach, focusing on the outer provinces which public-funded programmes had not reached. This required substantial investments in capacity building of dealers and end-users. Overall, the company witnessed several thousands of sales by private dealers over the past decade. Some sales were based on informal credit mechanisms, but the company believed that tens of thousands of cash-paying customers would exist if the market were fully developed.

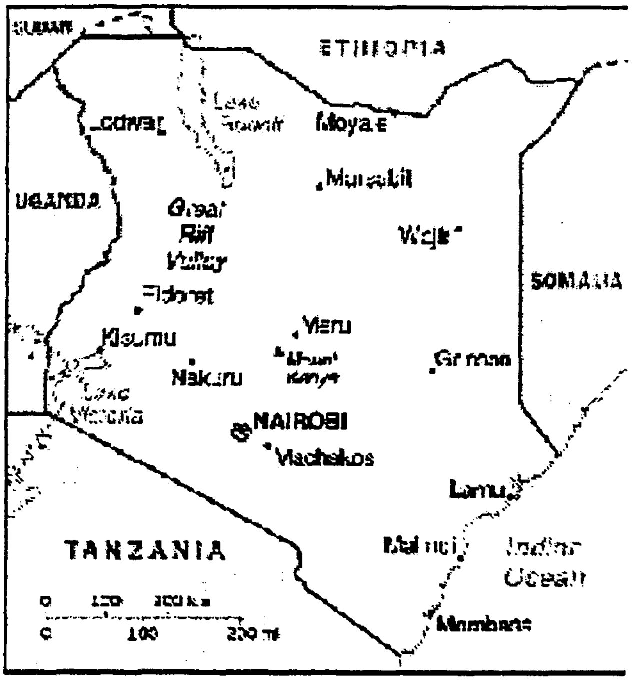
In 1995 it was reported that 13 000 SHSs had been sold privately. Smaller systems were found to be more profitable. Payment plans lasting longer than two years did not seem to work, apparently because battery failure occurred during repayment, at which time collection rates fell sharply.

This private initiative found that collection at village level was enhanced by having village level dealers who knew the individuals concerned. Dealers had to have previous experience of financing as it was not considered worthwhile to train them. Very few sales were through bank credit (perhaps because PV is not a income generating asset). Supplier credit for dealers was considered crucial for successful marketing and distribution. Many systems were sold for cash, and market development was viewed by the initiating company as more of a constraint than was the absence of special financing mechanisms.

In 1997, the GOI set a target for 50 MWp of PV by 2005, to be installed across 6 000 of the 13 000 islands, which make up Indonesia. It aimed to install 1 million SHSs nationwide. Marketing and credit would be managed by local government in co-operation with Co-operative Village Units (KUDs). Donor funds were to be on-lent through Bank Rakyat Indonesia (BRI). KUDs would act as financial intermediaries, with users signing a lease-purchase contract involving monthly fees until the total cost had been paid and ownership transferred. In the meantime, KUDs and suppliers would co-operate for installation and maintenance.

As a part of the above programme, World Bank and GEF funding was secured for 200 000 homes (10 MWp) in West Java, Lampung and South Sulawesi. Around ten dealers should receive five year loans at market rates through the commercial banks (refinanced by Bank Indonesia from donor funds). Dealers should set their own terms for clients, which were expected to be around 80 USD to 100 USD downpayment with subsequent monthly payments for 3 - 4 years. Dealers would receive a GEF grant of 75 USD per unit in Java and 125 USD per unit on the other islands.

Kenya



Land Area	569 000 km^2
Population	27 million
GDP per capita	377 USD
Population Density	47.5 inhab. per km^2
Urban Population	30 %
Labour Force	418 000
Population Growth Rate (1980-1996)	3.1 %
Literacy Rate	69 %

General Data			
Insolation	5.4 kWh.m^{-2}.day^{-1}	Latitude	1°00 N
Population unelectrified	90 %; perhaps 1 % of rural population electrified.	Terrain	Low plains rising to central highlands bisected by Great Rift Valley; fertile plateau in west.

PV Data	
PV power installed	Over 2 MWp
Technical potential	155 MWp (based on 50 Wp SHS for 65 % of households currently without electricity, assuming 5 people per household.)
PV programmes committed	Photovoltaic Market Transform Initiative
Government policy	Rural Electrification Master Plan should re-stimulate rural electrification activities. It was anticipated the plan wouldl give specific attention to PV.
Utility programmes & strategies	Kenya Power and Lighting Company responsible for implementation and operation of the Rural Electrification Programme.
Market sophistication	Advanced
Technical development	BOS components manufactured; modules imported.
Pricing structure	Commercial cash sales/ short term credit based market
Testing & Standards	There had been no organised standards, testing or certification programmes.

1 Economic and Political Aspects

Since 1993, the Kenyan government had implemented a programme of economic liberalisation and reform. These reforms included the removal of import licensing and price controls and the privatisation of publicly owned companies.

The population was approximately 29 million people, with a growth rate of 3.1 % between 1990 and 1996. Approximately 20 % of the population was urban based. Nairobi, the capital city, is the primary city of the region.

Gross Domestic Product was estimated to be 356 BUSD in 1996, with a growth rate of 5.8 % between 1990 and 1996: inflation over this period was estimated at 9.9 %. Between 75 % and 80 % of the 8.78 million strong labour force were engaged in agriculture, accounting for some 30 % of GDP. The primary industrial activities were the manufacture of small-scale consumer goods, processing of agricultural products, oil refining, cement and tourism. Imports were estimated at 2.6 BUSD in 1996 compared to exports of 1.9 BUSD. Tea and coffee accounted for nearly 55 % of export earnings. Kenya's main trading partners were Uganda and the United Kingdom.

2 Grid Electrification Status

Electricity generating capacity was estimated at 81.2 GW in 1995, with generation of 415 TWh in that year, providing a production per capita figure of 439 kWh. In 1995, over 83 % of Kenya's electricity was generated from large hydro sources along the Tana and Athi rivers. A further 9 % was generated from oil. There were two privately owned generators providing electricity to Kenya Power and Lighting Company (KPLC). Approximately 15 % of generated electricity was lost through transmission losses and theft. Demand had grown at approximately 6 % per year and the installed generating capacity had been unable to meet this growth in demand resulting in load shedding throughout the country. More than 50 % of the electricity generated was consumed in Nairobi province, with a further 20 % consumed in Coast Province.

Kenya's power sector was in the process of privatisation in an attempt to break the power monopoly of KPLC. The project, launched in 1997 was funded by the World Bank, the European Investment Bank and the Ministry of Energy.

Efforts to provide electricity to the rural areas of Kenya were started by KPLC in the 1960s and were formalised in the Rural Electrification Plan of 1973. However, it was not until the late 1980s that a larger scale development started to take place. The prime objective of the programme was to extend electricity into 'sub-economic rural areas' focusing on supply of electricity to agro-based and other small industries. Individual households were not given priority in REP planning as the costs were too high.

In 1994 the government of Kenya with the African Development Bank initiated the development of the Rural Electrification Master Plan in order to re-stimulate rural electrification activities. It was anticipated that the plan would give specific attention to the potential role of PV as a complement to traditional grid related activities. However, the documentation was not available.

3 PV Programme Experiences and Policy Issues

There had been a number of small PV projects in Kenya over the last 10 years funded by various multilateral and bilateral agencies.

Between 35 and 40 kWp of PV was installed as part of a project to develop commercial fishing in Lake Turkana in 1989. The PV equipment was used for power pumping, security lighting, refrigeration and office power systems. The fisheries project was not a success and much of the equipment was reused in other projects.

Several hundred PV vaccine refrigerators had been installed by the Ministry of Health under the Kenyan Extended Programme of Immunisation since 1990.

A water pumping project was initiated to install 10 to 12 PV pumps for Maasai communities around Amboseli. The project was funded by grants from Swedish donors who were no longer active in Kenya. Of the 10 to 12 pumps originally identified, only five or so were actually installed.

A programme started in 1994 to make low cost solar lanterns widely available in Kenya was started in 1994 funded by the World Bank ESMAP, CSC, the Ashden Trust and the UK DfID.

Government policy towards PV in Kenya was very positive although very little money was actually spent. The Ministry of Energy had a renewable energy and solar power section although it was not well funded. The Ministry of Energy runs 10 energy demonstration centres in various districts of Kenya.

Although duties on PV and associated equipment were lowered in 1994, the duty structures are complex: a PV module without bypass diodes attracts lower duties than one with bypass diodes. This effectively discriminated in favour of amorphous silicon modules. A PV module without bypass diodes attracted 5 % import duty and no VAT whereas a module with bypass diodes attracted between 10 % and 15 % duty and VAT (15 %). Charge controllers attracted full import duties (35 %) and VAT (15 %).

4 Domestic PV Industry

The PV market in Kenya had been active for over a decade and estimates were that over 50 000 solar home systems had been installed on a commercial basis and a large number of government/donor systems had been installed in other remote power markets.

There were as many as 15 PV module distributors and a further 20 or so companies manufacturing balance of system equipment, with hundreds of small independent agents marketing or installing PV systems in rural areas. Many of the large international PV manufacturers had appointed dealers in Kenya: these dealers import both modules and BOS components. There were two local manufacturers of batteries providing both automotive and solar batteries as well as numerous companies manufacturing lamps as well as limited manufacture of charge controllers and inverters.

In 1996 it was estimated that perhaps 270 kWp of PV was installed of which 110 kWp was amorphous silicon technology. Including BOS and installation, the PV market was worth in the region of 5 MUSD in 1997. Between 50 % and 60 % of this was in the solar home systems market.

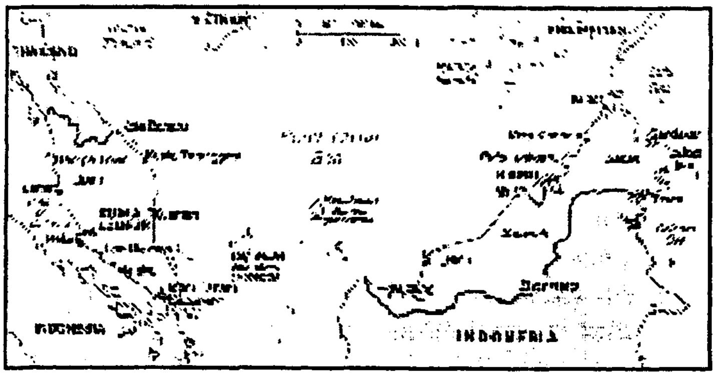
5 Financing Options

Although there were no operational finance schemes in place for solar home systems in Kenya, hire purchase schemes financed as many as 2 000 systems per year. These schemes were usually over a 12 or 24 month period and interest levels could be as high as 40 %. Kenya's banking system was one of the strongest in East Africa, but it was primarily based in Nairobi and other major cities. Local lenders and donors had prioritised rural credit for businesses and there were a number of initiatives investing in rural credit in the pubic and private sector. Credit was available to agricultural co-operative members through locally based co-operative agencies. However, PV was still a new concept to most banking organisations and no PV financing projects had gone beyond the pilot stage. NGOs have a role to play in the non-formal credit sector and Kenya Rural Enterprise Programme (K-REP) had been active in this area. K-REP had developed and implemented successful methodologies for providing small loans to rural entrepreneurs based on group security mechanisms. K-REP had been involved in a number of solar projects in the past. There were plans for the NGO to split into a Rural Bank (which will be capitalised with 1 MUSD).

The Co-operative Bank of Kenya was the largest rural credit provider in the country and worked with various rural co-operatives. The bank was in the early stages of a pilot financing project for solar home systems.

Over five years from 1998, PVMTI was expected to invest 5 MUSD at a preferred leverage of 2:1, increasing the annual PV market size from the current 300 kWp/year in 1997.

Malaysia



Land Area	329 000 km^2
Population	21 million
GDP per capita	4 724 USD
Population Density	63.8 inhab per km^2
Urban Population	54 %
Labour Force	8 000 000
Population Growth Rate (1980-1996)	2.5 %
Literacy Rate	78 %

General Data			
Insolation	5.1 kWh.m^{-2}.day^{-1}	Latitude	2 30 N
Population unelectrified	19 %	Terrain	Coastal plain rising to hills and mountains

PV Data	
PV power installed	640 kWp (1993)
Technical potential	26 MWp
PV programmes committed	Ministry of Rural Development established a rural community initiative encompassing the Sabah, Sarawak and Peninsular Malaysia Provinces in 1996. The 34 MUSD programme was to run for 5 years in 2 phases to improve rural village services.
Government policy	Supportive of PV for rural electrification providing it was economic.
Utility programmes & strategies	TNB utility had installed PV for evaluation purposes.
Market sophistication	Low
Technical development	No PV industry although technical capability exists.
Pricing structure	Unsubsidised
Testing & Standards	Group C member of International Electrotechnical Committee.

1 Economic and Political Aspects

Malaysia has a land area encompassing 329 000 km^2 of isthmus and island in the Pacific rim area, and an estimated population of 21 million in 1996. The population growth rate between 1990 and 1996 was estimated at 2.5 %. Approximately 54 % of the population was urban-based, while 20 % of the 8 million strong labour force was engaged in agriculture. Literacy tares were estimated at 78 %.

Malaysia is one of the "Tiger" economies of Asia, generally considered an emerging, rather than developing market. Gross Domestic Product was estimated to be 99 BUSD in 1996 with a growth rate between 1990 and 1996 of 8.7 %, the highest of the countries in this survey. This growth had resulted in a marked increase in real wages and a substantial reduction in poverty. (It must be noted that the recent financial crises in the area may call the sustainability of this growth into question.)

Prior to the crisis, Malaysia's economy was export led, with exports estimated at 84.6 BUSD in 1996, compared to imports of 83.2 BUSD in the same year. Exports were mainly of electronic goods and petroleum products to the USA, Singapore and Japan. The consumer price index between 1990 and 1996 averaged 4.2 %.

2 Grid Electrification Status

Installed electricity generating capacity was estimated at 8 GW in 1995, generating some 45.5 TWh in that year. In 1995, approximately 87 % of the generated electricity was from thermal sources and the remainder from hydro. Per capita electricity production was 2 167 kWh. Approximately 99 % of the Malaysian Peninsula was electrified, although in the Sabah and Sarawak regions, electricity only reached approximately 70 % of the population. Projections were that electricity demand would continue to grow for the foreseeable future. During the Seventh Malaysia Plan, (1996-2000) there were plans to commission more than 4 GW of electricity generating capacity. This increased capacity was to be met by the three existing utlitiies: Tenanga National, Sabah Electricity Board and Sarawey electricty Supply Corporation and nine Independent Power Producers. Work on the 2.4 GW Bakun Dam project was suspended indefinitely in 1997 citing an unexpected rise in the project cost due to the country's economic difficulties.

With regard to the rural areas, grid connection was not regarded as economical, primarily due to low consumption rates (estimated at less than 1 kWh/day). As a result, PV and mini/micro hydro systems were viewed as pre-grid electrification options to introduce the convenience of electricity.

The Malaysian Governments Energy Policy revolved around the supply, utilisation and environmental objectives. Supply objectives aimed to provide the nation with adequate and secure energy supplies: efforts to do this focused on reducing Malaysia's dependence on oil and by developing and utilising alternative energy sources. The utilisation objective aimed to promote energy efficiency and discouraging wasteful and no-productive patterns of energy consumption. The environmental objective sought to ensure that factors relating to the environment were not neglected in pursuit of the supply and utilisation objectives.

3 PV Programme Experiences and Policy Issues

There were a wide range of different PV systems applications in Malaysia, including water pumping, SHSs, professional systems (particularly telecommunications) and annual procurement with the military.

In the 1980s, the since privatised electricity utility in Malaysia, Tenanga National Berhad, through its R & D arm, TNRD, initiated a programme to evaluate the technical and economic potential of renewable energy, concentrating on mini-hydro and PV projects. Three stand-alone solar home projects were implemented by TNB: 37 houses in Apau, Langkawi; 70 houses in Tembeling, Pahang; and 50 houses in Pulau Sibu, Johor. These systems were all abandoned due to poor performance of the batteries and untrained staff following the departure of the project team.

In 1994 a 10 kWp plant was installed at Manahan, Sabah. The plant was used for supplying lighting and power for refrigeration, TVs and radios for 17 houses. In 1996 a 100 kWp plant was opened at Marak Parak, Sabah to provide power for 300 houses. In 1996 CASE completed the installation of two RAPS systems using PV-wind hybrid systems at two locations in Sarawak.

TNB/TNRD also had plans to install six, 3 kWp to 5 kWp grid connected PV systems at different locations in the Klang Valley between 197 and 1999.

In 1996 the Malaysian government established through the Ministry of Rural Development a rural community initiative encompassing the Sabah, Sarawak and Peninsular Malaysia Provinces. The programme was part of a 5 year programme to improve rural village services and had a major PV component. Phase 1 consisted of the installation of 1 200 stand-alone systems, and Phase 2, (co-funded by AUSAID) will involve the installation of 7 200 systems for home lighting, vaccine refrigerators and school facilities. Phase 1 was worth an estimated 4 MUSD with Phase 2 worth 30 MUSD between 1997 and 2002.

Aside from these programmes, experience with photovoltaic power systems was mainly in the private sector and concentrated in the telecommunications sector.

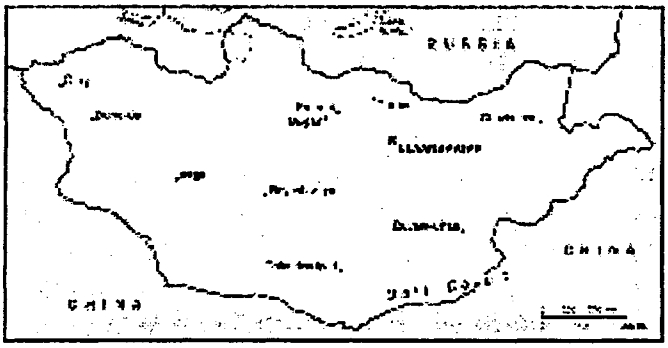
4 Domestic PV Industry

While Malaysia had a highly developed manufacturing base, photovoltaic production capacity was non-existent. As a result nearly all components, modules and BOS, were imported.

