SPREP

# Pacific Islands Renewable Energy Project

A climate change partnership of GEF, UNDP, SPREP and the Pacific Islands

GEF

UNDP

The Secretariat of the Pacific Regional Environment Programme

# RENEWABLE ENERGY TECHNOLOGY SUPPORT PROGRAMME FOR THE PACIFIC ISLANDS

PIREP

our islands, our lives...

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## ACRONYMS

| | |
|---|---|
| **ACP** | African, Caribbean and Pacific countries (associated with EU) |
| **ADB** | Asian Development Bank |
| **ADO** | Automotive Diesel Oil |
| **APACE** | Appropriate Technology for the Community and Environment |
| **APEC** | Asia Pacific Economic Cooperation forum |
| **ASTM** | American Standards for Testing of Materials |
| **CDM** | Clean Development Mechanism |
| **CILSS** | Comité Inter-Etat de Lutte contre la Sécheresse au Sahel |
| **$CO_2$** | Carbon dioxide, a key greenhouse gas |
| **CREDP** | Caribbean Renewable Energy Development Programme |
| **CROP** | Council of Regional Organisations in the Pacific |
| **DAC** | Development Assistance Committee |
| **DME** | Department of Minerals and Energy (South Africa) |
| **DOE** | Department of Energy |
| **DBP** | Development Bank of the Philippines |
| **DSM** | Demand Side Management |
| **EC** | European Community |
| **EDF** | European Development Fund |
| EDRC | Energy Development and Research Centre (South Africa) |
| **EMT** | External Management Team |
| **EPC** | Electric Power Company (Samoa) |
| **EPU** | Energy Planning Unit (Tonga) |
| **ESCAP** | Economic and Social Commission for Asia and the Pacific (UN) |
| **ESCP** | Energy for Sustainable Communities Programme |
| **EU** | European Union |
| **EWG** | Energy Working Group of CROP |
| **FEA** | Fiji Electricity Authority |
| **FINESSE** | |
| **FSED** | Forum Secretariat Energy Division |
| **FSM** | Federated States of Micronesia |
| **GEF** | Global Environment Facility |
| **GHG** | Greenhouse Gas |
| **GoSI** | Government of the Solomon Islands |
| **GTZ** | Deutsche Gesellschaft für Technische Zusamenarbeit (German Technical Cooperation) |
| **IBRD** | International Bank for Reconstruction and Development |
| **IDA** | International Development Association |
| **IEEE** | Institute of Electrical and Electronic Engineers |
| **IFC** | International Finance Corporation |
| **IMF** | International Monetary Fund |
| **IPP** | Independent Power Producer |
| **ISO** | International Standards Organisation |
| **IEC** | International Electrotechnical Commission |
| **JICA** | Japan International Cooperation Agency |
| **JREC** | Johannesburg Renewable Energy Coalition |
| **MDG** | Multilateral Development Bank |
| **MOU** | Memorandum of Understanding |
| **NGO** | Non-Government Organisation |
| **O&M** | Operations and maintenance |

| | |
|---|---|
| **OECD** | Organization for Economic Cooperation and Development |
| **PAS** | Publicly Available Specification |
| **PEDP** | Pacific Energy Development Programme (UN 1982-1991) |
| **PIC** | Pacific Island Country |
| **PICCAP** | Pacific Islands Climate Change Assistance Programme (GEF/UNDP) |
| **PIREP** | Pacific Island Renewable Energy Project (GEF/UNDP) |
| **PNG** | Papua New Guinea |
| **PPA** | Pacific Power Association |
| **PREFACE** | Pacific rural/Renewable Energy France-Australia Common Endeavour |
| **PREA** | Pacific Regional Energy Assessment |
| **PREGA** | Promotion of Renewable Energy, Energy Efficiency and GHG Abatement (ADB) |
| **PREP** | Pacific Regional Energy Programme |
| **PV** | Photovoltaic |
| **PV-GAP** | Photovoltaics Global Accreditation Programme |
| **QCA** | Quality Control Approach |
| **REEP** | Renewable Energy and Energy Efficiency Programme (ADB) |
| **REM** | Regional Energy Meeting |
| **RESCO** | Renewable Energy Service Company |
| **RET** | Renewable Energy Technology |
| **RSP** | Regional Solar Programme (Africa) |
| **SEC** | Solar Energy Company (Kiribati) |
| **SEP** | Sustainable Energy Planning |
| **SHS** | Solar Home System |
| **SI** | Supervisory Inspectorates (also Solomon Islands) |
| **SIDA** | Swedish International Development Agency |
| **SIDS** | Small Island Developing States |
| **SIVEC** | Solomon Islands Village Electrification Council |
| **SME** | Small to Medium Enterprise |
| **SOPAC** | South Pacific Applied Geoscience Commission |
| **SPC** | Secretariat of the Pacific Community |
| **S.P.I.R.E.** | South Pacific Institute for Renewable Energy |
| **SPREP** | Secretariat of the Pacific Regional Environment Programme |
| **SWH** | Solar Water Heater |
| **TAC** | Technical Assistance Committee |
| **TAU** | Technical Assistance Unit |
| **UL** | Underwriters Laboratory |
| **UN** | United Nations |
| **UNDP** | United Nations Development Programme |
| **UNEP** | United Nations Environment Programme |
| **UNESCO** | United Nations Educational, Scientific and Cultural Organization |
| **UNFCCC** | United Nations Framework Convention on Climate Change |
| **US** | United States |
| **USAID** | United States Agency for International Development |
| **VAT** | Value Added Tax |
| **VFEG** | Village First Electrification Group |
| **WB** | World Bank |
| **WSSD** | World Summit on Sustainable Development |