5 Financing Options

The recent financial crisis in the far East had affected the market for PV. The 40 % devaluation of the Ringgit, coupled with the fact that there were no indigenous PV manufacturers resulted in a sharp increase in the price of imported equipment and components and drastically reduced the affordability of PV systems. This situation was compounded by the fact that the rationale behind the Malaysian government's investment in rural electrification was to allow market mechanisms to establish prices. This provided little incentive for private sector involvement in PV.

Mongolia



Land Area	1 570 000 km^2
Population	3 million
GDP per capita	324 USD
Population Density	1.9 inhabs per km^2
Urban Population	61 %
Labour Force	1 000 000
Population Growth Rate (1980-1996)	2.6 %
Literacy Rate	83 %

General Data			
Insolation	4 kWh.m^{-2}.day^{-1}	Latitude	46 00 N
Population unelectrified	60 %	Terrain	Vast semi-desert and desert plains; mountains in west and southwest: Gobi desert in southeast.

PV Data			
PV power installed	80 kWp (1993)		
Technical potential	12 MWp	Commercial potential	5 MWp
PV programmes committed	Unknown		
Government policy	PV systems were seen by the Mongolian government as providing a possible method of providing electricity for nomadic herders.		
Utility programmes & strategies			
Market sophistication	Low		
Technical development	Low		
Pricing structure	No specific PV financing available.		
Testing & Standards	Unknown		

1 Economic and Political Aspects

Mongolia is a large, land-locked country sharing borders with China and the former Soviet Union. Mongolia had begun to undergo economic transition from a centrally controlled and planned economy. Mongolia had a population of approximately 3 million people and a land area of 1 570 000 km^2: Mongolia had a population density of 1.9 inhabitants per square kilometre, the lowest of the surveyed countries. Of the population, an estimated 51 % lived in urban areas. The population growth rate was estimated at 2.6%, with literacy estimated at 83 %.

The labour force was estimated at 1 million people, with 51 % engaged in agriculture and 36 % in government positions. The Mongolian lifestyle was traditionally nomadic, and a large number of the agriculture related labour was engaged in nomadic herding of semi-domesticated livestock.

Mongolia's economy was still in transition, the Gross Domestic Product in 1996 was estimated at 972 MUSD with a growth rate of 1.3 % between 1990 and 1996. The government of Mongolia had embarked on a programme of economic liberalisation, relaxing price controls, as well as liberalising domestic and international trade. However, Mongolia's severe climate, scattered population and large expanses of unproductive land had constrained economic development.

Economic activity had traditionally been based on agriculture, which accounted for nearly 30 % of GDP. In the past, a substantial mining and processing industry in coal, copper, molybdenum, tin, tungsten and gold was developed with support from the former Soviet Union. Copper exports accounted for nearly 50 % of Mongolia's export earnings but recent low prices had held back economic development.

2 Grid Electrification Status

The energy sector in Mongolia was an interesting mix of traditional resources (animal dung in rural areas), indigenous coal (for electricity production and district heating) and oil fuel (for electricity production and transportation). Electricity generation was the responsibility of the state owned utility. Electricity generating capacity in Mongolia was estimated at 1.25 GW in 1996 and electricity generation in 1994 was estimated at 3.07 GWh.

Electricity generation and distribution and in Mongolia can be divided into four categories. The Interconnected System served the three main cities and a number of larger towns in 6 of 18 provinces. Electricity was generated from coal powered thermal power stations with some electricity imported from Russia. A series of larger decentralised grids, powered by smaller coal fired power stations and diesel generators towns provided power in the other provinces. Smaller decentralised grids, powered by diesel generators of 60 kW and above provided power for rural municipal centres with populations of between 800 and 2 000 inhabitants. Stand-alone systems were used for rural households, these were usually gasoline generators, small wind powered generators and PV systems.

There was no history of renewable energy programmes or photovoltaic programmes in Mongolia, but PV systems were seen by the Mongolian government as providing a possible method of providing electricity for the nomadic herders.

3 *Programme Experiences and Policy Issues*

In general the experience with PV in Mongolia had been extremely positive and there were no significant technical barriers to utilising the technology. UN and Japanese co-operative projects had successfully demonstrated the effectiveness of the technology.

Research into photovoltaics began in the 1970s in Mongolia under the umbrella of a UNDP project. Between 1979 and 1983 two PV water pumps, a refrigerator and lighting systems were installed along with approximately 35, 6 Wp lighting systems for herding families. A follow on project finanaced by UNDP in 1987 resulted in the laboratory production of PV cells of 13 % efficiency. Small (0.5 Wp) battery chargers for radios were fabricated and field tested and 40 Wp systems for radio ,TV and lighting were imported from the USA for evaluation.

During 1989 and 1990, the Ministry of Energy, Mining and Geology distributed between 2 000 and 3 000 small PV lighting systems imported from China. Each unit consisted of an 11 Wp amorphous silicon module manufactured by Harbin Chronar of China and a Chinese manufactured lantern unit. It was reported that the amorphous silicon modules experienced some initial power degradation although no comprehensive evaluation of the project had been undertaken.

The Institute for Renewable Energy (IRE), in a collaborative project with Japan evaluated the performance of more than 100 PV systems for the nomadic herder families. The systems comprised of a 204 Wp array, a 200 Ah battery and an inverter thus allowing the use of standard domestic appliances.

In the telecommunications sector, 5 mobile communications systems using PV power supplies were in use and their use for repeater stations had been included in the new telecommunications master plan.

4 *Domestic PV Industry*

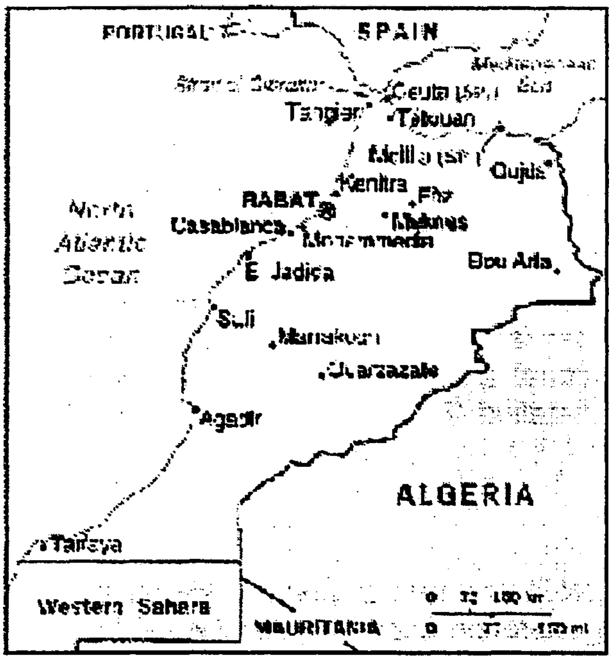
There were four organisations in Mongolia with experience of photovoltaics. The Institute of Renewable Energy which had experience in assembling systems using imported components. The Institute of Physics and Technology had manufactured cells from imported wafers and assembled PV modules (0.5 Wp to 6 Wp). These activities were primarily on a laboratory scale and facilities for commercial manufacture were not available.

The ABE Company is the only commercial organisation with PV experience (largely in the telecommunications sector) and had imported a PV module laminator with a capacity to manufacture 100 kWp/yr of modules. It was not known whether this was operational. A joint venture company, Monmar, was primarily involved in the manufacture of wind generator systems but had experience relevant to PV systems.

5 *Financing Options*

As far as was known there were no financing options for PV systems in place in Mongolia. All PV systems had been supplied as either aid or demonstration projects. It was unknown whether the initial projects would be followed up with further applications of photovoltaic systems, and if so where the funding would come from and whether cost recovery methods would be employed to develop a sustainable market. It was apparent that Mongolia did not have the capability to produce photovoltaic systems without importing primary components from abroad, and it can be assumed that this will be a hindrance to future programmes.

Morocco



Land Area	446 000 km^2
Population	27 million
GDP per capita	1 364 USD
Population Density	60.5 inhabs per km^2
Urban Population	53 %
Labour Force	11 million
Population Growth Rate (1980-1996)	2.1 %
Literacy Rate	35 %

General Data			
Insolation	kWh.m^{-2}.day^{-1}	Latitude	32°N
Population unelectrified	75 %	Terrain	Northern coast and interior are mountainous with large areas of bordering plateaus, intermontane valleys and rich coastal plains

PV Data	
PV power installed	2 MWp
Technical potential	130 MWp (based on 50 Wp SHS for 65 % of households currently without electricity, assuming 5 people per household.)
PV programmes committed	PVMTI
Government policy	Government was committed to electrifying most of the remainder of the country (1.6 million households) by 2010, and had indicated that approximately 5 % of those households should be electrified using off-grid solar and wind technologies.
Utility programmes & strategies	Utility, ONE, was starting to experiment with contracting the provision of PV-based electricity services to the private sector.
Market sophistication	Medium
Technical development	Six suppliers of modules from international sources and one active local manufacturer of PV modules. A number of firms are involved with BOS component manufacture.
Pricing structure	Micro-credit available from NGOs. The country's largest rural bank, had disbursed loans to entrepreneurs seeking to set up franchises for SHS/Battery charging stations. A number of other banks had expressed interest in co-financing rural electrification projects.
Testing & Standards	Unknown

1 Economic and Political Aspects

Morocco, on the north-western coast of Africa, had a land area of 446 000 km^2, and a population of 27 million people, which grew at a rate of 2.1 % in 1996. The urban population made up 53 % of the total population, while 50 % of the 11 million strong workforce were dependent upon rural agriculture. The country as a whole had an estimated literacy rate of 35 %.

From the early 1980s the Moroccan government had pursued an economic programme, with the support of the IMF and World Bank, to reduce government spending, reduce inflation, privatise state industries and open the economy to foreign trade and investment. Morocco's GDP was 36.8 BUSD in 1996, or 1 383 USD per capita. GDP grew at a rate 2.1 % between 1990 and 1996. Inflation during this period was 5.5 %. The mainstay of the Moroccan economy was the agricultural sector, although droughts had depressed agricultural activity resulting in a 7.5 % contraction in GDP in 1995. In 1996 exports totalled 7.7 BUSD in 1995 whilst imports were 9.8 BUSD.

2 Grid Electrification Status

The state owned Office National de l'Electicite, (ONE) was responsible for electricity generation and distribution. Installed electricity generation capacity was 2.4 GW of which 95 % was oil and coal generating plant. Electricity generation in 1995 was 12 TWh or 444 kWh per capita.

As of 1997, approximately half of Morocco had been electrified with a grid that was largely reliable. However, in rural sectors the figure was much lower (sources suggest between 16 % & 25 %). Building on a sequence of rural electrification programmes, the government was committed to electrifying most of the remainder of the country (1.6 million households) by 2010, and had indicated that approximately 5 % of those households should be electrified using off-grid solar and wind technologies. The state owned electricity provider, ONE, was starting to experiment with contracting the provision of PV-based electricity services to the private sector. ONE was flexible in its approach for rural electrification and encouraged private sector intervention and development. ONE had adopted two approaches: direct supply of equipment and training to an association who managed revenue collection and maintenance; and a franchising arrangement where the association assumed ownership and management responsibility for the systems and their implementation.

3 PV Programme Experiences and Policy Issues

In an attempt to provide electricity to the thinly spread communities in and beyond the Atlas Mountains, the Moroccan government and bilateral donor agencies had financed rural electrification programmes since the mid 1980s. In 1984, the Programme Nationale de l'Electrification Rurale (PNER) brought power through grid connection or diesel mini-grids to almost 3 000 of the country's 40 000 villages. In the early 1990s, the Programme de la Pre-Electrification Rurale (PPER) brought power using mini-grids, battery charging stations and solar home systems to a further 2 000 villages. Under the Phase I of PPER programme, 22 villages were electrified in 1995, mainly with battery charging stations although in a few villages SHSs were installed. However, system reliability and performance was reportedly poor. In Phase II of PPER, a further 90 villages were to be equipped, 40 with battery charging stations and 50 with SHS. Phase II designs would consist of either 20 Wp or 50 Wp SHS, or battery charging stations.

In 1995, the government rolled all programmes into the Programme de l'Electrification Rurale Globale (PERG), which planned to electrify the entire country by 2010. Preference was to be given to communities that came forward with all financing in place (including a commitment from a minimum number of end users).

A series of projects had also been funded by bilateral donors, such as JICA, GTZ, KfW, and the EU. These had resulted in the installation of off-grid systems in 2 000 villages, although specific PV installations had been limited to the provision of PV electrification for 320 houses, 8 mosques and 5 schools in 7 non-grid connected villages by SODEAN in the Provinces of Chefchaouen and Taounate through PNED

Import duties were levied on PV modules at 2.5% and on balance of systems components at 25 %, this included components not specifically related to PV such as pumps and wiring etc. Import duties on inverters were levied at 17.5 %. Sales taxes were levied at 20 %.

4 Domestic PV Industry

Some 30 organisations were involved in manufacture, systems integration, supply and/or distribution of PV equipment or BOS. There were six suppliers of modules from international sources and one active local manufacturer of PV modules that used cells from Siemens Solar. A number of firms were involved with BOS component manufacture, ranging from battery manufacture, to charge regulators, inverters, ballast/inverters for CFLs and pumps.

The Ministry of Energy and Mines (MEM) indicated that approximately 2 MWp of PV systems were installed by the end of 1994. It was not clear whether this took into account the private sector. It was estimated that the total cumulative power installed in 1997 was 1 MWp. Approximately 2 000 villages were equipped partially or totally with SHS, representing perhaps 20 000 systems.

INES, a private sector electrical consumer product firm which had diversified into the PV integration and supply market were installing approximately 100 kWp/year of systems in the private sector and had installed more than 200 kWp since 1994. Many of these installations were with amorphous modules and many with low powered systems with a retail price as low as 120 USD. The field operational performance was unknown but INES advised that many buyers went on to purchase additional modules to increase system size.

The private entrepreneur Afrisol had installed 1 200 SHS systems in Rif, most of which were AC systems ranging from 400 Wp to 2000 Wp. Afrisol imported 10 000 modules/year and supplied as much as 50 % of the PV sector.

The North African Pipeline Corp (NAPC) had equipped 8 villages with SHS and solar pumping systems through a grant of 0.69 MUSD from the Ministry of Interior. NAPC had obtained additional support from the Ministry to partly finance a scheme to be implemented over the next 5 years which would electrify and provide water supply to 500 villages. The first consignment of equipment had been shipped from the USA.

Noorweb, an energy service company, had installed approximately 85 SHS and launched 8 franchises since its inception in 1995. It projected growth to reach 0.5 MWp of installed capacity within 3 years. Sunlight Power Maroc in collaboration with Taqashams, the only indigenous module manufacturer, were a new entrant into the rural electrification market. A pilot programme through FONDEP (Local NGO) was being implemented for several hundred systems.

5 *Financing Options*

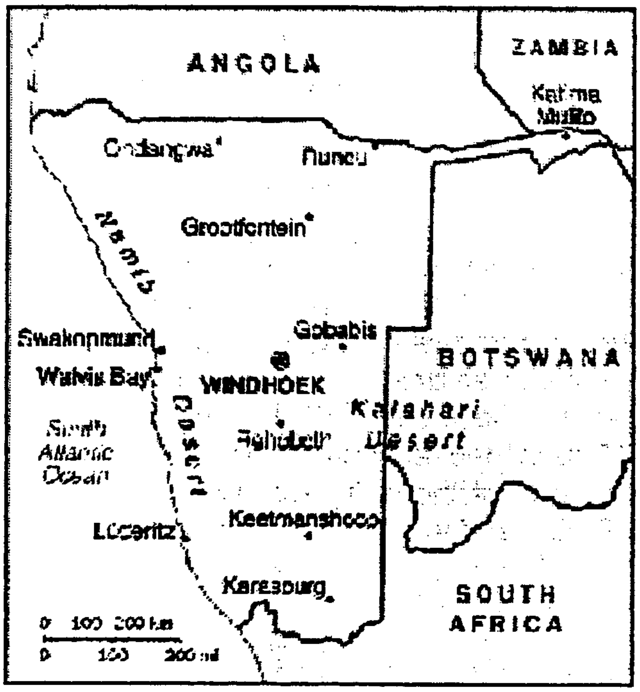
Lack of funding was the main stumbling block to PV implementation in Morocco, although the emergence of micro-credit was an encouraging development for potential PV entrepreneurs. Foundation Zakhoura was Morocco's biggest micro-credit agency. It provided loans in the range of 120 USD to 575 USD, 40 % of which were to commercial clients. Its client base was forecasted to increase from 2 000 to 12 000 by the year 2000, at which time it should become financially sustainable as a non-profit organisation. Loans were provided at 30 % rate of interest with repayment over 6 months with the possibility of refinancing based upon satisfactory performance. Guarantees were offered by a group structure of typically 5 borrowers. The group committed to repay the loan: 8 groups formed a centre and should 2 or 3 borrowers from one centre default, the centre lost the right to refinancing. Zakhoura focused on regions with a population of between 10 000 and 15 000 people. Default rates were 2.4 % for weekly collections and 20 % for monthly collections.

A second NGO, Micro-Development, provided loans of up to 500 USD to rural people, and recovery rates in excess of 95 % were registered.

CNCA, the country's largest rural bank, had disbursed loans to entrepreneurs seeking to set up franchises for SHS/Battery charging stations. The CNCA was the largest rural development bank and had a widespread presence throughout rural Morocco. A number of other banks, including BCM, Morocco's second largest bank and first investment institution, and the privately owned, BMCE - the third largest bank in Morocco –both expressed interest in co-financing rural electrification projects

As of 1998, PVMTI was expected to invest 5 MUSD at a minimum leverage of 1:1 (with co-financing realised directly from the end user or where "relevant co-finance" encompasses only the PV equipment component of the plan). The PVMTI investment was expected to generate a minimum of 20 MUSD of projects with an aggregate across projects of a 2:1 leverage. Growth of the annual PV market from 1.0 MWp/year in1997 to 2.0 MWp per annum over the next five years was anticipated rather than the 1.5 MWp per annum in a business as usual scenario without the PVMTI.

Namibia



Land Area	823 000 km^2
Population	2 million
GDP per capita	1 615 USD
Population Density	2.4 inhabs per km^2
Urban Population	37 %
Labour Force	1 million
Population Growth Rate (1980-1996)	2.7 %
Literacy Rate	38 %

General Data			
Insolation	6.4 kWh.m^{-2}.day^{-1}	Latitude	22°S
Population unelectrified	70 %	Terrain	Mostly high plateau, Namib Desert along coast, Kalahari Desert in East

PV Data	
PV power installed	800 kWp
Commercial potential	13 MWp, Technical Potential 9 MWp
PV programmes committed	Unknown
Government policy	By 1996, a basic infrastructure for rural electrification in the north and east of the country had been completed. The focus had shifted to the south of the country. The Ministry of Mines and Energy had given photovoltaic applications high priority for rural electrification.
Utility programmes & strategies	Unknown
Market sophistication	High
Technical development	Installation and supply of systems capability. Existing capacity to manufacture d.c. refrigeration units and some BOS components such as PV pumps, inverters, state of charge indicators, and regulators.
Pricing structure	Loans accessed from the Bank of Agriculture, on the same terms as for other agricultural equipment: there was no mechanism for providing subsidies. A funding scheme, FINESSE, was set up in 1992 to provide financing for small scale energy users.
Testing & Standards	The SADCC's Technical and Administrative Unit (TAU) is attempting to develop a regional code of practice covering system design, installation and performance.

1 Economic and Political Aspects

Namibia, has a land area of 823 000 km^2 and is located on the south-western coast of Africa. The population in 1996 was estimated to be 2 million with growth rate of 2.7 %. The labour force was estimated at 1 000 000, of which 50 % was engaged in rural agriculture, although it was estimated that 37 % of the population lived in urban areas. The literacy rate was estimated at 38%.

The Gross Domestic Product was estimated at 3 230 MUSD in 1996, with a growth rate of 4.1 % between 1990 and 1996. The economy was heavily dependent on the extraction and processing of minerals for export and mining accounted for almost 25 % of GDP. Average annual inflation over the period 1990 to 1996 was estimated 11.2 %. Namibia was the fourth largest exporter of non-fuel minerals in Africa and the world's fifth largest producer of uranium. Namibia also produced large quantities of diamonds, lead, zinc, tin, silver and tungsten. However, half the population depended on agriculture for its livelihood – 85 % of the agricultural income was provided by beef production. Namibia was also one of the main fish exporters in Africa. Exports in 1996 were estimated at 1.45 BUSD and imports were estimated to be 1.55 BUSD.

2 Grid Electrification Status

Installed electrical capacity was estimated at 406 MW, with annual production of 994 GWh and annual consumption per capita of 925 kWh. Electricity was available to less than 30 % of the population, and was provided by a single, state owned utility, Nampower. Electricity supplies were very sensitive to the available flow at the 240 MW Ruacana hydro station, which provided between 45 % and 60 % of Namibia's electricity. Shortfalls in supply were met by imports from South Africa.

After independence the Namibian Government embarked on an ambitious rural electrification programme. By 1996, a basic infrastructure for rural electrification in the north and east of the country had been completed. The focus had then shifted to the south of the country, although it must be noted that the primary aim was to provide electricity to local government users rather than to households. The rural electrification programme was implemented under the responsibility of the Ministry of Mines and Energy.

3 PV Programme Experiences and Policy Issues

The Government of Namibia had followed an active policy in terms of use of PV: the Ministry of Wildlife, Conservation and Tourism used PV for water pumping, and a number of PV systems had been installed in clinics and schools. The main user of PV systems was the Department of Posts and Telegraphs, which estimated that the savings on diesel costs allowed it to amortise the costs of a typical PV system within 14-26 months. The Ministry of Mines and Energy had given photovoltaic applications high priority for rural electrification, and systems were in use in various service applications.

As the market in Namibia had essentially developed in the absence of any multilateral or bilateral aid programmes, data on PV installations was difficult to source. However, it was estimated that at least 50 PV refrigeration systems had been installed in small shops; over 2 000 SHSs had been installed and a further 2 000 systems in schools, health clinics, shops, community farms and approximately 500 PV pumping systems[1] had been installed

Solar pumping stations were in operation to provide potable water, with 23 in game parks, while 90 railway stations and the national coastal navigation buoy system both relied upon photovoltaic power systems. Photovoltaic power systems were also in use in the television relay systems, providing power to the 5 stations not connected to grid power.

4 *Domestic PV Industry*

It appeared that the local SHS supply industry was competent in terms of ability to supply and install systems although standards and ongoing maintenance were identified as a significant barrier to widespread adoption of SHSs in Namibia.

There was the capacity in Namibia to manufacture d.c. refrigeration units and some other balance of system components such as PV pumps, inverters, state of charge indicators, and regulators. The manufacture of these components tended to be on a batch basis and some components were only manufactured on request. Batteries and modules were usually imported from South African agents or direct from manufacturers.

Research was ongoing at university level into PV applications, and six private companies were involved in supplying PV systems on a commercial basis and a further 12 companies were involved in PV systems on an occasional basis. The SADCC/TAU was attempting to develop a regional code of practice covering system design, installation and performance.

5 *Financing Options*

Despite the quality of the solar resource, SHSs were not widespread even though most homes were not connected to the electricity grid. The high initial capital outlay in combination with low incomes was a significant barrier. However, the PV market in Namibia had developed without the involvement of aid agencies and operated on a purely commercial basis without the need for subsidies.

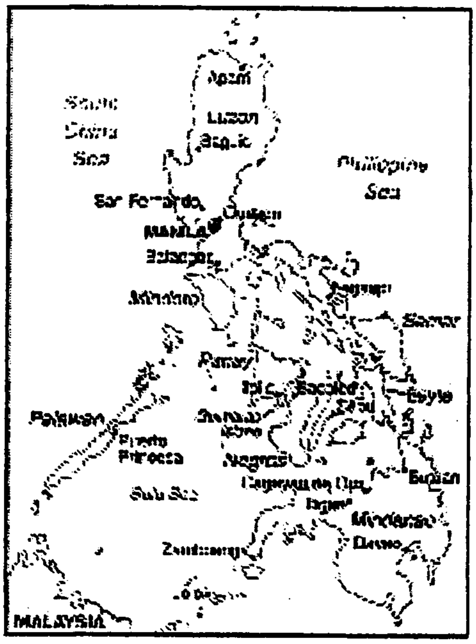
Consumers wanting to purchase a PV system could either access loans from the Bank of Agriculture, on the same terms as for other agricultural equipment: there was no mechanism for providing subsidies. Private sector loan sources operated at interest rates of up to 40 %, which effectively prevented the purchase of systems achieving financial feasibility.

A funding scheme, FINESSE, was set up in 1992 to provide financing for small scale energy users, administered by the Southern African Development Co-ordination Conference Technical and Administrative Unit (SADCC/TAU) and administered by the University of Namibia (NUFU), but the results of this programme were not available.

[1] FINESSE: Namibia Country Study.

SADCC/TAU had carried out an "Assessment of Applications and Markets for the Solar Photovoltaic Systems in the SADCC Region," which identified a lack of inter-regional co-operation, affordable financial mechanisms and historical reliability problems as the primary barriers to the development of photovoltaic power systems in the SADCC area. Suggestions to alleviate the first and last of these barriers included the development of a code of practice to cover system performance, the development of an industry co-operative body to provide training and information concerning the design and installation of systems, and the removal of prejudicial tariffs which were viewed as providing advantage to traditional generating systems. The provision of affordable financing mechanisms remained the most problematic, as the necessary funds were not available at the national level and must be sought from international sources.

The Philippines



Land Area	193 000 km^2
Population	9 million
GDP per capita	1 164 USD
Population Density	47 inhabs per km^2
Urban Population	44 %
Labour Force	2.5 million
Population Growth Rate (1980-1996)	2.7 %
Literacy Rate	38 %

General Data			
Insolation	kWh.m^{-2}.day^{-1}	Latitude	13°N
Population unelectrified	45 %	Terrain	Mostly mountains with narrow to extensive coastal lowlands

PV Data	
PV power installed	133 kWp
Technical potential	26 MWp (based on 50 Wp SHS for 65 % of households currently without electricity, assuming 5 people per household.)
PV programmes committed	BP Solar Australia had been contracted to design, supply and install 1 003 PV systems to provide electricity to 387 villages electrifying over 1 million people in one of the biggest solar projects world-wide.
Government policy	The government aimed to achieve 100 % electrification of all villages by 2010 and connect all potential customers by 2018.
Utility programmes & strategies	Rural Electric Co-operatives distributed electricity in remote areas and were the organisations through which the government aimed to extend electrification.
Market sophistication	Medium
Technical development	PV modules and charge regulators were imported whilst other electrical equipment were normally be manufactured locally
Pricing structure	The Rural PV Electrification programme used the existing REC network to act as financial intermediaries. The RECs own the solar generators, financed them on long term loans and offered them to consumers at low, yet cost covering fees.
Testing & Standards	Unknown

1 Economic and Political Aspects

As a result of the policies pursued by the Aquino and Ramos administrations the Philippine economy has undergone a profound restructuring and liberalisation. Overall, the Philippines has not attained its economic potential. However, the economy has recently enjoyed three years of growth, primarily led by exports and investment.

Whilst the Philippines economy was enjoying sustained growth, this was at the expense of a widening current account deficit. To counter this, exports were being encouraged and it was hoped that the liberalised business environment would promote foreign direct investment. This would help finance the deficit in the short term and improve the economy's ability to compete in the longer term.

There was a large disparity in incomes in the Philippines - the top 20 % had over ten times the income of the poorest 10 %. Whereas most of the other East Asian economies had seen a narrowing of income disparities, in the Philippines, the opposite had been the case. There was also a high level of regional inequality. The region around Manila accounted for one-third of the country's national income, with a GDP per head twice the national average.

The pace of economic growth had stabilised in the 1990s, following the volatility of the previous decade, and the improvement in economic performance saw a reduction in inflation to around 8 %. Meanwhile, the proportion of people below the poverty line fell from 59 % in 1991 to 39 % in 1996.

The population of the Philippines was relatively young, with over half of the population under the age of 20. The proportion of the population living in rural areas decreased from 70 % in 1960 to 56 % in 1992, whilst the rate of population growth slowed from an average of over 3 % in the 1960s, to around 2.7 % in 1996. The Philippines had also suffered from a high level of emigration, averaging at 64 000 per year in the 1990s.

2 Grid Electrification Status

The responsibility for centralised power generation plant belonged to the National Power Corporation (NPC or NAPOCOR). This state owned company was in the process of privatisation. There were three main companies operating in the energy sector: the NPC, the PNOC and the NEA. The remaining 140 companies and utilities were all investor or member owned.

Due to the geographic nature of the Philippines (i.e. an archipelago), the energy supply did not rely solely on centralised grid power sources, but on a mix of diesel-powered mini-grids and renewable energy sources.

Electricity was distributed by 26 private or municipal owned distribution utilities and 119 Rural Electric Co-operatives (RECs). The state-owned National Electrification Administration (NEA) was responsible for financing and providing related technical support to the 119 RECs, who bought power from the NPC or other generator and distributed it in their own grids.

RECs accounted for about 16 % of electricity sales, and were organisations through which the government intended to extend electrification. As of 1995, a total of 23 610 villages were supplied with electricity. This brought the electrification level to around 67 %. The government aimed to achieve 100 % electrification of all villages (totalling 35 213) by 2010 and connect all potential customers by 2018.

Energy production per capita in 1994 was 337 kWh and total national production was 29.7 GWh. Total installed capacity was estimated at 7 400 MW. Around 84 % of capacity was owned by the state-owned National Power Corporation. Demand for electricity was forecast to rise at 11.8 % per annum to 2005, and then at 9.5 % 2006 - 2010.

The capital cost for grid connection was around 700 USD per household. For families that would consume an average of perhaps 40 kWh per month, the prospects for grid connection are very low.

Typical monthly charges to a Philippine family for conventional energy was 2.5 USD for kerosene and 1 USD for dry cell batteries. Present commercial PV initiatives were charging 5.75 USD / month, which was expected to fall to around 4 USD as projects were commercialised.

3 PV Programme Experiences and Policy Issues

Photovoltaics had been in use in the Philippines for 20 years, although the total installed capacity was still only around 133 kWp. In 1991 the Office of Energy Affairs (OEA) - now the Department of Energy (DOE) estimated that, in conjunction with a five year plan, around 1 000 of the 13 667 unelectrified communities could be targeted for PV battery charging stations; that SHSs could eventually be introduced to about 10 % of the unelectrified rural households (c. 520 000 households), and that up to 1 000 small rural enterprises could be potential buyers of PV.

The goal of the DOE REPP (Renewable Energy Power Programme) provided for dissemination of technically and financially viable renewable energy projects; to provide an accommodating market environment for local / foreign implementation of such projects; to provide funding support and to assist in the national government's power development programme.

The Philippine-German Solar Energy Project, PGSEP (1982 - 1988), was implemented under the Ministry of Energy, later the Office of Energy Affairs. Initially, a 13.3 kWp village plant was installed in Pulong Sampaloc, Bulacan, which supplied 60 households with electricity (70 % village power requirement). The purpose was to provide a training ground for PV engineers and to serve as a model for centralised village electrification. The project failed due to high capital investment costs. The second phase of the project therefore focused more heavily on SHSs and communal battery charging stations. The project also demonstrated a commercialisation approach for remote island electrification in Burias Island.

The subsequent Special Energy Programme SEP (1987 - 1995), was the first co-operation of GTZ with the National Electrification Administration. This included the development of PV as well as mini-and micro-hydro plants. Based on these experiences, in 1991 the SEP started a nation-wide pilot implementation of 10 Rural PV Electrification projects. By the end of the programme around 1 700 households had been electrified and 41 RECs have since proposed follow-on RPE projects.

The Philippine – German PV Pumping Programme (1991 - 1995) aimed to prove the technical and economic viability of solar pumping systems in tropical developing countries. It involved close co-operation with national and local water and energy authorities, universities and manufacturers of PV pumping equipment. The Philippine project was initiated with the installation of five PV Pumping Stations in Cebu Province, followed by projects in Pilar, Camotes; Sablayan, Mindoro Occ.; and Limawasa, Leyte.

Preferred Energy Investments (PEI) was a programme which aimed to provide technical assistance and financing for the implementation of commercially viable renewable energy technologies. PEI was being implemented through a co-operative agreement between USAID and Winrock International, and was supported by the Environmental Enterprises Assistance Fund (EEAF) in the management of its capital investment fund. PEI ran the Philippine Renewable Energy Project Support Office (REPSO) in Manila as part of its dissemination and support activities.

The Consortium for Asian Renewable Energy (CARE) Philippines was a corporate joint venture founded in 1995 between Solar Resources Inc. (USA) and three Philippine companies. The aim of CARE was to remove institutional barriers which blocked acceptance of PV and the strategy included the establishment of local distribution, installation and servicing for village SHS systems.

The project included a 2 year feasibility study and 2 000 SHS installations as well as a smaller number of 500 Wp to 1000 Wp hotel systems (possibly PV-wind). The final stage of the project targeted long-term commercialisation of rural PV systems. The joint venture set a minimum annual installation goal of 3 000 SHS.

BP Solar Australia recently (April 1997) won a contract to design, supply and install 1 003 PV systems to provide electricity to 387 villages in the remote Visayas and Minanao regions, electrifying over 1 million people. One of the biggest solar projects world-wide, it will include provision of potable water pumping, electricity for hospitals, vaccine refrigerators, community centre lighting and TV and radio for schools' education. The project will be funded by a concessional loan from the Australian Export Finance and Insurance Corporation and a 13 MAUD government grant from AusAid. The installations were expected to be completed by mid-2000.

4 Domestic PV Industry

PV modules and charge regulators were imported whilst other electrical equipment was usually manufactured locally. The NCE Act of 1991 exempted imported solar energy equipment from import tax and duties, providing this equipment was not manufactured locally, thereby protecting the in-country industry.

Commercialisation of PV systems was first introduced in the Burias Islands in 1987. There were at least 15 suppliers dealing in PV systems, supplying modules from most major PV manufacturers including BP Solar, Siemens, Kyocera, Solarex, Shell Solar and NAPS. The network of distributors and dealers was serviced mainly from the larger islands, with bases in Manila, Iloilo and Cebu.

5 Financing Options

The PGSEP Burias Island project encouraged the islanders to form the San Pascual Masbate Solar Power Inc. (SAPMASOPCO) co-operative, which negotiated with DBP to finance the initial order of 100 SHSs. SAPMASOPCO acted as the handling agent between users and the bank. Money was borrowed at 13 % and passed on at 16 %, compared to commercial bank interest rate of 21.5 %. The down-payment of 140 USD was 25 % followed by 36 monthly amortisation payments of 13 USD - equal to previous expenditure on kerosene and dry cells. Lastly, the end-user was entitled to a three month grace period to make the monthly payment and, in case of default, all previous payments were forfeited. Battery charging stations had also been tested, charging 0.40 USD to 1.10 USD per charge (equivalent to one week's electricity consumption). GTZ estimated such a business would need 5 700 USD in capital, recoverable over 6 - 7 years at 7 % interest.

The Rural PV Electrification programme of the Solar Energy Programme used the existing REC network to act as financial intermediaries. The RECs owned the solar generators, financed them on long term loans and offered them to consumers at low, yet cost covering fees. The SEP demonstrated and evaluated a variety of financing models, including Lease and Credit Concepts. One typical model was based on 25 % down-payment and 36 monthly instalments.

Financing of RECs in the GTZ projects was arranged through the Development Bank of the Philippines (DBP). By end 1994, there were 10 RECs in three regions with 1500 SHSs. Financing involves a long term loan on long life cycle components with an up-front payment to cover installation, battery and lights (106 USD) amounting to less than the cost of connection to the grid. 50 % of costs were funded by GTZ, the balance by a loan from the NEA to the REC, charged at 12 %. Various mechanisms were tested for payment of the balance, monthly charges being around 7.50 USD. RECs obtain SHSs duty and VAT free.