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# 1 INTRODUCTION

This report is an outcome of a series of studies conducted under the framework of the Pacific Islands Renewable Energy Project (PIREP) – a climate change mitigation partnership of the Global Environment Facility (GEF), the United Nations Development Programme (UNDP), the Secretariat of the Pacific Regional Environmental Programme (SPREP) and Pacific Island Countries (PICs).

The PICs are currently heavily dependent on fossil fuels. Renewable energy (RE), mostly hydro, is estimated to contribute less than 10 percent of each PIC's commercial energy use and the region is characterized by scattered and fragmented efforts to promote RE technologies that are based on unreliable and unsubstantiated data on RE resource potentials. The PIREP aims to facilitate the promotion within the PICs of the widespread implementation and ultimately, commercialisation of RE technologies (RETs) through the establishment of a suitable enabling environment. The establishment of an environment conducive to the region-wide adoption and commercialisation of RETs would involve the design, development and implementation of appropriate policies, strategies and interventions addressing the fiscal, financial, regulatory, market, technical and information barriers to RE development and utilization. It also involves the development of interventions for strengthening of the relevant institutional structures and national capacity for the coordination and the sustainable management (design, implementation, monitoring, maintenance, evaluation and the marketing) of RE initiatives in each PIC.

An RE assessment study[1] conducted by the PIREP in 15 PICs identified, among others, the insufficient technical capacity in the PICs to be major technical barrier to the RE development in the PICs.

This report reviews technical support needs of the PICs and develops a regional renewable energy technology support programme that is based on PIREP Country Reports, the PIREP Regional Synthesis and the comprehensive study of training in the Pacific Region and capacity building project development work done by ESCAP in 2004[2].

There are a number of on-going successful renewable energy projects in the PICs that include solar thermal, solar PV, geothermal, hydro, biogas, biomass and biofuel technologies. However there have been many more renewable energy projects that have failed. In many cases this has been due to a lack of sufficient capacity in the country to plan, install, or maintain the project. Many of the projects have been part of donor programmes which have provided equipment, system engineering and initial training but most of these programmes turn over the project for local operation and maintenance without adequate or continuing capacity development support. There have been technical system failures and institutional system failures that often have been due to inadequate local capacity to keep these two systems operating smoothly.

The justification for the cost of capacity building in renewable energy has been demonstrated in a number of projects world-wide, where good quality training and technical assistance has had a direct positive impact on the sustainability of a project. The cost for capacity building

[1] This study produced 15 Country Reports and a Regional Synthesis.

[2] "Renewable Energy Training in Pacific Island Developing States – An analysis and proposal for long-term provision of timely, relevant and targeted training on renewable energy" ESCAP, Bangkok 2004.

can be as little as a few percent of a project budget, but that small component may directly determine whether the project is a success or not.

To ensure more sustainable dissemination of renewable energy, capacity building is required across many sectors, organisations and groups. As outlined in the country reports the technical assistance that is required is diverse and the actual requirements vary from country to country. The type of capacity building activities that have been found to be generally needed in the PICs include developing the skills for:

- evaluation and selection of technology options;
- resource assessments;
- standards and certification development;
- renewable energy system design;
- locally based, on-going training for both technical and business subjects;
- accessing and understanding technical advisory services;
- design of institutional structures for sustainable operation;
- developing project finance;
- setting tariff structures;
- project monitoring, data collection analysis and storage;
- operation and maintenance (O&M);
- preparation of business plans;
- financial and economic analysis;
- product development
- quality assurance;
- awareness raising and market development; and
- monitoring, accounting, record keeping and data analysis procedures.

This is a diverse group of requirements that includes capacity development for government agencies, businesses and educational institutions and many other capacity development needs may exist that are specific to the PIC being assisted and the technologies in use in that country.

It is the purpose of this report to examine the Pacific and international experience in renewable energy development and using that experience to propose a support mechanism for renewable energy technology development that provides for the necessary capacity development and the maintenance of that capacity for the long term.

To that end, this report reviews programmes and successful models of renewable energy capacity development in the region, other SIDS and developing countries, in particular looking at their technical and institutional support. It also examines failed projects and the lessons learned from those failures. Using the experiences and lessons learned from these programmes a regional renewable energy technology support programme is proposed.

# 2 PIC RENEWABLE ENERGY CONTEXT

## 2.1 Introduction

Until recently, nearly all renewable energy projects (with the exception of hydro and biomass waste combustion for agricultural processing industries) have been of a pilot or demonstration nature with limited scope. Those projects were generally funded by donor agencies that typically provided project designs, system designs, component specifications, arranged for the purchase of components and supervised the installation of the renewable energy systems. Capacity building for those projects typically consisted of on the job training short formal training in technical procedures and the provision of manufacturer manuals for the operation and maintenance of each component – sometimes written in a language not used in the target country. Additional capacity building by regional agencies and donor agencies has been carried out through local and regional workshops, funding participation for external training and through the exchange of personnel between project operators to share experiences and improve the operations of both operators. Unfortunately since the closing in the mid-1990s of the PEDP/S.P.I.R.E/FSED long term coordinated training effort (see the Annex for details), there has been no regional plan for renewable energy capacity building and training has been the result of opportunity rather than plan.