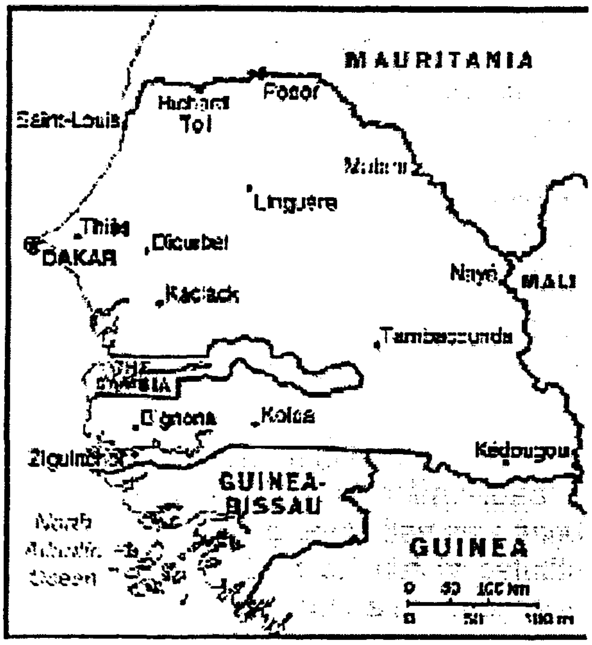
The Department of Energy (DOE) established and funded a Renewable Energy Association of the Philippines (REAP), comprising private suppliers of such equipment. Financing for REAP products was available through the Development Bank of the Philippines (DBP) with 25 % of cost to be paid in advance and the balance paid in monthly fees over three, five, or seven years depending on the buyer's repayment capacity.

The Consortium for Asian Renewable Energy (CARE) had a project to support SHS and other community PV installations in Central Visayas. A total of 39 000, 48 Wp to 75 Wp SHS were to be installed over 8 years, continuing thereafter at 5 000 units a year. This was to be replicated in other areas. The project was to work through RECs and other community based organisations, renting out or leasing the systems to users but retaining ownership. Partner organisations would perform monthly payment collection and maintenance for a fee.

The Renewable Energy Financing and Technical Assistance Project (REFTA) was aprogramme financed by USAID as part of its commitment to the GEF. REFTA will expand the work of REPSO Philippines in identifying project opportunities and provide investment capital to be administered by the Environmental Enterprises Assistance Fund.

Preferred Energy Investments (PEI) provided both equity and financing for commercially viable RE projects. This assistance was available at 300 000 USD per project and leveraged against other funds if found insufficient. Co-financing with government financial institutions, private investors and other development institutions were also being pursued.

Senegal



Land Area	193 000 km^2
Population	9 million
GDP per capita	573 USD
Population Density	47 inhabs per km^2
Urban Population	44 %
Labour Force	2.5 million
Population Growth Rate (1980-1996)	2.7 %
Literacy Rate	38 %

General Data			
Insolation	5.8 kWh.m^{-2}.day^{-1}	Latitude	14°N
Population unelectrified	75 %	Terrain	Generally low rolling plains rising to foothills in south east.

PV Data	
PV power installed	800 kWp
Technical potential	43 MWp (based on 50 Wp SHS for 65 % of households currently without electricity, assuming 5 people per household.)
PV programmes committed	Unknown
Government policy	Government was actively promoting the use of renewable energy resources and equipment for all PV systems was exempt from VAT and import duties.
Utility programmes & strategies	Due to the low density of demand and the lack of economic viability of rural connections, the state owned utility, SENELEC, dids not actively promote connections to the electricity distribution network. The company was evaluating opportunities for the implementation of solar energy and was willing to invest in independent power supplies.
Market sophistication	Low
Technical development	All PV system components were imported although Senegal manufactured automotive batteries.
Pricing structure	Limited credit available. Rural financing available through informal revolving savings schemes.
Testing & Standards	Unknown

1 Economic and Political Aspects

Senegal's Gross Domestic Product (GDP) was estimated at 5 160 MUSD or approximately 573 USD per capita, with a growth rate of 1.8 %. In 1996, imports exceeded exports by 1.8 BUSD to 1.6 BUSD and the consumer price index was estimated to average 7.6 % between 1990 and 1996. The currency was devalued by 100 % in 1994 as part of an Economic Recovery Programme. The World Bank and International Monetary Fund responded favourably to the restructuring plans, and had supported the economy during the period of crisis.

Exports were reliant upon fishing, phosphate mining and groundnut cultivation. While groundnut cultivation was prone to failure through drought, agriculture remained the major source of income and employment, accounting for 18 % of GDP and 77 % of the labour force in 1996.

2 Grid Electrification Status

Electricity generating capacity was estimated at 230 MW, with annual generation of 900 GWh. Senegal was entirely dependent upon traditional thermal generation for primary electrical generation. Per capita consumption was estimated at 100 kWh. A National Electrification Programme had been instituted to run from 1995 to 2005. This programme provided for the electrification of 559 rural localities although funding had not been secured. Due to the low density of demand and the lack of economic viability of rural connections, the state owned utility, Societe Nationale d'Electricite (SENELEC) was not actively promoting connections to the electricity distribution network.

Senegal was in the process of selling 49 % of SENELEC to a private company. Plans existed to spend 200 MUSD boosting output over the next 5 years through rehabilitating existing plant and expanding capacity. The company was evaluating opportunities for the implementation of solar energy and was willing to invest in independent power supplies.

About 60 % of the population had no access to electricity (5.5 million people) with only about 150 of the 13 000 Senegalese villages (over 200 000 rural households) connected to the national grid. Even in electrified localities only 5-15 % of all households had access to the electricity network. This amounted to approximately 20 000 households in urban regions without access to electricity and with no prospect of being connected to grid in the foreseeable future.

3 PV Programme Experiences and Policy Issues

The photovoltaic industry in Senegal was entirely dependent upon aid projects. Installed capacity was estimated to be in the region of 800 kWp including solar home systems, health centres, village power stations and pumping units. More than 2 000 SHS had been installed, mainly with funding from the German Aid Agency, GTZ, in conjunction with central government under the Energie Solaire Photovoltaic project. The project was well received by users although the currency devaluation in 1994 meant that the cost of replacing broken or defective components became much higher. Nevertheless, the success of this project has meant that PV has been selected as one of the alternative options for rural electrification. The co-operatives that were formed to administer and maintain these systems merged to form Fopen-Solaire, a national organisation that now provides technical assistance and equipment.

A total of 36 village level battery charging stations had been installed since 1991, managed by the Centre d'Etudes et de Recherche sur les Energies Renouvelables de Dakar. Each station had 10-15 portable rechargeable lamps that were rented out with tariffs levied for each recharge. Some technical problems had been encountered but the lamps are rented 80 % of the time.

Senegal had historically levied high import tariffs although tax free manufacturing zones permit the import of duty free manufacturing goods which could be assembled locally for regional distribution. However, the government was actively promoting the use of renewable energy resources and equipment for all PV systems was exempt from VAT and import duties.

4 *Domestic PV Industry*

Research and development capabilities in Senegal were limited although there were some existing research centres. However, the institutional linkages between the centres and the industrial/commercial sectors that could benefit from them were weak and they were not sufficiently exploited.

All PV system components were imported although attempts were made to set up local production of regulators. The facility was linked to the GTZ funded project described above so production ceased on closure of the project. Senegal did manufacture automotive batteries.

5 *Financing Options*

Limited credit was available in Senegal with levels of interest which varied between 10 % and 24 %, but these were mainly for productive purposes and did not adapt well to the purchase of PV systems. Interest rates for bank loans were in the order of 6 % to 17 % and the term of the loan was usually between 24 and 48 months for consumer equipment and more than 10 years for housing.

The Caisse Nationale de Credit Agricole du Senegal (CNCAS), founded in 1984, extended credit exclusively through rural self-help co-operatives for agriculture and social purposes. It may be possible to extend this for financing SHS with CNCAS providing financing and the co-operatives managing the actual lending and administration. GTZ successfully tested a similar scheme on a pilot scale with a village co-operative.

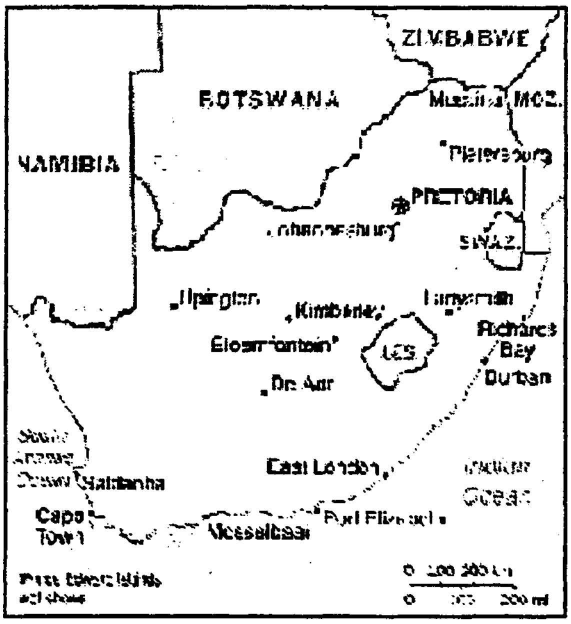
The Agence de Credit pour l'Enterprise Privee (ACEP) had 19 branches and extended loans averaging 1 000 USD for small income generating activities. Loans to over 2 000 borrowers had typical terms of 12 months repayment and interest rates of 20 %. Only 3 % of loans were over three months in arrears. This scheme was considered to be both financially and operationally self-sufficient.

Credit Mutuel Senegal (CMS), a branch of the French bank, was managing guarantee funds for NGOs and development agencies. This meant that the French Aid Agency, Caisse Française de Developpement (CFD) could use this mechanism to guarantee loans to village committees.

The Catholic Relief Service (CRS) was also working with a banking system for the poorest groups, especially women. This had led to investment of the savings in services such as electricity, one project aimed to electrify 800 houses in the region of Kolda.

Rural financing was also available through informal revolving savings schemes which were widespread - these also included traditional money lenders and informal savings and loan associations (tontines).

South Africa



Land Area	1 220 000 km^2
Population	38 million
GDP per capita	3 324 USD
Population Density	31 inhabs. per km^2
Urban Population	50 %
Labour Force	15 million
Population Growth Rate (1980-1996)	2.0 %
Literacy Rate	76 %

General Data			
Insolation	5.5 kWh.m^{-2}.day^{-1}	Latitude	29°S
Population unelectrified	33 %	Terrain	Vast interior plateau rimmed by rugged hills and narrow coastal plain.

PV Data			
PV power installed	5 MWp to 6 MWp		
Technical potential	80 MWp (based on 50 Wp SHS for 65 % of households currently without electricity, assuming 5 people per household.)	Commercial potential	30 MWp by 2010
PV programmes committed	REFSA established and charged with developing PV SHS programme. Subsidy of 1 500 ZAR per system for approved pilot projects. ESKOM committed to manage the electrification of 16 400 schools that will not be connected to the grid under the RDP. 4 000 health clinics have been targeted for PV electrification		
Government policy	The National Electrification Forum aimed to increase dwellings connected to the grid from 45 % to 67 % by 2000 and 79 % by 2012.		
Utility programmes & strategies	ESKOM had electrification programme, with target of 400 000 connections per annum. ESKOM coverage had risen from 31 % to 45 % of households since 1992. RDP aimed to electrify 72 % of households by 2000.		
Market sophistication	Advanced		
Technical development	Manufactured all PV components from modules to BOS components.		
Pricing structure	REFSA provided a subsidy of 1 500 ZAR per PV for pilot PV SHS projects. ESKOM offered financing for SHSs at a concessional 3 % interest rate. Business plan to install 1 800 SHS on a cost recovery basis. SELF developed pilot scheme with 20 % deposit, 15 % interest, 3 year repayment.		
Testing & Standards	REFSA support standards to be developed by Global Accreditation Programme.		

1 Economic and Political Aspects

The political and economic landscape of South Africa was dominated by the collapse of apartheid, and attempts to redress the society through the Reconstruction and Development Programme (RDP). South Africa had entered a period of transition and transformation, with the realisation of the democratic government. At present, despite massive unemployment and high crime rates, the new administration had been able to maintain stability in the nation.

The country was divided into 9 provinces. The most densely populated of these was Guateng (in which Johannesburg was located) and the least densely populated Northern Cape (2.2 inhabitants per km^2). The population of South Africa was 38 million, greater than all its neighbours (Namibia, Botswana, Zimbabwe, Mozambique, Lesotho and Swaziland) together. Of the population, 26 % lived in shacks/informal dwellings/zozos and 17 % in traditional dwellings.

Gross Domestic Product was estimated at 126 BUSD, with a growth rate of 1.2 % and inflation of 10.4 %. South Africa had an export led economy, with exports of 24.3 BUSD and imports of 18.1 BUSD. The major recipients of South Africa's exports in 1994 were Switzerland (6.0 MZAR), United Kingdom (5.9 MZAR), USA (4.4 MZAR) and Japan (4.2 MZAR). Imports came mainly from Germany (13.0 MZAR), USA (12.5 MZAR) and the United Kingdom (9.0 MZAR)

2 Grid Electrification Status

Energy production per capita in 1995 was 4 916 kWh and total national production was 187 GWh. The vagaries of the apartheid system left an odd legacy, in that there was a greater percentage of the urban population without electricity than rural (76 % to 21 %). South Africa had an electricity generation capacity of about 40 GW with an extended national grid spanning some 239 000 km of high voltage transmission lines. This grid was interconnected with that of a number of its immediate neighbours. Maximum demand was about 25 GW, leaving South Africa with substantial excess capacity. Average tariff levels were 7.5c/kWh for domestic users, 4c/kWh for industrial users (1994 figures).

The electricity industry in South Africa was dominated by ESKOM, an independent, self financing, vertically integrated, utility, 100 % owned by the government. ESKOM was largest utility in Africa and generated 97 % of South Africa's electricity (over half of Sub-Saharan Africa's). The rest was generated by local authorities (2%) and industry (1%), who sold surplus electricity to ESKOM. ESKOM had a monopoly on transmission and sold 44% of its electricity to municipal distribution utilities with the remainder being distributed by ESKOM. The privatisation of ESKOM was considered unlikely as ESKOM is efficient, self funding, and "strategic".

A major part of the South African population, an estimated 55-60%, were not connected to the national electricity grid and relied on wood, paraffin (kerosene) and coal (if close to the coal fields) for their basic energy needs. The National Electrification Forum (NELF) was established in 1993 to develop a strategy for accelerated grid extension. NELF aimed to increase the percentage of dwellings connected to the national grid from the present 45 % to 67 % by the year 2000 and

79 % by 2012. Taking population growth into account, this implied that some 2.5 million dwellings would still be without access to the electricity grid at that time.

ESKOM was leading a large electrification programme, with a target of 400 000 connections per annum, and was building a 4 GW coal fired station to come on stream 1996-2001. Both of these were being internally financed and managed, although there was a joint venture with EDF and East Midlands to electrify a township of 60 000 homes near Cape Town using pre-payment meters.

Renewables in 1995 covered 10.7 % of energy consumption. Grid extension was expensive (averaging 720 USD a service point). ESKOM coverage had risen from 31 % to 45 % of households since 1992 but this included the rapid growth of new housing in urban areas. A major component of the RDP was to bring electric power to 72 % of households by 2000.

3 PV Programme Experiences and Policy Issues

A GEF funded mission to evaluate the PV market was completed in early 1995. The value of the market was estimated as 800 MUSD in initial equipment sales. South Africa had yet to ratify the Climate Change Convention and was therefore not eligible for GEF funded projects.

There were three principal PV programmes being implemented in South Africa at the time of writing. In 1996, REFSA was established and charged with developing a national PV SHS programme. In April 1997 it announced a subsidy of 1 500 ZAR per system for approved pilot projects. ESKOM had committed itself to manage the non-grid electrification of the 16 400 schools that would not be connected to the grid under the RDP. Some 1 100 schools had been electrified with PV by ESKOM, although the installation rate had slowed. Approximately 4 000 health clinics which were without electricity had been targeted for PV electrification. IDT had electrified approximately 180 of these by early 1997.

The European Union supported a comprehensive study entitled 'Scheme for large-scale implementation of solar home systems' during 1995/96. The objectives of the project were to undertake a techno-economic analysis and develop a strategy for PV household electrification in South Africa. The E.U. was also supporting an energy specialist at DME to investigate opportunities for E.U. collaborative projects. The E.U. was also proposing to support the PV electrification of clinics and schools.

SELF were undertaking a small SHS pilot project in KwaZulu-Natal. REFAD, USA had supported training programmes at Peninsula Technikon. CASE Australia were investigating establishing a Centre for the Application of Solar Energy in South Africa.

The UNDP-SADC FINESSE programme appointed consultants to identify bankable PV projects. A 600 000 USD SHS project had been identified in KwaZulu-Natal for which further pre-investment studies were underway. DGIS, of the Netherlands, were considering providing some initial financing with the Triodos Bank for a SHS project.

4 Domestic PV Industry

All components of PV SHS were manufactured in South Africa including modules (manufactured by Africa Solar using imported cells). A second company, SunCorp, recently ceased production. Most major international module manufacturers had a distributor in South Africa. The principal suppliers of modules to the South African market were Siemens Solar, Solarex and Kyocera. There were between 50 and 80 companies in the South African PV Industry (mainly systems houses and distributors). Estimates of staff employed by the industry varied from 300 to 1 500. Companies active in South Africa include: Siemens, Franklin Electric, Africa Solar, First National Batteries (Solarex), Grinaker BP Solar, National Luna, Willard Battery and representatives of Photowatt and Total

Although South Africa had a well developed photovoltaic industry, this was developed internally during the apartheid era. It was estimated that present installed power is between 5 MWp and 6 MWp, with 34 000 to 50 000 Solar Home Systems, 2 400 to 4 000 solar pumping stations, and numerous schools, clinics, telecommunications and coastal navigation systems. Annual sales of PV for SHS was estimated as 160 kWp or around 4 000 systems per year in 1996.

The Energy and Development Group in their assessment of the potential market for PV systems for the FINESSE studies estimated annual sales of SHS rising to 40 000 systems per annum by 2010 for non-subsidised systems and 80 000 systems if a subsidy was continuously available. This would indicate an annual market of between 2 MWp and 4 MWp of PV for SHS by 2010 or a cumulative market of at least 25 MWp.

There were some 16 000 schools and 4 000 clinics to be electrified by PV. DME estimated that these would be electrified mainly before 2005 and peaking in 1999/2000. This represented a cumulative market of 4 MWp. DME had also indicated annual sales of PV pumps rising to 1 000 units by 2010 from negligible sales at present.

Potential barriers to the market included the lack of published rural electrification maps/plans coupled with an expectation of consumers to be eventually connected to the utility and the growing problem of theft of PV modules.

5 Financing Options

The government established a renewable energy development financing agency, Renewable Energy For South Africa.(REFSA). REFSA planned to promote the PV electrification of homes and was charged with establishing a National PV SHS programme. In May 1997, REFSA announced that a subsidy of 1 500 ZAR per PV SHS would apply for pilot PV SHS projects.

The majority of sales of PV systems were on a cash basis or short term dealer credits. While consumer credit facilities in urban areas were well established, they were virtually non-existent in rural areas. ESKOM, through a low income housing programme, offered financing for SHSs at a concessional 3 % interest rate.

Provincial Electricity Authority (PEA) on four renewable energy pilot projects. These included the integration of 7.2 kWp of PV with an existing 90 kW mini-hydro system to provide electricity for lights, refrigeration and cooking for 90 households in a mountain village. A second project integrated 12 kWp of PV with existing diesel generators to provide power for 170 households, a temple, a school and clinic on a small island in the Gulf of Thailand. PEA also owns three PV power plants for village supply totalling 150 kWp which was funded by NEDO of Japan.

With regard to import duties and tariffs in Thailand, there was a measure to reduce import tax on raw materials for cell manufacture to lay the foundations for PV business in Thailand.

4 *Domestic PV Industry*

The industrial base in Thailand was extensive, and was capable of supplying all components for a photovoltaic system, including PV modules where there was some private sector involvement. A number of joint ventures in PV module assembly had been established and total local production capacity was put at 1MWp, but the domestic market did not generate sufficient demand to require capacity increases. BP Thai Solar imported cells and assembled modules locally; SolarTron had established a joint venture to import cells and assemble modules; Siam Solar was another joint venture (partner unidentified) importing cells and assembling modules and there was a local Solarex distributor.

There were also a number of Institutes involved in PV R&D including Semiconductor Device Research Laboratory (SDRL) which had been undertaking fundamental R&D since 1975, and had a complete crystalline silicon cell fabrication line. Some novel thin-film research was also undertaken. Chulalongkorn University had investigated PV applications for rural electrification and the Asian Institute of Technology (AIT) undertook some PV system design.

5 *Financing Options*

There was little available information on financing experience for PV systems. It appeared that the majority of systems installed to date had been supported by the government. Users of the battery charging stations paid cash to have their batteries recharged. The operators of the charging stations apparently received no salary for their services, but were eligible for free recharges. It was unclear where the income from the charging stations goes to – presumably it was repaid to the implementing government department.

considering large scale PV installations (centralised PV power plants connected to a grid) in its future plans.

Thailand also had considerable hydropower potential – estimated at over 8 GW – but large-scale dam construction continued to prove controversial, making further hydro capacity expansion unlikely beyond that already planned. There was potential for some small hydro in the mountainous north, and some wind potential in southern coastal areas.

3 PV Programme Experiences and Policy Issues

National Energy Planning was the responsibility of the National Energy Policy Committee (NEPC), which governed strategies for electricity generation, energy conservation and development of alternative energy sources. The Department of Energy Development and Promotion (DEDP) was responsible for overall rural energy matters, although rural electrification was the responsibility of the Provincial Electricity Authority (PEA).

An energy Master Plan was prepared during the 1980s and subsequently developed under successive five-year plans. There was no distinct rural energy plan, but rural energy issues had a high priority under the rural development component of the National Economic and Social Development Plan.

There was a New & Renewable Energy Programme under the Energy Conservation Programme, which recognised that renewables are expected to play a major role in the future Thai energy economy. Under this programme, investment subsidies of between 20 % and 60 % were available to organisations for pilot projects, project preparation and management, programme marketing, training, and after-sales service and maintenance. The projects must satisfy the eligibility criteria which were based on a calculation of internal rates of return - projects with an internal rate of return of less than 9 % were not eligible for subsidy.

Most PV projects in Thailand were conducted independently by government Departments and as a result over 90 % of Thailand's installed PV capacity (estimated at 2.5 MWp) had been government funded. DEDP had utilised PV for battery charging centres in 300 remote villages between 1995-99, as well as for water pumping projects and domestic lighting systems. PWD administered a PV battery charging station programme under the sixth Five-year Plan and had committed itself to install PV in 50-100 villages per year. PWD had also undertaken some PV water pumping projects. The Ministry of Public Health, Ministry of Education, Royal Irrigation Department and Royal Agriculture Program had each used PV for various applications including water pumping, health care centres and schools. For example, the Ministry of Education had installed 20 kWp in remote primary schools using locally manufactured modules.

Donor activity for PV projects had been very limited, although the Thai government was encouraging involvement from international agencies in renewable energy production. The German Aid agency, GTZ, provided support for the Kenitra Special Energy Project between 1991 and 1993 to install 200 SHS. AUSAID had collaborated with Australia's Centre for Application of Solar Energy (CASE) and the

1 Economic and Political Aspects

Located in Southeast Asia, Thailand encompasses a land area of 511 000 km^2, including numerous islands. The population was estimated at 60 million, with an estimated 20 % in urban centres; annual growth rate between 1990 and 1996 was estimated at 1.6 %. The population was well educated at the primary level, with a literacy rate estimated at 94 %. The labour force was estimated at approximately 34 million, of whom 57 % were engaged in rural agriculture: the unemployment rate was estimated at 2.6 % in 1996.

Thailand has been considered one of the "Tiger" economies of Asia and is usually listed as an emerging, rather than developing, market. Economic growth was led by cheap labour manufacturing labour-intensive export goods. Exports were valued at 57.3 BUSD in 1996 compared to imports of 72.4 BUSD. Increasing prosperity in the country, coupled with increased competition in the low-wage sector from China and Vietnam, had led to attempts to move to reliance upon more sophisticated manufacturing processes.

Recently, however the financial markets had collapsed and the local currency, the Baht, had been devalued considerably. More conservative fiscal policies suggested by the International Monetary Fund (IMF), required to qualify for a 16 BUSD loan to prevent a balance-of-payments crisis, were expected to lead to recovery, but there was question as to whether the political will existed to carry out these measures. Prior to the currency crises, Gross Domestic Product in 1996 was estimated at 185 BUSD, with a growth rate of 8.3 % between 1990 and 1996. Average annual inflation over this period was estimated at 4.8 %.

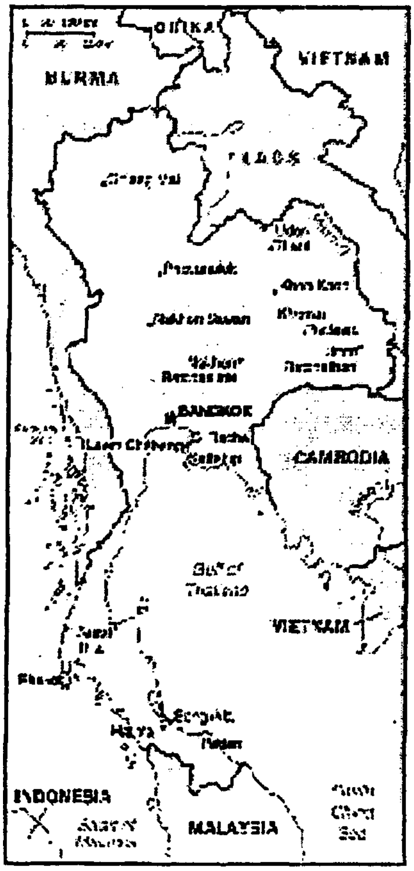
2 Grid Electrification Status

The installed electricity generation capacity of 10 GW produced approximately 80.1 TWh in 1995, equating to a per capita generation of 1 335 kWh. The majority of electricity was consumed by industrial loads and urban centres. Electricity generation was largely dependent on thermal generation from gas, oil and coal, which accounted for over 90 % of generation: the remainder being provided from hydro-electric schemes.

As Thailand is mainly composed of one main island, extension of the electricity grid was fairly easy. Figures for the extent of rural electrification vary, but grid availability appeared widespread with over 98 % of villages connected to the grid and between 70 % and 86 % of rural households electrified. Decentralised electricity needs were therefore restricted to isolated communities where village co-operatives tend to own any generating facilities with support from the Department of Public Works and the Department of Energy Development and Promotion.

The major organisation governing electricity generation and supply was the Electricity Generating Authority of Thailand (EGAT). EGAT had a programme to develop alternative energy sources, including wind, geothermal and fuel cells. The company had installed approximately 70 kWp of PV, mainly for commercial applications (e.g. communication repeaters and navigation aids), but was reportedly

Thailand



Land Area	511 000 km^2
Population	60 million
GDP per capita	3 084 USD
Population Density	117.4 inhabs per km^2
Urban Population	20 %
Labour Force	34 million
Population Growth Rate (1980-1996)	1.6 %
Literacy Rate	94 %

General Data			
Insolation	4.8 kWh.m^{-2}.day^{-1}	Latitude	15°N
Population unelectrified	27 %	Terrain	Central plain, Khorat plateau in the East, mountains elsewhere.

PV Data	
PV power installed	2.5 MWp
Technical potential	105 MWp (based on 50 Wp SHS for 65 % of households currently without electricity, assuming 5 people per household.)
PV programmes committed	
Government policy	There was no distinct rural energy plan, but rural energy issues had a high priority under the rural development component of the National Economic and Social Development Plan.
Utility programmes & strategies	Main utility, EGAT has a programme to develop alternative energy sources.
Market sophistication	Medium
Technical development	Joint ventures in PV module assembly had been established and total local production capacity was put at 1MWp, but the domestic market did not generate sufficient demand to require capacity increases.
Pricing structure	Unknown
Testing & Standards	Unknown

1 Economic and Political Aspects

Tanzania is located on the East coast of Africa and had a population of 30 million and occupied an area of 884 000 km^2, giving a population density of 33.9 inhabitants per square kilometre.

The GDP was estimated to be 5 840 MUSD (1996 figures) equivalent to a GDP per capita of 195 USD. The GDP growth rate between 1990 and 1996 was 3.2 % and the rate of inflation for the same period was 26.8 %. Agriculture was the predominant occupation, employing 90 % of the workforce and contributing 57 % of the GDP.

There had been economic growth in Tanzania during the 1990s mainly due to increased agricultural production and funds provided by bilateral donors, the World Bank and the International Monetary Fund. Industrial production and mining of minerals had also seen an increase.

Tanzania exported agricultural produce and imported manufactured goods, oil and some foodstuffs. The total value of exports was 679 MUSD (1995) compared to total imports valued at 1.69 BUSD (1995) resulting in a considerable trade deficit of around 1 BUSD.

Politically, Tanzania was considered one of the more stable countries in the Southern Africa Development Co-ordination Conference (SADCC) region.

2 Grid Electrification Status

Electricity was supplied by a single utility, the Tanzania Electric Supply Company, which covered approximately 40 % of the country. Installed electricity generation capacity was estimated at 405 000 kW with an annual production of 1 800 GWh of which 86 % was generated from hydro sources and the remainder from thermal generation. The nominal electricity production per capita in 1995 was 60 kWh. The majority of the population, an estimated 19 million people, in Tanzania did not have access to electricity and the extension of the utility grid into rural areas was not a high priority.

3 PV Programme Experiences and Policy Issues

Unlike neighbouring Kenya, the majority of photovoltaic activity in Tanzania to date had been prompted by Aid organisations, in particular UNICEF, DANIDA, NORAD, SIDA, Oxfam, Norwegian Volunteers, Commonwealth Science Council, and Catholic Relief Services. Funding from these agencies had been used to install vaccine refrigerators, solar pumping stations, and telecommunications relay stations, usually through grants to the particular ministry concerned, for example the Ministry of Health for vaccine refrigerators. For these projects there had been no attempts made at cost recovery. NAPS Kenya, a subsidiary of NESTE of Finland and one of the PV firms active in the SADCC region, had been involved in the installation of many of the systems and was involved in the installation of microwave relay stations and satellite earth stations, as well as providing training to local technicians.

The SADCC's Technical and Administrative Unit (TAU) was attempting to develop a regional code of practice covering system design, installation and performance. Additional recommendations include encouragement of inter-regional trade in photovoltaic components; as almost none of the system components were manufactured in Tanzania, this could assist in accelerating the use of systems in the private sector. It should be noted that, while this would encourage the use of systems, it could be detrimental to the development of local production capacity.

4 Domestic PV Industry

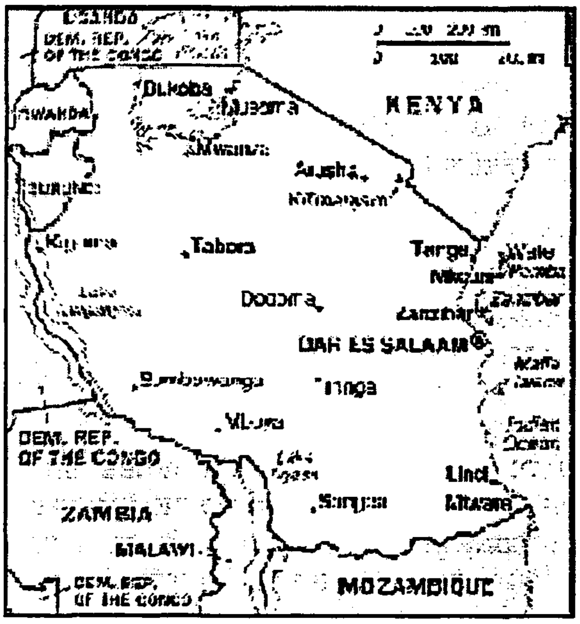
A small but growing – estimated at 9 firms - private sector industry in photovoltaic system installation was developing in Tanzania, usually to install lighting systems. None of the components were manufactured locally but were imported from abroad, and systems purchased privately were not subsidised by the government in any way. Minor efforts were being made to research further photovoltaic applications and to assemble systems locally with the inclusion of some Tanzanian components, but these efforts had not matured.

5 Financing Options

The majority of the PV market in Tanzania was still linked with aid projects, which had generally been well received. Future projects had been planned using photovoltaic systems to develop a wider network providing basic electrification but these were dependent upon external funding. The opportunity existed for the private sector to develop, but the widespread application of photovoltaics would require either a breakthrough in the capital costs of systems or the provision of long term, low interest funding.

SADCC/TAU carried out an "Assessment of Applications and Markets for the Solar Photovoltaic Systems in the SADCC Region," which identified a lack of inter-regional co-operation, lack of affordable financial mechanisms and historical reliability problems as the primary barriers to the development of photovoltaic power systems in the SADCC area. Suggestions to alleviate the first and last of these barriers included the development of a code of practice to cover system performance, the development of an industry co-operative body to provide training and information concerning the design and installation of systems, and the removal of prejudicial tariffs seen as providing advantage to traditional generating systems. The provision of affordable financing mechanisms remains the most difficult barrier to overcome, as the necessary funds were not available at the national level and must be sought from international sources.

Tanzania



Land Area	884 000 km^2
Population	30 million
GDP per capita	195 USD
Population Density	33.9 inhabs per km^2
Urban Population	25 %
Labour Force	16 million
Population Growth Rate (1980-1996)	3.1 %
Literacy Rate	46 %

General Data			
Insolation	4.8 kWh.m^{-2}.day^{-1}	Latitude	6 00 S
Population unelectrified	96 %	Terrain	Coastal plains, a central plateau and highlands in the north and south

PV Data	
PV power installed	NA
Technical potential	190 MWp (based on 50 Wp SHS for 65 % of households currently without electricity, assuming 5 people per household.)
PV programmes committed	Unknown.
Government policy	Unknown.
Utility programmes & strategies	Extension of the utility grid into rural areas was not a high priority
Market sophistication	Low
Technical development	All components were imported although a small industry in photovoltaic system installation was developing.
Pricing structure	Systems purchased privately were not subsidised in any way. Lack of affordable finance.
Testing & Standards	The SADCC's Technical and Administrative Unit (TAU) was attempting to develop a regional code of practice covering system design, installation and performance.

South Africa was a participant in the SADC programme on Financing Energy Services for Small Scale Energy users (FINESSE). As part of this programme a business plan to install 1 800 SHS in KwaZulu-Natal had been developed on a cost recovery basis requiring 588 000 USD of financing. The project appeared financially viable - the average income in the region is about 90 USD per month. The Department of Minerals and Energy of the Government of South Africa was supporting continuation of pre-investment activities for FINESSE (which is primarily supported by The Netherlands Ministry of Foreign Affairs (DGIS) via UNDP).

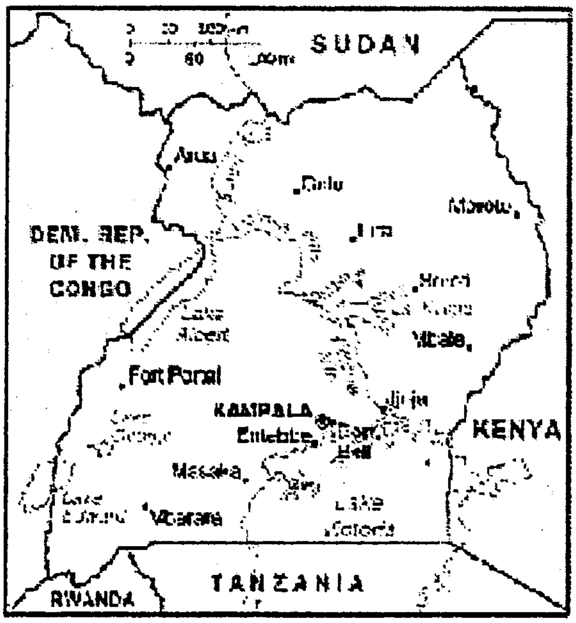
SELF with US Department of Energy funding, developed a pilot covering 75 households (50 Wp SHSs and 200 Wp village centre) in KwaZulu-Natal. The KwaZulu Finance Corporation channelled financing to the 'ocal community based Electrification Committee for financing end-user credit (20 % deposit, 15 % interest, and three year repayment term).

In order to incorporate planned preventative maintenance into programmes and reduce initial down payments some PV marketing specialists were promoting the use of utility style schemes, leasing schemes or prepayment metering. There was however a tradition of non-payment of utility bills as a means of protest (not necessarily about energy matters) and repossession of systems was not always possible.

5 Financing Options

Future programmes were planned, expanding the current electrification and increasing the number of modules provided for each consumer. This expansion was entirely dependent upon funding from external sources, as the local population were only able to pay for the upkeep of the systems and the co-operative, without providing a net income to fund expansion. Monthly payments into the credit schemes were typically 15 USD per month.

Uganda



Land Area	200 000 km^2
Population	20 million
GDP per capita	306 USD
Population Density	100 inhabs per km^2
Urban Population	13 %
Labour Force	10 million
Population Growth Rate (1980-1996)	2.7 %
Literacy Rate	48 %.