Today, there is strong emphasis on large scale implementation of renewable energy to offset $CO_2$ produced by the combustion of fossil fuels. The “large” PV project of 10 years ago served 100 households but today that is a mini-project. In 2003 Fiji developed plans and project funding requests for over 10,000 SHS for rural electrification that would include a number of RESCO operators in many locations. In 2005 Kiribati completed the installation of 1500 additional SHS in their rural electrification programme. In Papua New Guinea Several thousand solar home systems (SHS) are said to be installed privately. . Megawatts of wind power are being developed in Fiji by IPPs and FEA, additional megawatts of geothermal are under construction in PNG and there are plans for biofuel and biomass generation in Samoa that would provide a significant percentage of the Upolu electricity supply. Coconut oil as a diesel fuel replacement is exciting entrepreneurs and governments since the cost of diesel fuel has risen to match or exceed that of coconut oil in several countries and there is no indication that the fossil fuel cost will fall in the near future.

These large scale programmes cannot rely on regional workshops, sending a few persons for overseas training or one-time training for operating and maintenance technicians. For these larger projects to succeed for the long term, there must be developed the capacity for technician and business training within the countries so there can be continuously available training for local technicians, installation and maintenance personnel. Locally based business training with special emphasis on the problems of renewable energy businesses will also be important for the successful development of the many new businesses that will be needed to support the increased use of renewable energy.

However, it takes many years to gain the necessary experience and knowledge needed to successfully design and implement large scale projects and in the early years of larger scale renewable energy development most of the PICs will continue to have to rely on external assistance in project design, standards development, component specification and the structuring of the policies, legislation and institutions needed to support large scale renewable energy development.

The approach proposed for the development of a renewable energy technology support mechanism must include both a strong emphasis on locally based training and on the provision of high quality technical and business advice from a regional base.

## 2.2 Renewable Energy Activities in the Pacific

Activities in renewable energy in the Pacific are listed below.

1. Rural electrification projects using solar photovoltaics. Large numbers of small PV systems typically deployed in remote areas.
2. Trials and small -scale demonstrations of renewable technologies such as biogas digesters, crop dryers and small wind generators. Typically located near urban areas for convenience in monitoring and access for visitors.
3. Biomass for process heat and power generation using agricultural and forestry processing wastes. Located at the site of agricultural and forestry processing facilities such as sugar mills and sawmills.
4. Large and small hydro development for electricity generation. Large hydro installations are located in rural areas with electricity transmitted from the sites to urban grids – often with nearby rural areas remaining unelectrified (e.g. Monasavu in Fiji). Small hydro is typically used for independent grids to electrify rural villages and is located near to the population centre it serves (e.g. Iriri in the Solomon Islands).
5. Small businesses selling and installing renewable energy systems. Generally located in urban areas, sometimes with agents in rural areas for installation and service.
6. Small businesses manufacturing renewable energy equipment. Solar water heaters and balance of system components for SHS are being manufactured in the Pacific.
7. Small businesses specializing in the installation and maintenance of renewable energy systems (RESCOs). The Fiji, Vanua Levu RESCO trials use a local, private contractor for installation, operation and maintenance. The Solar Energy Company (SEC) of Kiribati, a commercially operated energy service company, has installed, operates and maintains around 2000 SHS and community PV installations and contracts with other agencies for maintenance of their remote solar installations.
8. Government energy departments that manage renewable energy pilot projects and generally establish policies and regulations relating to renewable energy implementation. (e.g. the Tonga Energy Planning Unit that has implemented nearly all the renewable energy projects for the country and is strongly involved in operation and maintenance activities as well).

### 2.2.1 Rural electrification

The technology that historically has had the most attention in the PICs has been the use of solar photovoltaics for home lighting and small appliance use in rural areas. Rural electrification projects in the Pacific began in the early 1980s and have a history of building on that long experience with gradual improvements in both technical and institutional systems. With the success of “solar utility” or “fee for service” or “RESCO” type of rural electrification schemes well demonstrated in Kiribati, Fiji and Tonga, this approach has expanded into the thousands of installations and there are plans for more than 15,000 new installations over the next few years.

Successful rural electrification using solar PV systems has been the result of good quality designs optimized for the Pacific environment that have sufficient capacity to reliably provide the desired services and of continuing good quality preventive and repair maintenance provided by professional service personnel. With the expansion of rural electrification comes the need for training of those service personnel and of the personnel in the businesses that provide the services. Experience has shown that there is rapid turnover of field technicians – technical training enables the persons trained to move to urban areas where technical skills are in strong demand – and that combined with the expansion of programmes requires continuing access to technical and business skills training for the RESCOs.