General Data			
Insolation	4.8 kWh.m^{-2}.day^{-1}	Latitude	1°N
Population unelectrified	95 %	Terrain	Mostly plateau with rim of mountains

PV Data	
PV power installed	150 kWp
Technical potential	120 MWp (based on 50 Wp SHS for 65 % of households currently without electricity, assuming 5 people per household.)
PV programmes committed	Funding had been secured for a 1.76 MUSD GEF funded PV for Rural Electrification Project. The project aimed to install 2,000 SHS and solar lanterns in rural communities.
Government policy	The NRSE (New & Renewable Sources of Energy) within the Department of Energy in the Ministry of Natural Resources activities included facilitating the development of renewable sources of energy and this ensured government involvement.
Utility programmes & strategies	Unknown
Market sophistication	Low
Technical development	System components were imported and assembled in country. There were a number of dealers and installation companies.
Pricing structure	The World Bank / GEF programme intended to assist in developing rural credit facilities to assist in the development of a sustainable market. PV system manufacturers will extend short term credit for private purchases.
Testing & Standards	Unknown

1 Economic and Political Aspects

Following independence in 1962 the economic prospects for Uganda were extremely good. However, by 1980, after almost a decade of chronic mismanagement by General Idi Amin and a damaging civil war, the economy lay in ruins. Only subsistence farming and the small-scale coffee sector survived in reasonable order.

The problem, since 1980, has been how best to rebuild the shattered economy. Strong remedial action of a conventional nature was introduced in 1981 by the government of Milton Obote, supported by an IMF stand-by arrangement. The plan principally involved floating the currency, removing price controls, increasing agricultural producer prices and imposing strict limits on government spending. The government hoped that these measures would encourage foreign aid and investment, and the Expropriated Properties Act was introduced to persuade the Asian community to return. The plan was successful initially, and the economy began to grow, but the improvements were only superficial. The government could not attract significant support from the donor community, and when the authorities failed to maintain budgetary discipline the IMF withdrew its support in 1984.

In 1987 the government published its definitive Economic Recovery Programme (ERP). The long-term goal was to create a viable and, as far as possible, self-sufficient economy. The immediate objectives of the programme were to rehabilitate the production sectors, in particular the critical infrastructure on which those sectors depended, to reduce inflation by tackling budget deficits and to address a crisis in the balance of payments which left the country with very low reserves and uncertain supplies of foreign exchange.

The recovery programme had been supported by the IMF, in a 175 MUSD three year Enhanced Structural Adjustment Facility (ESAF) approved in September 1994, and by credits from the World Bank's soft-loan arm, the International Development Association (IDA). These re-established Uganda's credentials with the aid organisations and donor countries of the West, and generated significant flows of funds in the form of balance-of-payments support and project assistance.

Economic output was dominated by agriculture, which was responsible for about 46 % of GDP including substantial non-monetary production. Most Ugandans owed their survival during the troubles of the 1970s and 1980s to the resilience of the informal agricultural sector, and most wage earners still used small plots for domestic food supplies. Food crop production was by far the most important economic activity, accounting for more than one-quarter of GDP, compared with only 5 % for cash crops. Manufacturing output contributed only about 7 % of GDP. It suffered badly from the decades of instability and failed to recover the position it held in the economy at independence. Most agricultural production took place in the south, where climatic conditions have always supported the densest rural populations.

The basis of regional economic variations in Uganda was partly climatic (the south favours agriculture much more than the north) but also historical in that the construction of the Uganda Railway during the colonial period laid down the infrastructure for subsequent urban developments. The contrast between a more prosperous south and less prosperous north also broadly coincided with the major ethnic division between a Bantu south and Nilotic north.

2 *Grid Electrification Status*

The electrical distribution system suffered through years of neglect and was plagued by failures. Electricity generation capacity was 172 MW, of which 168 MW was accounted for by a single hydroelectric plant. Annual generation in 1996 was 974 GWh, of which 262 GWh was exported to Kenya, leaving per capita consumption of less than 32 kWh. The Uganda Electricity Board (UEB) was responsible for all generation, transmission and distribution in Uganda. However, the government granted a licence in 1995 to a US and South African consortium to construct a 290 MW hydroelectric plant although the plant was not expected to start generating until after 2002. The construction of a 60 MW thermal plant in Kampala, which was originally scheduled for completion in 1997, had been delayed by contractual difficulties. An agreement had also been reached with a Norwegian company for the construction of an underground electricity plant at Karuma Falls in Western Uganda. The first phase of the project will aim to improve distribution in northern and eastern Uganda.

National electricity requirements were 240 MW and were growing at an estimated 24% annually. The domestic energy sector was responsible for 80 % of total energy consumption, and 97 % of this was biomass, illustrating the poor state of the economy and low level of industrialisation. Commercial energy represented only about 10 % of total energy consumption, with most energy being met from fuelwood and charcoal. Between 3 % and 5 % of the population had access to electricity with only 2 % of the rural population with access.

Power shortages seriously affected manufacturing industry and were hampering growth (which reached 8.7 % in 1995 and could exceed 12 % with adequate electricity supplies).

3 *PV Programme Experiences and Policy Issues*

As of 1996, Uganda had an installed photovoltaic capacity of approximately 150 kWp, mostly in communications, refrigeration and domestic lighting systems. The Uganda Posts and Telecommunications Corporation and Uganda Railways Corporation have installed photovoltaic microwave repeater stations and radio call stations.

The Solar Electric Light Fund (SELF) in conjunction with Habitat for Humanity International (HHI) who build 10,000 homes a year world-wide mostly in unelectrified rural areas initiated a pilot project to install 100 PV SHS on HHI homes. The full cost of systems was 800 USD and a 50 % subsidy was provided by the US Department of Energy. It was planned that the financing mechanism would be developed into a revolving fund. The project included training of technicians and owners, as well as a public information work and training in additional economic activities. Systems were assembled in Uganda to minimise costs

In order to ensure that PV systems went to customers who were not likely to default on payments, only home owners would had completely repaid their mortgages were allowed to apply for a Solar Home System. Repayments were through a three year loan using the existing HHI credit system on house mortgages. The possibility of receiving a system appeared to encourage payment of mortgages (many of which were in arrears). For the pilot programme, payment was for 50 % costs (400 USD) with a 10 % down-payment followed by 36 monthly payments of 10 USD. The monthly payment was estimated to be equivalent to costs of kerosene, candles & dry cell batteries. There were no defaulters on payment therefore no repossessions. In fact, some loans were paid off early after the additional lighting enabled additional money generating activities.

The project appeared to have been very successful although it was unclear why it had not developed further. The project was to be developed into a revolving fund at full system cost but this had not happened due to 'administrative problems'.

Funding had been secured for a 1.76 MUSD GEF funded PV for Rural Electrification Project. The project aimed to install 2,000 SHS and solar lanterns in rural communities. The project will act as a pilot using different financing schemes to assess their suitability. A key part of the financing schemes will be the use of NGOs already active in providing credit in the rural areas. The SHS will be installed on a full cost recovery basis but using development rates for loan interest.

Other planned projects included the installation of 360 solar home systems in dioceses of Church of Uganda which would be subsidised by 50 % by the Anglican church of USA. The Ministry of Health was planning to install more than 500 solar units and 117 solar refrigerators in health centres.

PV components were zero tax rated for import duties and until 1995, solar equipment was also exempt from VAT. However, in 1996 VAT was levied on solar equipment at 17 %. Certain educational/health goods are currently VAT exempt and NRSE (New & Renewable Sources of Energy, within the Department of Energy in the Ministry of Natural Resources) are pressing for PV to be included in this exemption.

4 Domestic PV Industry

Uganda had very little manufacturing capability. System components must be imported, and assembled in country. There were nine companies in Uganda dealing with photovoltaic power systems, usually either selling systems to middle and upper income consumers, or working in conjunction with electrification projects.

The NRSE (New & Renewable Sources of Energy) within the Department of Energy in the Ministry of Natural Resources was an important institutional player in Uganda, providing support for private industry NRSEs major functions include facilitating the development of renewable sources of energy and this ensured government involvement in renewables. NRSE carried out a review of rural energy carried out and were instrumental in developing the GEF PV for Rural Electrification Project

5 Financing Options

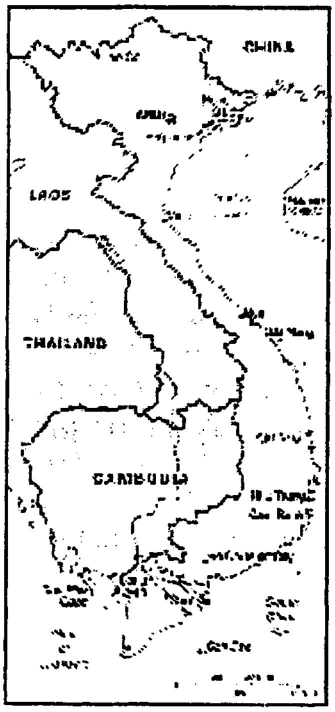
The Uganda Commercial Bank had an extensive nation-wide network and was particularly active in supporting sub-sectoral and other small farmers' programmes. The Small Farmers' scheme developed into a semi-autonomous area of the bank's activities which had greatly extended the outreach of the bank. The Co-operative Bank managed to develop a viable rural banking system in parallel to the credit activities of producer and marketing co-operatives and the network of savings and credit co-operatives.

Several organisations tried to establish micro-lending programmes in the early 1990s but retreated because of widespread corruption and theft. Nonetheless, a village banking programme promoted by FINCA through local NGOs, which began in 1992, had proved a success, channelling 1.3 MUSD into the hands of low-income women over the last five years. By the end of 1996, 110 village banks had been established with over 3 300 members, almost all of whom were women. Average loans were small (120 USD) but significant in relation to income levels: recovery was put at 99 %.

In 1996, IFC provided a loan to Uganda Leasing Company (ULC), part owned by the Development Finance Company of Uganda. IFC had an equity stake in both organisations. ULC started operations in mid-1995 as the first dedicated leasing company in the country. The IFC loan was designed to enable ULC to undertake foreign currency denominated leases, largely for export oriented companies.

The World Bank / GEF programme was intended to assist in developing rural credit facilities to assist in the development of a sustainable market. PV system manufacturers would extend credit for private purchases although only for a maximum term of 45 days. System suppliers extended credit over same period or longer (4 months quoted from one supplier) to customers at zero interest rate.

Vietnam



Land Area	325 000 km^2
Population	75 million
GDP per capita	311 USD
Population Density	231 inhab per km^2
Urban Population	19 %
Labour Force	38 million
Population Growth Rate (1980-1996)	2.1 %
Literacy Rate	94 %

General Data			
Insolation	kWh.m^{-2}.day^{-1}	Latitude	16°N
Population unelectrified	80 %, 6 million households without electricity	Terrain	Low flat delta in south and north, central highlands, hilly, mountainous in far north and northwest.

PV Data	
PV power installed	100 kWp
Technical potential	195 MWp (based on 50 Wp SHS for 65 % of the 6 million households without electricity)
PV programmes committed	The World Bank and DANIDA provided funding for a Rural Electrification Masterplan to identify regions to be supplied by the grid, and those which would be supplied by a variety of other energy sources, including micro-hydro and PV.
Government policy	The Government had played a major role in establishing PV industry and energy policy. The National Program for New and Renewable Sources of Energy (NRSE) was established by a government initiative to improve living conditions in rural areas.
Utility programmes & strategies	The state utility, Electricity of Viet Nam collaborated with the Institute of Energy for long term planning in the power sector, including rural electrification and renewable energy.
Market sophistication	Low
Technical development	Organisations involved in design, fabrication, supply and installation of PV systems and three dealers of international PV companies.
Pricing structure	The Solar Electric Light Fund collaborated with the Vietnam Women's Union on a pilot project to install SHS. Loans for rural electrification projects may be available through the Vietnam Bank of Agriculture. In addition, there is one private company involved in supply, installation and financing of PV systems.
Testing & Standards	Unknown

1 *Economic and Political Aspects*

Up until the early 1980s, Vietnam was a centrally planned economy. Since then a number of liberalising measures had been introduced through a reform programme begun in 1986 known as 'Doi Moi'. This dismantled collectives and returned the land to family farming, liberalised most pricing structures, encouraged new private businesses, and opened the trade and investment regime. This resulted in low inflation and an average growth rate of 8 % since 1991.

Although the average GDP of 311 USD per capita puts Vietnam amongst the poorer countries in the world, the country had many social characteristics of a much higher income, for example life expectancy of 68 years and adult literacy of 94 %. There was also clear evidence of a rapidly growing economy in the huge number of consumer goods in the shops and the surge in traffic in major towns. Investment capital, however, remained very scarce and was a major constraint on government and local authority spending.

Responsibility for energy lay with both the Ministry for Science and Technology and the Ministry of Industry. The Ministry of Planning and Investment (MPI) was in charge of all domestic and foreign investment affairs. All foreign investments must be licensed with MPI, and it could take 6 - 12 months for this process to be completed.

2 *Grid Electrification Status*

The World Bank and DANIDA provided funding for a Rural Electrification Masterplan, which had been developed by the Institute of Energy on behalf of the state utility, under the Ministry of Industry. This plan identified the regions to be supplied by the grid, and those which would be supplied by a variety of other energy sources, including micro-hydro and PV. This Masterplan was due to be completed in 1998.

New power plants and extension of transmission lines constructed as a result of economic reforms since 1986 greatly increased the implementation of rural electrification in Vietnam. However, the World Bank's power engineer for Vietnam estimated that it will be at least 20 years before the majority of rural households could be electrified.

Total national electricity generation was 16.4 TWh in 1996. Energy production at around 225 kWh per capita was low, although production was growing at 8 % per annum. The government aimed to increase capacity by about 15 % per annum to 2000, increasing capacity from 6.7 GW in 1996 to 9 GW in 2000.

The state utility, Electricity of Viet Nam (EVN), was responsible to the Ministry of Industry. It collaborated with the Institute of Energy for its long term planning in the power sector, including rural electrification and renewable energy. The projects were implemented by regional branches of EVN. At the time of writing, about 5 000 of the country's 9 000 communes were supplied by the grid.

The domestic tariff for electricity was around 0.04 USD/kWh. Around 6 million rural households remained without a grid connection, and little prospect of one in the next ten years. The degree of rural electrification coverage varied over the country. The highest coverage was in the Red River delta where a majority of homes were reported to have a supply. Coverage was considerably less in the central areas of the country and less still in the Mekong delta where lack of accessibility was a major obstacle. A recent World Bank ESMAP study of rural electrification in Vietnam was pessimistic about prospects for wide-spread electrification due to the lack of investment resources.

3 PV Programme Experiences and Policy Issues

The Government of Vietnam played a major role in establishing PV industry and energy policy, and was expected to continue to do so. Although the political environment was rapidly becoming more liberal, the government will still have a large influence over future economic and technical developments.

To date a total capacity of around 100 kWp of PV had been installed throughout the country, at least 70 % of which had been for telecommunications systems.

The National Program for New and Renewable Sources of Energy (NRSE) was established by a government initiative to improve living conditions in rural areas. Based at the Ho Chi Minh Polytechnic, the NRSE was focused on research, development and application of different types of NRSE for rural, mountain and island areas.

The 'Solarlab' research team at the Centre of Physics, Ho Chi Minh city, together with the French NGO, FONDEM collaborated in a project to construct and install several types of PV systems including village 'solar stations' of 300 Wp to 1200 Wp, telecommunication systems (1200 Wp), and hundreds of other smaller systems such as vaccine refrigerators, navigation flashlights and height indicators. Over 40 solar stations and cultural houses had been set up in rural areas with amenities for public battery charging, TV/video, kareoke, lighting and local radio broadcasting.

An analysis reported that the Vietnamese perceive advantages of solar stations over SHS including a reduction in installation costs, easier management, control and maintenance, and a high level of safety. Training of women as solar educators, technicians and entrepreneurs was seen as one of the benefits of this project. With good management capital investment was expected to be returned within 5 years through charges for battery-charging, video and kareoke ticket sales etc.

The Solar Electric Light Fund (SELF) a Washington DC-based non-profit organisation, and the Vietnam Women's Union (VWU) representing 11 million women had collaborated to install 240 SHS, 5 community centre PV systems and street lights in two village markets. The project received financial and technical assistance from the Rockefeller Brothers Fund and Sandia National Laboratories (funded through the US-DoE).

Following on from this project, SELF and the VWU proposed a programme of one million SHS to be installed over the next 10 years (150 000 in 5 years) by establishing SELCO-Vietnam. SELCO-Vietnam was a 100 % foreign owned company providing financial and technical assistance for management, administration, training, consumer credit and marketing, while the VWU would be in charge of system installation, troubleshooting, service and revenue collection. SELCO-Vietnam would operate a range of cash, credit and leasing schemes through 40 'Solar Service Centres' around the country.

Photovoltaic related materials and equipment were listed as duty-free imports in Vietnam.

4 Domestic PV Industry

There were five Vietnamese organisations involved in design, fabrication, supply and installation of PV systems and three dealers of international PV companies. In addition, there was one established private company involved in supply, installation and financing of PV systems. All of the organisations in the first category had some capacity for manufacture of solar electronic components (charge controllers), and two were involved with small-scale PV module manufacture. Indigenous batteries were of poor quality and better products were imported from Korea.

There was still an element of government control and ownership in all of the Vietnamese organisations, but nevertheless, there was keen rivalry between the institutes.

Solarlab was founded as part of the National Centre for Science and Technology in 1989 and was the country's leading PV institute. Solarlab staff had designed and manufactured their own PV modules and a regulator-inverter apparatus called the 'solarstat'. They had installed a number of *Solarstat* battery charging stations, island power systems, and telecommunications systems under government and military contracts.

The Solar Electric Light Company (SELCO) was to begin electrifying the country's 6-7 million off-grid rural households with solar home systems (see below). SELCO-Vietnam expected to be manufacturing PV equipment in Vietnam towards the end of the decade.

5 Financing Options

The Solar Electric Light Fund (SELF) collaborated with the Vietnam Women's Union (VWU) on a pilot project (not fully cost recoverable) to install 130 SHS, completed in early 1995, and expanded to a further 110 in 1996. Individual families paid for their residential systems through a subsidised revolving loan fund established by SELF and operated by the VWU. Families made a 20 % down-payment and monthly payments over 4 years. Collection rates were around 95 %.

It was not clear whether the fund as actually managed to revolve due to unforeseen expenditure required to resolve early technical problems. In the next phase, SELF and VWU were planning a sustainable solar program based on full cost recovery, and funds had been requested from UNDP.

Loans for rural electrification projects were sometimes available through the Vietnam Bank of Agriculture (VBA) although their financial resources were limited. As well as the Vietnam Women's Union, the Vietnamese Farmers Union covered the whole country and may be a useful vehicle for PV sales/dissemination. It was co-operatives such as these that had the organisational structure to take SHSs into the rural areas.

In early 1997 the UNDP proposed a 350 000 USD plan for financing an additional 1 000 solar home systems on the SELF / VWU model, with the Vietnam Bank for Agricultural Development managing the revolving fund on behalf of the VWU.

Unfortunately historical factors and distrust of the banking sector had limited the extent of financial deepening even under transition of the economy and a large proportion of assets were held outside the banking system in the form of foreign currency, gold, precious stones and metals. In 1995 such hoarding was estimated at 2 BUSD.

DRAFT

QUALITY MANAGEMENT IN PHOTOVOLTAICS

TRAINING MANUAL

PV GAP

August 1999

QUALITY MANAGEMENT IN PHOTOVOLTAICS

Manufacturers Quality Control Training Manual

Prepared For

The World Bank

Produced By

Global Approval Program for Photovoltaics (PV GAP)

Geneva, Switzerland

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QUALITY MANAGEMENT IN PHOTOVOLTAICS

Appendices

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Appendix I: Glossary of Terms

Accreditation: The procedure by which an authoritative body gives formal recognition that a body or person is competent to carry out specific tasks.

(As) needed/ (as) appropriate/(as) necessary: These indicate requirements that may or may not apply to your business.

Audit: A systematic and independent examination to determine whether or not quality activities and related results comply with planned arrangement, and whether or not these arrangements are implemented effectively and are suitable to achieve objectives.

Auditor: An individual who is tasked with performing audits.

Certification: The procedure by which a third party gives written assurance that a product, process, or service conforms to specified requirements.

Component: A constituent part of a product.

Conformity evaluation: The systematic examination of the extent to which a product, process, or service fulfills specified requirements.

Continuous improvement: A process by which an organization or a process is regularly reviewed against its actual and expected functioning or results in an attempt to improve its functioning.

Contract: Agreed-upon requirements between a supplier and customer transmitted by any means.

Corrective action: An action taken to eliminate the causes of an existing situation of nonconformity, defect or other undesirable condition in order to prevent recurrence.

Customer: An individual or organization that purchases and receives a commodity, product or service provided by the supplier.

Deficiency: Sub-standard or non-complying, relative to objective standards.

Documentation: Furnishing or authenticating with documents; evidence of a process; conformity to historical or objective facts or standards.

IEC: International Electrotechnical Commission

IECQ: IEC Quality Assessment System for Electronic Components

ISO 9000: A family of standards, under the International Standards Organization (ISO), which specify requirements for quality systems and which provide guidance to aid in the interpretation and implementation of the quality system.

Inspection: Conformity evaluation by observation and judgment accompanied, as appropriate, by measurement, testing, or gauging.

Management representative: The organization's representative who shall have defined authority for ensuring that a quality system is established, implemented, and maintained in accordance with the standard, and reporting on the performance of the quality system to management for review and as a basis for improvement of the quality system.

Manager: The person who is exercising authority, taking responsibilities, making decisions, and fulfilling similar managerial functions on behalf of the business.

Non-conformity: Any instance of failure to meet a specified requirement.

Objective evidence: Information that can be proven true, based on facts obtained through observation, measurement, test, or other means.

Organization: A company, corporation, firm, enterprise or institution, or part thereof, whether incorporated or not, public or private, that has its own functions and administration.

Photovoltaic: Solid-state, semiconductor-based solar electric technology that directly converts light energy into electricity.

Preventive action: An action taken to eliminate the causes of a potential nonconformity, defect or other undesirable situation, in order to prevent occurrence.

Procedure: A specified way to perform an activity; a description that details by whom, with what, when, where, and how processes are carried out.

Process: A series of actions or activities directed to a planned or specific result or product that transform inputs into outputs.

Product: The result of activities or processes.

Project: A unique process consisting of a set of coordinated and controlled activities with a start and finish dates, undertaken to achieve an objective conforming to specific requirements, including the constraints of time, cost and resources.

PV GAP: Global Approval Program for Photovoltaics: a world-wide organization for promoting satisfactory photovoltaic products, and systems.

Quality: The totality of characteristics of an entity that bear on its ability to satisfy stated and implied needs.

Quality assurance: All the planned and systematic activities implemented within the quality system, and demonstrated as needed, to provide adequate confidence that an entity will fulfil requirements for quality.

Quality control: Operational techniques and activities that are used to fulfil requirements for quality.

Quality improvement: Actions taken throughout the organization to increase the effectiveness and efficiency of activities and processes, in order to provide added benefits to both the organization and its customers.

Quality manager: A management representative with responsibility for the quality system, its implementation, and its maintenance.

Quality manual: The document in which is compiled the organization's procedures and documentation for quality and quality improvement programs.

Quality plan: The document setting out the specific quality practices, resources and sequence of activities relevant to a particular product, project or contract.

Quality policy: The overall intentions and direction of an organization with regard to quality as formally expressed by top management.

Quality system: The organizational structure and procedures by which an organization's processes are carried out, writing down how things are done and recording the results to show how things were done.

Quality team: An organization's team of management and staff responsible for developing and reviewing the organization's quality systems.

Registrar: An independent, third-party body that audits organizations for accreditation/certification and registers those qualified organizations.

Review: The broad overview of the activities relevant to the situation under study. Here, used in three situations: management review, contract review, and design review.

Service: The result generated by activities at the interface between the supplier and the customer and by supplier internal activities to meet the customer needs. Also the non-tangible result of a process or effort (e.g., testing, maintenance, repair, consulting, etc.)

Shall: This means a requirement has to be followed whenever it occurs in the manual.

Should: (may/can) These items are normally used to suggest or recommend a course of action. They are never used to indicate a requirement that must be followed.

Specified requirements: Product requirements prescribed by the customer and agreed to by the supplier. Also, requirements prescribed by the supplier that are perceived as satisfying a market need.

Subcontractor: Any organization from which you purchase products or services, or both. You normally refer to them as your vendors or your suppliers.

Supplier: In this manual, this term refers to the company or laboratory providing the product or service; therefore it means you.

Supply chain: A set of interrelated resources and activities that accepts inputs from suppliers, adds value to those inputs, and produces outputs for customers.

Tender: An offer made by a supplier in response to an invitation to satisfy a contract award to provide a product or service.

Training: Processes to introduce, expand, and/or improve the knowledge and skills of individuals and teams in a systematic way.

Vendor: An outside provider of a product or service.

Appendix II: Publications Issued by IEC TC 82

IEC 60891 Ed. 1.0 (1987-04)
Procedures for temperature and irradiance corrections to measured I-V Characteristics of crystalline silicon photovoltaic devices

IEC 60891 Amd.I Ed. 1.0 (1992-06)
Amendment No.1

IEC 60904-I Ed. 1.0 (1987-12)
Photovoltaic devices. Part 1: Measurement of photovoltaic current-voltage characteristics

EC 60904-2 Ed. 1.0 (1989-05)
Photovoltaic devices. Part 2: Requirements for reference solar cells

IEC 60904-2 Amd.1 Ed. 1.0 (1998-02)
Amendment I

IEC 60904-3 Ed. 1.0 (1989-02)
Photovoltaic devices. Part 3: Measurement principles for terrestrial photovoltaic (PV) solar devices with reference spectral irradiance data

IEC 60904-5 Ed.. 1.0 (1993-10)
Photovoltaic devices - Part 5: Determination of the equivalent cell temperature (ECT)
of photovoltaic (PV) devices by the open-circuit voltage method

IEC 60904-6 Ed. 1.0 (1994-09)
Photovoltaic devices - Part 6: Requirements for reference solar modules

IEC 60904-6 Amd.I Ed. 1.0 (1998-02)
Amendment 1

IEC 60904-7 Ed. 2.0 (1998-03)
Photovoltaic devices - Part 7: Computation of spectral mismatch error introduced
in the testing of a photovoltaic device

IEC 60904-9 Ed. 2.0 (1998-02)
Photovoltaic devices - Part 8: Measurement of spectral response of a photovoltaic (PV) device

IEC 60904-9 Ed. 1.0 (~995-09)
Photovoltaic devices - Part 9: Solar simulator performance requirements

IEC 60904-10 Ed. 1.0 (1998-02)
Photovoltaic devices - Part 10: Methods of linearity measurement

IEC 61173 Ed. 1.0 (1992-09)
Overvoltage protection for photovoltaic (PV) power generating systems - Guide

IEC 6II94Ed. 1.0 (1992-12)
Characteristic parameters of stand-alone photovoltaic (PV) systems
IEC 61215 Ed. 1.0 (1993-04)
Crystalline silicon terrestrial photovoltaic (PV) modules – Design qualification and type approval

1EC61277Ed. 1.0 (1995-03)
Terrestrial photovoltaic (PV) power generating systems - General and guide

IEC 61345 Ed. 1.0 (1998-02)
UV test for photovoltaic (PV) modules

IEC 61646 Ed. 1.0(1996-11)
Thin-film terrestrial photovoltaic (PV) modules - Design qualification and type approval

IEC 61701 Ed. 1.0 (1995-03)
Salt mist corrosion testing of photovoltaic (PV) modules

IEC 61702 Ed 1.0 (1995-03)
Rating of direct coupled photovoltaic (PV) pumping systems

IEC6T721 Ed. 1.0 (1995-03)
Susceptibility of a photovoltaic (PV) module to accidental impact damage (resistance to impact test)

IEC 61724 Ed 1.0 (1998-04)
Photovoltaic system performance monitoring - Guidelines for measurement, data exchange and analysis

IEC 61725 Ed. 1.0 (1997-05)
Analytical expression for daily solar profiles

IEC 61727 Ed. I 0 (1995-06)
Photovoltaic (PV) systems - Characteristics of the utility interface

IEC 61829 Ed. 1.0 (1995-03)
Crystalline silicon photovoltaic (PV) array - On-site measurement of IV characteristics

IEC6I836TR2Ed. T.0~(1997-I0)
Solar photovoltaic energy systems - Terms and symbols

IEC TC 82 Work in Progress

IEC 60904-9 Ed. 2.0
Amendment to IEC 60904-9 (1995) to take into account thin-film silicon

IEC 61683 Ed. 1:0
Photovoltaic systems - Power conditioners -Procedure for measuring efficiency

IEC 61723 Ed. 1.0
Safety guidelines for grid connected photovoltaic (PV) systems mounted on buildings

IEC 61728 Ed. 1.0
Safety test procedures for utility grid connected photovoltaic inverters

IEC61729Ed. 1.0
Equipment and safety specifications for direct coupled PV-pumping systems

IEC61730 Ed.~.0
Safety testing requirements for PV modules

IEC 61836-2 Ed 1.0
Solar photovoltaic energy systems - Terms and symbols - Part 2

1EC61849 Ed 1.0
Design qualification and type approval of photovoltaic (PV) modules for marine environments

IEC618S3 Ed.1.0
Power and energy rating of photovoltaic (PV) modules

IEC 62078 Ed. 1.0
Certification and accreditation program for photovoltaic (PV) components and systems -Guidelines for a total quality system

1EC62093 Ed. 1.0
BOS components - Environmental reliability testing
-Design qualification and type approval

IEC62IO8 Ed 1.0
Concentrator photovoltaic (PV) receivers and modules
Design qualification and type approval

IEC 621Q9 Ed. 1.0
Electrical safety of static inverters and charge controllers for use in photovoltaic (PV) power systems

IEC 62116 Ed. 1.0
Testing procedure - Islanding prevention measures for power conditioners used in grid connected photovoltaic (PV) power generation systems

IEC 62124 Ed. 1.0
Photovoltaic stand-alone systems - Design qualification and type approval

IEC/PAS 62111 Ed. 1.0
Specification for the use of renewable energies in rural decentralized electrification

❖ PNW 82-225 Ed. 1.0
Crystalline silicon terrestrial (PV) modules - Blank detail specification– Qualification approval

❖ PNW 82-226 Ed. 1.0
Thin-film terrestrial PV modules - Blank detailed specification – Qualification approval

PWI 82-1 Ed. 1.0
Photovoltaic electricity storage systems

PV GAP "PVRS" introduced as New Work Item

Appendix III: IEC Standards

Possibly Useful for PV[1]

BATTERIES

IEC 1044 Ed. 1.0	Opportunity-charging of lead-acid traction batteries
IEC 1056-1 Ed. 1.0	Portable lead-acid cells and batteries (Valve regulated types) - Part 1: General requirements, functional characteristics - Methods of test
IEC 1056-2 Ed. 1.0	Portable lead-acid cells and batteries (Valve regulated types) - Part 2: Dimensions, terminals and marking
IEC 1056-3 Ed. 1.0	Portable lead-acid cells and batteries (Valve-regulated types) - Part 3: Safety recommendations for use in electric appliances
IEC 254-1 Ed. 3.0	Lead-acid traction batteries - Part 1: General requirements and methods of test
IEC 254-2 Ed. 3.0	Lead-acid traction batteries - Part 2: Dimensions of cells and terminals and marking of polarity on cells
IEC 896-1 (1987-01)	Stationary lead-acid batteries - General requirements and methods of test. Part 1: Vented types.
IEC 896-1 Amd.1 Ed. 1.0	Amendment No. 1
IEC 896-1 Amd.2 Ed. 1.0	Amendment No. 2
IEC 896-1 Ed. 1.0	Stationary lead-acid batteries - General requirements and methods of test. Part 1: Vented types
IEC 896-1-am1 (1988-01)	Amendment No. 1
IEC 896-1-am2 (1990-12)	Amendment No. 2
IEC 896-2 (1995-11)	Stationary lead-acid batteries - General requirements and test methods - Part 2: Valve regulated types.
IEC 896-2 Ed. 1.0	Stationary lead-acid batteries - General requirements and test methods - Part 2: Valve regulated types
IEC 95-1 Ed. 5.0	Lead-acid starter batteries. Part 1: General requirements and methods of test
IEC 95-2 Amd.1 Ed. 3.0	Amendment No. 1
IEC 95-2 Amd.2 Ed. 3.0	Amendment No. 2
IEC 95-2 Ed. 3.0	Lead-acid starter batteries. Part 2: Dimensions of batteries and dimensions and marking of terminals
IEC 95-4 Amd.1 Ed. 1.0	Amendment No. 1
IEC 95-4 Ed. 1.0	Lead-acid starter batteries. Part 4: Dimensions of batteries for heavy trucks

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IEC 952-1 (1988-07)	Aircraft batteries. Part 1: General test requirements and performance levels.
IEC 952-1 Ed. 1.0	Aircraft batteries. Part 1: General test requirements and performance levels
IEC 952-2 (1991-03)	Aircraft batteries - Part 2: Design and construction requirements.
IEC 952-2 Ed. 1.0	Aircraft batteries - Part 2: Design and construction requirements
IEC 952-3 (1993-07)	Aircraft batteries - Part 3: External electrical connectors.
IEC 952-3 Ed. 1.0	Aircraft batteries - Part 3: External electrical connectors

CABLING / WIRING

IEC 610 (1978-01)	Principal aspects of functional evaluation of electrical insulation systems: Aging mechanisms and diagnostic procedures.
IEC 611 (1978-01)	Guide for the preparation of test procedures for evaluating the thermal endurance of electrical insulation systems.
IEC 614-1 (1994-03)	Conduits for electrical installations - Specification - Part 1: General requirements.
IEC 614-1-am1 (1995-09)	Amendment No. 1
IEC 614-2-1 (1982-01)	Specification for conduits for electrical installations. Part 2: Particular specifications for conduits. Section One: Metal conduits.
IEC 614-2-1-am1 (1993-10)	Amendment No. 1
IEC 614-2-5 (1992-11)	Specifications for conduits for electrical installations - Part 2: Particular specifications for conduits - Section 5: Flexible conduits.
IEC 811-1-1 (1993-10)	Common test methods for insulating and sheathing materials of electric cables - Part 1: Methods for general application - Section 1: Measurement of thickness and overall dimensions - Tests for determining the mechanical properties.
IEC 811-1-2 (1985-07)	Common test methods for insulating and sheathing materials of electric cables - Part 1: Methods for general application - Section Two: Thermal aging methods.
IEC 811-1-2-am1 (1989-11)	Amendment No. 1
IEC 811-1-4 (1985-07)	Common test methods for insulating and sheathing materials of electric cables - Part 1: Methods for general application - Section Four: Test at low temperature.
IEC 811-1-4-am1 (1993-08)	Amendment No. 1

EC 811-4-1 (1985-10)	Common test methods for insulating and sheathing materials of electric cables - Part 4: Methods specific to polyethylene and polypropylene compounds - Section One - Resistance to environmental stress cracking - Wrapping test after thermal aging in air - M
IEC 811-4-1-am2 (1993-08)	Amendment No. 2
IEC 812 (1985-07)	Analysis techniques for system reliability - Procedure for failure mode and effects analysis (FMEA).
IEC 998-1 (1990-05)	Connecting devices for low voltage circuits for household and similar purposes. Part 1: General requirements.
IEC 998-2-1 (1990-05)	Connecting devices for low voltage circuits for household and similar purposes. Part 2-1: Particular requirements for connecting devices as separate entities with screw-type clamping units.
IEC 998-2-2 (1991-11)	Connecting devices for low-voltage circuits for household and similar purposes - Part 2-2: Particular requirements for connecting devices as separate entities with screwless-type clamping units.
IEC 998-2-3 (1991-11)	Connecting devices for low-voltage circuits for household and similar purposes - Part 2-3: Particular requirements for connecting devices as separate entities with insulation piercing clamping units.
IEC 998-2-4 (1993-05)	Connecting devices for low-voltage circuits for household and similar purposes - Part 2-4: Particular requirements for twist-on connecting devices.
IEC 998-2-5 (1996-01)	Connecting devices for low-voltage circuits for household and similar purposes - Part 2-5: Particular requirements for connecting boxes (junction and/or tapping) for terminals or connecting devices.