Over the past 20 years, most of the technical problems that have faced renewable energy based projects have been the result of:

- a poor design that fails to provide adequate capacity to meet the requirements of users;
- use of components that are not acceptable under international standards;
- the use of components that are acceptable under international standards and design guidelines but fail prematurely in the harsh Pacific environment;
- failure to provide higher quality, higher reliability components for the more remote sites that cannot be accessed readily for maintenance;
- the use of solar panels with less than 36 cells;
- unacceptably high failure rates for lights usually due to failure to question the experience with the lights in other projects or purchases based on price rather than quality;
- inadequate maintenance resulting in premature failure of components and unreliable system performance. This is the most common cause of failure for renewable energy systems world wide and the Pacific is no exception; and
- installation procedures that do not follow acceptable standards.

It is noted that all the above problems (except for inadequate maintenance) were the result of poor design, improper component specification or lack of experience. It is also noted that all those problems occurred with external expertise providing the designs and specifications which were generally based on “accepted international standards” of the day. Experience has clearly demonstrated that the requirements of design and of component selection need to be specifically established for the Pacific Island context and should be based on the long experience in the Pacific with PV based rural electrification. In particular, where RESCO type electrification is used, system sizing rules and component specifications will need to be different from those typically used for PV systems that are sold to end users. Life cycle cost must be the criterion for RESCO implementation, not minimizing the initial cost through design of a minimally acceptable system as is the case when specifying components for a PV system that is to be sold to a low income user. Experience in the Pacific indicates that increasing the initial cost of a RESCO installed system by 25% - 30% can result in 50% lower lifecycle costs for maintenance and battery replacements with the added bonus of the higher quality system providing more acceptable service to end users.

#### 2.2.2 Technology trials and small scale demonstrations

For technologies that have not had wide acceptance or visibility, government energy agencies and sometimes RET manufacturers or vendors arrange for small scale trials and technology demonstrations to gain local experience and to show the viability of the technologies. Some technologies, such as biogas, have been in the trial and demonstration mode for over 20 years in the Pacific and are yet to find the specific mix of technology and application that will cause a rapid expansion in use. Others, such as solar PV for rural electrification have left the trial stage and are being implemented in large numbers.

One continuing problem with doing trials and demonstrations is too often they do not work and end up providing a negative view of the technology. A common reason for this result is a lack of project design skills, dependence on external experts whose experience is not regionally based causing designs to be made following incorrect criteria, poor maintenance of the installed systems due to a lack of understanding of the actual maintenance requirements and inadequate monitoring and analysis of system operations so problems often go unnoticed for long periods and multiply to the point of failure. All these problems can be traced to a lack of capacity in pilot project design, installation, management, monitoring and analysis. Assistance specifically oriented toward PIC conditions is needed by most PIC energy offices in the design of pilot projects and in the procedures necessary for their successful operation and follow-on development.

#### 2.2.3 Biomass for process heat and power production at agricultural processing facilities

Large quantities of biomass waste products are produced by sugar mills, forest product mills and other agricultural processing facilities. The waste products represent a serious environmental problem and their combustion or gasification to produce process heat or electrical power is a solution both for the waste disposal problem and for helping meet the high energy requirements of agricultural processing. PNG, Fiji, Solomon Islands, Tonga, Vanuatu and Samoa have had – and most still have – significant energy production from this source. This use is typically large scale, in the megawatt range, and highly skilled operators and maintenance personnel are required. However, the number of persons required is small since the number of such facilities is small and so training of personnel is typically handled in-house, often with the assistance of equipment manufacturers and installation firms. Each installation is technically unique and training has to be specific for that installation. Therefore external capacity building support is not needed nor could it be delivered by a regional programme at an acceptable cost.

#### 2.2.4 Large and small hydro development for power generation

Except for the traditional uses of biomass for cooking, hydro power represents the largest use of renewable energy in the Pacific. Papua New Guinea, Fiji and Samoa all have power systems that include a large percentage of hydro generation. There is substantial potential for further development in those countries and in the Solomon Islands and to a lesser extent in Vanuatu. Pohnpei in FSM has useable hydro resources as well. These hydro developments have been carried out by national utilities. These utilities maintain in-house training capabilities and external capacity building support is not generally needed.

Small hydro for independent village scale grids has been developed in PNG, Fiji, Solomon Islands and Vanuatu. In those installations, reliability has often been low and many problems of maintenance, institutional structure and inadequate design are faced. Clearly local operators, maintenance personnel and management could all benefit from capacity development and for these projects to be sustainable local programmes focusing on their needs are required.

#### 2.2.5 Small businesses selling renewable energy equipment

Over the past 20 years, many small businesses have been established to sell solar PV equipment for rural household use and solar water heaters for urban use in the PICs. Very few have survived five years or more. Failure is not inevitable, clearly there is a market for these products and their sale should be sufficient to maintain a small business if that business is properly structured, understands how to market the products, has adequate finance and practices good management techniques. Most of the businesses that have failed would have benefited from training in good management, in marketing, in accounting and in the basics of the technology they are selling. With the exception of the technical training, those skills are not unique to renewable energy businesses though there are special aspects that need to be considered, particularly in marketing and after sales support. Making business training, with a focus on renewable energy marketing and after-market support, readily available to existing and aspiring entrepreneurs would help reduce the failure rate of renewable energy businesses and improve the quality of the sales that are made.