CHARGE CONTROLLER

IEC 439-1 (1992-12)	Low-voltage switchgear and controlgear assemblies - Part 1: Type-tested and partially type-tested assemblies.
IEC 439-1-am1 (1995-11)	Amendment No. 1
IEC 439-1-am2 (1996-12)	Amendment No. 2
IEC 439-2 (1987-11)	Low-voltage switchgear and controlgear assemblies. Part 2: Particular requirements for busbar trunking systems (busways).
IEC 439-2-am1 (1991-09)	Amendment No. 1
IEC 439-3 (1990-12)	Low-voltage switchgear and controlgear assemblies. Part 3: Particular requirements for low-voltage switchgear and controlgear assemblies intended to be installed in places where unskilled persons have access for their use - Distribution boards.

IEC 439-3-am1 (1993-10)	Amendment No. 1
IEC 439-4 (1990-12)	Low-voltage switchgear and controlgear assemblies. Part 4: Particular requirements for assemblies for construction sites (ACS).
IEC 439-4-am1 (1995-12)	Amendment No. 1
IEC 439-5 (1996-03)	Low-voltage switchgear and controlgear assemblies - Part 5: Particular requirements for assemblies intended to be installed outdoors in public places - Cable distribution cabinets (CDCs) for power distribution in networks.
IEC 529 (1989-11)	Degrees of protection provided by enclosures (IP Code). Applies to the classification of degrees of protection provided by enclosures for electrical equipment with a rated voltage not exceeding 72,5 kV. Has the status of a basic safety publication.
DC SAFETY	
IEC 1204 (1993-02)	Low-voltage power supply devices, d.c. output - Performance characteristics and safety requirements.
INVERTER	
IEC 146-1-1 (1991-04)	General requirements and line commutated convertors - Part 1-1: Specifications of basic requirements.
IEC 146-1-1-am1 (1996-07)	Amendment No. 1 to IEC 146-1-1.
IEC 146-1-2 (1991-04)	General requirements and line commutated convertors - Part 1-2: Application guide.
IEC 146-1-3 (1991-04)	General requirements and line commutated convertors - Part 1-3: Transformers and reactors.
LAMPS	
IEC 400 (1996-06)	Lampholders for tubular fluorescent lamps and starterholders.
IEC 400-am1 (1997-04)	Amendment No. 1
IEC 598-1 (1996-12)	Luminaires - Part 1: General requirements and tests
IEC 598-2-1 (1979-01)	Luminaires. Part 2: Particular requirements. Section One: Fixed general purpose luminaires.
IEC 598-2-1-am1 (1987-01)	Amendment No. 1
IEC 598-2-23 (1996-04)	Luminaires - Part 2: Particular requirements - Section 23: Extra low voltage lighting systems for filament lamps.
IEC 598-2-3 (1993-04)	Luminaires - Part 2: Particular requirements - Section 3: Luminaires for road and street lighting.
IEC 598-2-3-am1 (1997-04)	Amendment No. 1
IEC 598-2-4 (1997-04)	Luminaires - Part 2: Particular requirements - Section 4: Portable general purpose luminaires
IEC 598-2-5 (1979-01)	Luminaires. Part 2: Particular requirements. Section Five: Floodlights.

IEC 598-2-5-am1 (1987-01)	Amendment No. 1
IEC 598-2-5-am2 (1993-04)	Amendment No. 2
IEC 598-2-7 (1982-01)	Luminaires. Part 2: Particular requirements. Section Seven: Portable luminaires for garden use.
IEC 598-2-7-am1 (1987-01)	Amendment No. 1
IEC 598-2-7-am2 (1994-08)	Amendment No. 2
IEC 598-2-8 (1996-07)	Luminaires- Part 2: Particular requirements - Section 8: Handlamps.
IEC 81 (1984-01)	Tubular fluorescent lamps for general lighting service.
IEC 81-am1 (1987-01)	Amendment No. 1
IEC 81-am2 (1988-01)	Amendment No. 2
IEC 81-am3 (1992-07)	Amendment No. 3
IEC 81-am4 (1993-09)	Amendment No. 4
IEC 81-am5 (1994-12)	Amendment No. 5
IEC 810 (1993-10)	Lamps for road vehicles - Performance requirements.
IEC 810-am1 (1994-07)	Amendment No. 1
IEC 924 (1990-07)	D.C. supplied electronic ballasts for tubular fluorescent lamps - General and safety requirements.
IEC 924-am1 (1993-03)	Amendment No. 1
IEC 925 (1989-06)	D.C. supplied electronic ballasts for tubular fluorescent lamps - Performance requirements.
IEC 925-am1 (1996-05)	Amendment No.1
IEC 95-1 Amd.1 Ed. 5.0	Amendment No. 1
IEC 95-1 Amd.2 Ed. 5.0	Amendment No. 2
IEC 1162-1 (1995-'11)	Maritime navigation and radio communication equipment and systems - Digital interfaces - Part 1: Single talker and multiple listeners. Contains the requirements for data communication between maritime electronic instruments, navigation and radio communication.

Appendix IV: PV GAP Recommended Standards*

PVRS 1 (Version 1.1)

Photovoltaic Stand-alone Systems
Design Qualification and Type Approval

PVRS 2

Crystalline silicon terrestrial photovoltaic (PV) modules. Blank detail Specification – Qualification Approval under the IEC Quality Assessment System for Electronic Components (IECQ)

PVRS 3

Thin-film terrestrial photovoltaic (PV) modules. Blank detail Specification – Qualification Approval under the IEC Quality Assessment System for Electronic Components (IECQ)

* As of July 25, 1999

Appendix V: Example of a Certifiable Standard

Table 1 — Test schedule for quality conformance inspection
(Part 1)

Subclause number and Test of IEC 61215	Destructive or non-destructive	Conditions of test	Performance requirements
GROUP A INSPECTION (100%)			
Subgroup A1	**ND**		
10.1 Visual inspection			As in 10.1 of IEC 61215
4 Marking		Check that marking is present	Clear and indelible.
— Dimensions (gauging)			See the outline drawing in item (7) of the cover page of this specification and any related tables.
Subgroup A2	**ND**		
10.2 Performance at STC			See 2.1 and the manufacturer's data sheet with the calibration reference
10.3 Insulation test			As in 10.3 of IEC 61215
GROUP B INSPECTION (100%), covering additional important characteristics			
none			

Table 1 — Test schedule for quality conformance inspection (Part 2)

Subclause number and Test (see Note 1) of IEC 61215	D or ND	Conditions of test	Sample size and acceptance criterion (see Note 1)			Performance requirements
			p	n	c	
GROUP C INSPECTION (periodic)						
Subgroup C1			24	1	0	or change in product see 2.1
10.4 Measurement of temperature coefficients	ND					See 2.1
10.5 Measurement of NOCT	ND					See 2.1
10.6 Performance at NOCT	ND					See 2.1, first five items
10.7 Performance at low irradiance	ND					See manufacturer's data sheet
10.8 Outdoor exposure	ND	After, repeat tests 10.1, 10.2, 10.3 of IEC 61215				
10.9 Hot-spot endurance	D					
GROUP C INSPECTION (periodic)						
Subgroup C2	**D**		**12**	**2**	**0**	
10.10 UV test		IEC 61345				See clause 7 of IEC 61345
10.11 Thermal cycling		50 cycles After, repeat tests 10.1, 10.2, 10.3 of IEC 61215				See 10.1, 10.2, 10.3 of IEC 61215
10.12 Humidity freeze						See 10.1, 10.2, 10.3 of IEC 61215
10.14 Robustness of terminations				1	0	See 10.14.5 of IEC 61215
10.15 Twist				1	0	See 10.15.4 of IEC 61215

Table 1 — Test schedule for quality conformance inspection (Part 3)

Subclause number and Test (see Note 1) of IEC 61215	D or ND	Conditions of test	Sample size and acceptance criterion (see Note 1)			Performance requirements
			p	n	c	
Subgroup C3	**D**		**12**	**2**	**0**	
10.11 Thermal cycling		200 cycles				See 10.11.5 of IEC 61215
Subgroup C4	**D**		**12**	**2**	**0**	
10.13 Damp heat		1 000h				See 10.13.4
10.16 Mechanical load				1	0	See 10.16.4

NOTE 1 - In this table:
p = periodicity (in months)
n = sample size
c = acceptance criterion (permitted number or non-conforming items)

Modifications
(Part 1)

Modifications likely to affect Qualification Approval

For the modifications listed below, the Qualification Approval tests in IEC 61215 shall be repeated as indicated :

a) Modification to thin-film layers

For modifications such as

- metallization materials and/or process,
- anti-reflective coating,
- diffusion process,
- order of cell process, and
- change of manufacturing site of the thin-film layers

repeat

- thermal cycling, 200 cycles (10.11),
- humidity freeze (10.12),
- damp heat (10.13),
- outdoor exposure (10.8), and
- hot spot endurance (10.9).

b) Modification to encapsulation system

For modifications such as

- different materials,
- different additives,
- different primer or method of priming, and
- modification of encapsulation process (that is, different time, temperature, pressure, etc.)

repeat

- thermal cycling, 200 cycles (10.11),
- UV (10.10, IEC 61345) / thermal cycling, 50 cycles (10.11) / humidity freeze sequence (10.12),
- insulation test (10.3), and
- outdoor exposure (10.8).

Modifications
(Part 2)

c) Modification to superstrate

For modifications such as

- different material,
- different thickness,
- different additives, and
- different preparation process,

repeat

- UV (10.10, IEC 61345) / thermal cycling, 50 cycles (10.11) / humidity freeze (10.12) sequence,
- twist test (10.15),
- mechanical load test (10.16),
- insulation test (10.3),
- hail test (10.17), and
- damp heat (10.13) (if non-glass)

d) Modification to backsheet/substrate

For modifications such as

- different thickness,
- different additives, and
- different preparation process,

repeat

- UV (10.10, IEC 61345) / thermal cycling, 50 cycles (10.11) / humidity freeze (10.12) sequence,
- robustness of terminations (10.14),
- damp heat (10.13) (if non-glass).

If there is a change from superstrate to substrate design or from substrate to superstrate design, the entire qualification test sequence in IEC 61215 shall be conducted.

Modifications
(Part 3)

e) Modification to frame and/or mounting structure

For modifications such as

- cross section of frame
- different framing material, and
- elimination of frame altogether,

repeat

- mechanical load test (10.16),
- outdoor exposure (10.18) if plastic material is used,
- UV (10.10, IEC 61345) / thermal cycling (10.11), 50 cycles / humidity freeze (10.12) sequence, if plastic material is used, and
- hail test (10.17), unless tempered glass is used as superstrate.

f) Modification to junction box/electrical termination

For modifications such as

- different material,
- different design, and
- different method of attachment

repeat

- robustness of terminations (10.14),
- thermal cycling, 200 cycles (10.11), and
- insulation test (10.3).

g) Lower or higher efficiency cells in identical package and identical cell process

Repeat

- hot-spot endurance (10.9),
- thermal cycle, 200 cycles (10.11), and
- damp heat (10.13).

Modifications
(Part 4)

Modifications that do not require re-testing

Provided that all structural components, materials used and processes (including cell process) remain the same, the following modifications shall not require re-testing:

— fewer cells in module;
— smaller cells in module, as long as each cell has the same number or area of interconnects and equivalent numbers of solder bonds per unit area.

Marking

Marking of the PV module shall be in accordance with clause 4 of IEC 61215. The detail specification may also require that, in addition, the following be marked:

— maximum power (W);
— maximum power current (A);
— open-circuit voltage (V);
— short-circuit current (A);
— NOCT (°C).

Marking of the package may also be required, for example

— manufacturer's name, logo or trade mark;
— model/type number;
— serial number.

Appendix VI: Bibliography

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3. *Global Approval Program for Photovoltaics (PV GAP) Reference Manual.* PV GAP Recommended Standard PVRS 2 Amendment 1, December 1998.

4. Manufacturing Quality Process Manual for Photovoltaic Components and Systems Version1.5, June 30,1999.

5. Photovoltaic Test Laboratory Quality Manual. DRAFT Document, Version 1.1, February 22,1999.

6. ISO 9000-1:1994, *Quality management and quality assurance standards* — Part 1: *Guidelines for selection and use.*

7. ISO 9000-2: 1993, *Quality management and quality assurance standards* — Part 2: *Generic guidelines for the application of ISO 9001, ISO 9002 and ISO 9003.*

8. ISO 9000-3: 1991, *Quality management and quality assurance standards* — Part 3: *Guidelines for the application of ISO 9001 to the development, supply and maintenance of software.*

9. ISO 9000-4: 1993, *Quality management and quality assurance standards* — Part 4 Guide to dependability programme management.

10. ISO 9001: 1994, Quality Systems—*Model for quality assurance in Design, development, production, installation and servicing*.

11. ISO 9002:1994, Quality systems — *Model for quality assurance in production, installation and servicing.*

12. ISO 9003:1994, Quality systems — *Model for quality assurance in final inspection and test.*

13. ISO 9004-1: 1994, *Quality management and quality system elements* – Part 1: *Guidelines.*

14. ISO 9004-2: 1991, *Quality management and quality system elements* – Part 2: *Guidelines for services.*

15. ISO 9004-3: 1993, *Quality management and quality system elements* – Part 3: *Guidelines for processed materials.*

16. ISO 9004-4: 1993, *Quality management and quality system elements* – Part 4: *Guidelines for quality improvement.*

17. ISO 10005: 1995, *Quality management – Guidelines for quality plans.*

18. ISO 10006: (tbp), *Quality management – Guidelines to quality in project management.*

19. ISO 10007: 1995, *Quality management – Guidelines for configuration management.*

20. ISO 10011-1:1990, *Guidelines for auditing quality systems* — Part 1: *Auditing.*

21. ISO 10011-2:1991, *Guidelines for auditing quality systems* — Part 2: *Qualification criteria for quality systems auditors.*

22. ISO 10011-3:1991, *Guidelines for auditing quality systems* — Part 3: *Management of audit programmes.*

23. ISO 10012-1:1992, *Quality assurance requirements for measuring equipment* — Part 1: *Metrological confirmation system for measuring equipment.*

24. ISO 10013:1995, *Guidelines for developing quality manuals.*

25. ISO/TR 13425:1995, *Guidelines for the selection of statistical methods in standardization and specification.*

Appendix VII: Pilot Training Schedule

	MONDAY	TUESDAY	WEDNESDAY
9:00 a.m.	I-1 Introduction Review of Objectives and Agenda;	Homework Review	Homework Review
9:30 a.m.	Introduction of Participants Identification of Participant Expectations	Group Interaction	Group Interaction
10:00 a.m.	**Break**	**Break**	**Break**
10:15 a.m.	I-2-Elements of a Quality System (Q&A)	II-1-Quality in Manufacturing Procedures & Planning (ISO 4.2)	III-1-Process Control (4.9) Inspection & Testing (4.10) Control of Insp. & Test Equip (4.11,4.12)
11:15 a.m.	I-3-Global Approval Program for PV (PV GAP)	II-2-Contract Review Process and Design Control (4.3, 4.4)	III-2--Non-conforming Produ (4.13), Corrective Action(4.1 Training (4.18)
12:30 p.m.	**LUNCH**	**LUNCH**	**LUNCH**
1:30 p.m.	I-4-The evolution and merits of the ISO Standards	II-3-Document and Data Control (4.5) and Control of Quality Records (4.16)	III-3- Handling, Storage, Packaging, Preservation anc Delivery (4.15)
2:30 p.m.	I-5-ISO Standards for Quality in Manufacturing and ISO levels 9001, 9002, 9003	II-4-Case Study #1: Contract Control Participant Interaction	Servicing (4.19) III-4-Case Study #2: Module Process Control Participant Interaction
3:45 p.m.	**Break**	**Break**	**Break**
4:00 p.m.	I-6-The Fundamentals of Quality Management (ISO 4.1)	II-5- Purchasing (4.6) Customer supplied Product (4.7),& Product ID and Tracking(4.8)	III-5 Statistical Data(4.20)
5:00 p.m.	Daily Recap Homework Assignment and Survey/Evaluation	Daily Recap Homework Assignment and Survey/Evaluation	Daily Recap Homework Assignment and Survey/Evaluation
5:30 p.m.	End of Session	End of Session	End of Session

	THURSDAY	FRIDAY
9:00 a.m.	Homework Review	V-1- Quality Audits (Q & A) (4.17)
9:30 a.m.	IV-1 Existing Standards Case Study #3: PV Standards	V-2-The Steps to ISO Qualification
		Break
10:00 a.m.	**Break**	V-3-IECQ/PV GAP Approval Process
10:15 a.m.	IV-2-When There Are No Standards Certifiable Standards	
11:15 a.m.	Group Interaction on Standards	
12:30 p.m.	**LUNCH**	**LUNCH**
1:30 p.m.	IV-3-Intermediate Tests & Final Product Test	V-4-PV GAP Mark & Seal (Q & A)
2:30 p.m.	IV-4-Case Study #4: Charge Controller Conundrum Participant Interaction	V-5-The Costs and Benefits of Quality Unresolved Problems
3:45 p.m.	**Break**	**Break**
4:00 p.m.	IV-5-Testing Labs (Q & A)	Group Discussion and Final Evaluation of Training Course
5:00 p.m.	Daily Recap Survey/Evaluation	Summary and Final Remarks Refreshments
5:30 p.m.	End of Session	

IV.　あ と が き

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５年計画でスタートした新タスクの初年度版であり、活動目標に基づく基本計画の構築が中心の活動であった。

今後　Subtask 10/20/30 のワークプランの固めが進み、並行して開発途上国の中からモデルとなるターゲット国の選定が行われ、推奨ガイド（ＲＰＧｓ）編纂の作業に進むことになる。

タスクメンバーはこれまでの日本の開発途上国援助に対する実績等を高く評価しており、日本は活動・協力の範囲をSubtask 30 以外のSubtask 10/20 にも相応の意見・提案を行うことが望まれよう。

従って　今後の作業部会メンバーはSubtask 10/20/30 全てに対応することを念頭に、経験・実績の豊富なメンバーの協力も求めて作業を進める必要があろう。

タスクIXの活動は太陽光発電システムの開発途上国への導入が無償援助案件から資金供与案件に一歩前進するための大きなきっかけとなるものであり、我国としても積極的な支援・協力が必要であろう。

以上

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