#### 2.2.6 Small businesses manufacturing renewable energy equipment

Most renewable energy technology is imported to PICs. The market is too small in most of the Pacific Island countries to sustain local manufacture. However successful renewable energy manufacturing businesses do exist in the Pacific and their experience can be transferred to other PICs where a similar market for the products can be found.

*Solar Water Heaters*

The manufacture of solar water heaters is not a complex process and is carried out in many developing countries. Some local manufacturers only assemble products actually manufactured overseas, others manufacture the components on site using licensed designs from overseas companies and a few manufacture the components using a local design.

Fiji has experience with the manufacture of solar water heaters since the 1970s. The most common of the local designs (Beasley) uses a separate collector and copper tank in an efficient and reliable thermo-siphon design that has had wide acceptance over the years. The systems are well made, efficient, cost effective and have a long life but are relatively difficult to install and are not good looking. The Australian designs typified by Solar Edwards and Solahart have been recently more successful in the urban Fiji market. Their success is mainly due to their ease of installation and relatively attractive appearance.

In Tonga a company located in Nuku'alofa has manufactured integral thermo-siphon solar water heaters for more than a decade but now finds the market getting more difficult to penetrate. Besides the limited acceptance of piped hot water in Tongan households, there is a problem with calcium carbonate deposition on the inside of solar water heater collectors when ground water is used and that has resulted in maintenance problems for many users. Where rain water is used in solar water heaters, maintenance requirements are generally much lower but, unlike some atoll countries, rain water is not commonly used for piped household water supply in Tonga.

*Small-scale Biogas Digesters*

A number of small-scale biogas digesters have been constructed locally for pig farms and dairies with varying levels of success in PNG, Fiji and the Cook Islands. The early experience was not favourable but in Fiji a better understanding of the technology and the requirements of the Fiji farmers has allowed development of biogas systems more suited to

Fiji conditions and therefore are becoming more successful. With that development has come increased interest by the pig and dairy industry and a number of new installations are proposed.

#### *Micro-hydro components*

Micro hydro installations in Fiji, PNG and the Solomon Islands have used locally made Pelton type turbines with success. The market is small and a business could not expect to be profitable if depending only on the sale of Pelton turbines for small hydro development, but can be an interesting sideline for a company that has the metal casting and machining capacity needed for their construction. External assistance is typically needed for the design of the turbines, however.

#### *Solar PV System Balance of System Components*

The Kiribati Solar Energy Company (SEC) has manufactured S.P.I.R.E. designed solar PV controllers with both technical and financial success. The units have been installed in the approximately 2000 SHS installed in Kiribati and over 1000 units have been exported to other PICs and Asia. The SEC also manufactures high efficiency DC/DC converters that allow radios that require other than 12VDC to be operated from SHS. This has made the SEC the largest manufacturer of technical products in Kiribati.

The high efficiency 12V fluorescent lights used in the EC funded 1994 PV follow-up project and in the current EU funded Kiribati Outer Islands Electrification Project were manufactured in Fiji.

Batteries specifically designed for use in SHS are being manufactured by Pacific Battery in Fiji and have been used extensively in recent Fiji solar projects with apparent success.

### 2.2.7 Small businesses acting as RESCOs and providing renewable energy system installation, operation and maintenance services.

The Fiji RESCO development project funded by GEF in 2002-2003 thoroughly considered the use of private companies for the installation, operation and maintenance of rural electrification systems using renewable energy. The programme included development of training materials and processes for RESCOs and included the development of management, marketing, financial analysis and record keeping skills. If RESCOs are to become the approach to be used for large scale renewable energy based rural electrification, such training needs to be made available to existing and aspiring RESCOs on a continuing basis along with the technical training needed for the field maintenance personnel.

## 2.3 Key lessons learned regarding renewable energy implementation in the PICs

A major component of the PIREP country reports is a summary of the lessons learned and the needs for capacity building. Generally, the PICs are lacking in sufficient qualified personnel, legislative basis and policy frameworks. There are capacity needs in those national and regional institutions that are expected to develop and implement sustainable renewable energy policies and projects.

The country reports summarize the key lessons learned from their renewable energy experience. The lessons that are of a regional nature (that apply to groups of PICs) are listed below:

- very limited human resources make it difficult to achieve the levels of staffing needed for reliable technical services;
- turnover of technical personnel is high since technical services are in strong demand and technical training improves the trainee's chances for moving to a higher level job. This means that training for replacement personnel must be continuously available locally;
- clear energy policy and institutional support is needed to provide continuity and reassurance to renewable energy project developers and in most countries this is lacking. In countries where policies have been prepared, they often are not followed on practice. In some countries this is further compounded by the functional independence of different islands and states within one country, e.g. FSM, that requires multiple policy and institutional arrangements;
- rural RET installations require high quality, reliable components that are capable of long life under Pacific conditions. The more remote the site, the more important long life and high reliability of service becomes since the cost of for technical support increases rapidly as access becomes more difficult and more costly;
- village management of energy projects has been generally poor with maintenance and repairs inadequate. Funds are typically poorly managed and often when money is needed for repairs, it is not available even though fees have been collected for services provided. Technical competence at the village level is not good and training is essential both at the time of installation and on a continuing basis;
- recipients of energy projects need to be self-designated and have a high priority for the services provided by the renewable energy systems. Selection of a village, business or individual for an energy project without that village, business or person actually desiring the project leads to project failure in most cases. There must be a commitment on the part of the recipients to properly operate, pay the costs and care for the project;
- undersizing of energy systems results in overloading and a high failure rate. It is more cost effective in the long run to oversize systems so users always have adequate capacity to fulfil their requirement for energy. It is also important to incorporate energy efficiency and demand side energy management into system (and project) design so that the limited capacity of the installed systems is not wasted;
- the Pacific environment with its high humidity, salty air, high ambient temperature and frequent heavy rains is very hard on energy equipment, particularly complex electronics. For reliable service, it is important to choose components proven to perform well in the PIC environment;
- an external authority for operation, maintenance and fee collection is needed if village energy systems are to be successful. Village based institutional structures do not generally have the technical or management competence necessary and do not have the internal discipline needed to enforce fee collection and proper maintenance procedures;
- training is needed, but not readily available for private sector development, that includes rural project management, business operations and technical training;
- some islands do not have local technical education facilities and feel that the overseas courses are only marginally relevant to their situation, e.g. Tokelau; and

- there are few local standards relating to renewable energy technology and international standards often are not appropriate for the rigorous Pacific environment.

# 3 KEY TECHNICAL CAPACITY REQUIREMENTS FOR RENEWABLE ENERGY

There are considerable capacity gaps that need to be met before the sustainable deployment of renewable energy can become widespread in the PICs. The PIREP Country Reports include emphasis on capacity requirements for renewable energy development. They include:

- a better understanding of renewable energy and the part it can play in future energy planning is required in governments and in particular in the energy planning units, national utilities and energy authorities. There is little understanding of the requirements for large scale implementation of renewable energy, most experience has been with small pilot projects;
- there is insufficient capacity for energy planning, least cost analysis and financing structuring. Projects are often approved on an ad-hoc basis without any overall long-term vision or plan. To enable planning and integration of renewable energy into future supply systems, capacity has to be developed for energy data gathering, analysis and storage. The PIREP reports indicate a very poor state of energy statistics in the PICs and little understanding of how to use those statistics for energy planning;
- project design, management training, monitoring and evaluation skills are needed in government departments to support renewable energy projects. This should include resource assessment, technical design, tender preparation, monitoring and evaluation. Support is also required to develop appropriate financial arrangements for implementing renewable energy programmes and for the development of applications for funding;
- on-going installation, operation and maintenance skills for renewable energy systems are needed in the public sector, most utilities and the private sector. Local personnel will always be responsible for the long-term operation of renewable energy projects and therefore on-going training is very important for sustainability, particularly since there is a high turnover of skilled personnel in many PICs. In some countries there will be needs for specific skills, such as in Fiji where there is likely to be an expansion of grid-connected wind power systems;
- where RESCOs are the preferred option for rural electrification, for example in Fiji, Tonga, FSM and RMI, training on business operations is critical for the private sector. Similarly where micro-credit is offered, training in rural credit management will be important;
- the local technical colleges' capacity to train technicians in renewable energy skills needs to be improved in all countries;
- preparation and implementation of standards and certification schemes should be established. To date no PIC has renewable energy standards or certification schemes that are enforced and most have no standards at all. Locally focused standards and certification procedures need to build on international efforts but directly importing externally generated standards has not worked well due to the special conditions that exist in the Pacific Island environments; and
- significant capacity building is needed within the PIC finance community to encourage the local financial institutions to invest in renewable energy.

### 3.1 Lessons learned

Although there have been many lessons learned during the more than two decades of renewable energy capacity building efforts in the Pacific, the principal lessons are:

- there is a need for in-country training capability for upgrading the skills of existing technicians and training new technicians. Without this local capability, project technical sustainability is at great risk since the quality of technical services cannot be maintained;
- training needs to be continuous to account for the high turnover of staff and to ensure the on-going sustainability of the projects;
- training is best carried out by professional educators. Most training by manufacturers, vendors and local technical personnel have not met the needs of the trainees. Educators who are trained in teaching technical subjects to persons with limited existing technical skills are more able to transfer the needed knowledge;
- training is generally needed for all stakeholders, from the consumers to the government. Renewable energy in general is not yet generally well understood by non-specialists and there are many misconceptions that need to be dispelled if RETs are to be widely used;
- it is best that training is carried out in the local language especially where training is in a rural context;
- with the ready availability of computers connected to the Internet, the use of interactive networks to encourage communication is attractive. However, it is easy for a network to become a one-way communication as has been the case for the PREFACE and the SOPAC networks. Thought intended for interactive use, their use has been typically for programme announcements and have rarely been used by PICs for interactive communication purposes. Networks should be designed to encourage multi-respondent interchanges and users need to receive training in how to take advantage of their features.
- training must take into account the time pressures of the trainees and the needs of their employers. It is often not practical for participants to work continuously through a training process and breaking it up into small units may be more effective and better received by trainees;
- some technical capacity can never be developed and kept at a local level and needs to be made available to PICs at a regional or sub-regional level. Except possibly in Fiji and PNG, PICs are unlikely to be able to retain high -level renewable energy expertise, there is not enough demand for those skills for small island employment to be an attractive option to the experts. However, the expertise does still need to be available to the country and it should be the responsibility of regional technical organisations to retain that expertise and make it available to countries as needed; and
- companies doing local manufacturing of RE components need both technical and business advice so as to be competitive with imported goods in technical quality as well as cost.

# 4 TECHNICAL SUPPORT FOR RETS

## 4.1 Support for Government Energy Offices

A better understanding of renewable energy and the part it can play in energy planning is required in most PIC governments. This can be split into the following major categories:

Energy Policy and Planning;

Project Design Support;

Specification and Tendering; and

Project Management, Monitoring and Evaluation.

### *4.1.1 Energy Policy and Planning*

For a consistent and positive environment for RET implementation, policies and plans supporting RETs need to be in place and followed by PIC governments. This has been recognised by the PICs and a regional programme, the Pacific Islands Energy Policy and Strategic Action Planning (PIEPSAP) project, has been funded by Denmark through UNDP. The project is located within SOPAC and has as its task the provision of assistance to National Governments in the development of energy policy and energy plans. The programme is extensive, well funded and long term, therefore it is not proposed that GEF technical support include energy policy or planning capacity building.

### *4.1.2 Project Design Support*

Although project design is a function not only of government but also of private developers, to date the majority of RET projects have been implemented by government agencies and government owned corporations. Increased understanding and capabilities are needed at the project design level for all renewable energy technologies. There should be a broad-based training capability for all RET technologies but with a common focus on sustainability and quality. Training should be provided on how to carry out resource assessments, on the technologies themselves including their applicability and limitations, their operating and capital costs, and how to carry out project designs for each technology.

As a part of project design technical support, expertise should be made available for the review of proposed project designs along with expert assistance for the preparation of project documents for presentation to funding agencies.

### *4.1.3 Specification and Tendering*

Where there are not yet accepted standards for many RETs, it is important that the supply of RE system hardware is correctly specified within technical specifications and tender documentation. Capacity within the governments and utilities should be increased to enable them to prepare specifications and tenders or to at least fully understand the activities of sub-contracted specialists. As a part of a technical support programme, expert assistance should be made available for review of RET project tender documents and, where needed, direct assistance should be provided for their preparation.

### *4.1.4 Project management, Monitoring and Evaluation*

To assess the impact of RE development, to incorporate lessons learned and to plan for future RET development it is important that there is sufficient capacity to monitor and evaluate projects and programs. Capacity needs to be developed to perform quality monitoring and evaluation of RET implementations within government agencies, utilities and the private sector. The sharing of project information between PICs is also an important function and is one that a technical support project can facilitate.

## 4.2 Technical Quality

For any renewable energy technology or programme there are three important areas of quality control:

technical standards – The preparation of appropriate technical standards and enforcement of compliance provides a degree of assurance that components and systems meet performance criteria;

quality of training – ensures that system design, installation, commissioning and maintenance personnel have been trained to an acceptable level of competence; and

quality of management – helps ensure that the operational procedures of the organisations involved – from system manufacturers, installers and hardware suppliers to technical consultants, financiers and service providers – are appropriate to the task at hand.

A requirement that recognised levels of quality are maintained in each of these three areas will help to ensure the sustainability of the RET deployment. The benefits of meeting quality standards will also be recognised by many stakeholders thereby raising confidence in the RET implementation. In particular finance and donor organisations will be able to assess the project risks more easily if quality standards are applied. The use of quality standards will provide a means for evaluating hardware and personnel as well as for local manufacturers to assess their products objectively by direct comparison to standards of performance.

### *4.2.1 Technical Standards*

The adoption of industry-wide standards and a personnel skills certification programme can help both in guaranteeing a quality product to the consumer and in providing sustainable development of the renewable energy sector.

As outlined in the country reports, renewable energy technologies, such as stand-alone PV systems, are frequently installed with little attention to quality issues. The is due to:

general lack of standards or “good practice” guidelines;

lack of data and analysis of failed and successful projects using that RET;

the work required to implement quality control procedures are perceived as being complicated and costly and necessary procedures are not developed or if available are not enforced;

inadequately trained or poorly supervised installers produce poor quality installations; and

certification for training and proper installation standards are essential to the provision of consistently good quality energy delivery..

The development of codes of practice, quality procedures and a licensing or technician certification framework can greatly reduce these problems and help ensure equipment is properly and safely installed, well maintained, and that the end user is educated regarding the system capabilities and proper use. This will help ensure an adequate, sustainable and reliable service to the end user, which at the same time protects the interests of the renewable energy industry by providing successful implementations that attract more investors in the technology.

While the environmental conditions do vary between the PICs it is considered appropriate to develop regional technical standards and training certification procedures for RET implementation. These can be further adapted to fit the requirements of an individual country if necessary due to the existence of special conditions. This would help ensure that any future projects or programmes are of minimum acceptable quality as well as developing a common skills base in the region and making training development easier.

Standards and product certifications are widely recognised and utilised throughout the world, primarily as a means of ensuring that products are independently tested and certified to agreed norms. This process provides a level of assurance that a certified product will perform according to those norms. A number of national standards bodies have developed standards for renewable energy, for example the International Electrotechnical Commission (IEC) Technical Committee 82 (TC82) generally develops standards related to PV. The IEC has also published a Publicly Available Specification (PAS) on renewable energy used in rural electrification. It should be noted that this document is not an IEC standard, but an industry specification.

The PV-GAP (Photovoltaics Global Accreditation Programme) is an example of an international initiative to develop quality in products, companies and training courses and a number of other PV and wind standards initiatives are in varying stages of completion and application. However the direct application of international generic standards for RETs is not recommended since there are special requirements for equipment to be reliably used in the Pacific environment both as to environmental conditions and to special use requirements. Therefore it is important that there be specific development of regional standards for RETs by a competent regional authority and that they be further refined for individual country use. The published guidelines and generic standards should, however, generally be the basis for further development of Pacific standards and some standards, notably those for solar panels, are so widely accepted that modifications are unlikely to be acceptable to manufacturers, at least at an affordable cost.

It is noted that the ongoing ADB REEP (Renewable Energy and Energy Efficiency Programme) includes assistance to Fiji and Samoa in the development of appropriate standards for components. The Fiji standards development activity is focused on the RESCO approach to PV based rural electrification while the Samoa activity is focused on biofuels for diesel fuel replacement.

#### *4.2.2 Certification of Locally Manufactures Components*

If a local manufacturing industry is to be developed it is important that the quality of the products meet recognised safety and operating standards. To ensure that a given product meets objective standards (e.g., European Committee for Electro-technical Standardisation (CENELEC), ISO/IEC, IECQ, Underwriters Laboratories (UL), IEEE, ASTM, etc.), it is necessary to have products tested by approved laboratories (e.g. those recognised by the Supervisory Inspectorates (SIs) of the IECQ, or accredited under the guidelines of the ISO Guide 25) against the standards.

Each different product must be approved and/or certified separately, and any product where the design is changed after approval must be re-tested and re-approved. Testing should be on randomly selected products to make sure that the supplied samples represent the general production quality. Testing is for each product so if one product passes the laboratory tests this does not automatically qualify all of the company's other products.

Unfortunately the process is expensive and with the limited market volumes and small manufacturing companies found in PICs, the cost of the testing may be difficult to justify. At the very least, products should be locally compared against international standards for safety and only designs that ensure safe operation should be used.

#### 4.2.3 Training quality

Training has been implemented in nearly all PICs at some point. However, most training has been financed by bilateral and multilateral donors in association with specific projects and the training has not been coordinated with other projects. These training programmes have typically lacked follow-up programs for skill improvement or for the training of new personnel. Programmes have not generally been built on one another, and isolated training activities have been undertaken often "reinventing the wheel" in terms of content, lab and field activity, method and logistics.

It is important that a common basis for renewable energy training be established and fully integrated into the existing PIC technical training processes so RET training is received by all trainees in a technical training programme. In particular, RET curriculum modules need to be integrated into trades training at PIC polytechnics and vocational schools. For example plumbing trades trainees should receive training in solar water heater installation and maintenance. Electrical trades trainees should receive training in solar photovoltaics. With RET training integrated into standard training programmes, all graduates of the PIC trade training programmes will have at least a basic understanding of the RETs they are likely to be required to operate or maintain.

The development and enforcement of certifiable programmes for RET technicians that include specific requirements for training, experience and practical examinations could greatly improve the average quality of renewable energy technical services. The preparation of curriculum modules for integration into PIC training institutions and the development of suitable regional certification processes for the training of various levels of RET technician would be appropriate to include in a regional capacity building programme.

# 5 LOCAL FINANCIAL COMMUNITY SUPPORT

The local financial community in the PICs has an important role in helping the introduction of renewable energy. All levels of the local financial community, from large trans-national commercial banks to small rural credit programmes should understand at least the basics of renewable energy and its applications and how the financial sector may help in the development of the market by providing:

- credit facilities for end-users to buy the systems;
- savings facilities for rural populations;
- finance through business loans for new businesses (e.g. suppliers and installers) to enter the industry or to expand their business/market; and
- finance for entrepreneurs and project developers to introduce new RET projects.

## 5.1 Modes of Support for the Financial Community in the PICs

To date, most renewable energy finance has been in the form of donor grants for RET pilot projects, loans from multinational development banks for hydro projects and commercial or government loans to large scale agricultural processing companies for biomass combustion of processing waste. There has been little experience in most PICs with finance of renewable energy businesses or RET systems for small scale users such as households, communities or rural businesses.

With the goal of rapid expansion of RET use in the PICs comes the need for finance for that expansion. There are a number of finance institutions present in the PICs to service those needs:

- trans-national commercial banks (e.g. ANZ Bank, Westpac Bank, Bank of Hawaii, Bank of Guam);
- National Development Banks (e.g. National Development Bank of Tuvalu);
- local commercial banks (e.g. Bank of Samoa, Colonial Bank);
- National Pension Funds (e.g. Fiji National Provident Fund); and
- various micro-finance agencies (credit unions, cooperatives, NGOs).

For these institutions to participate in RET finance, it is vital that they understand the technology, its market and its potential for the region. Therefore a technical support program for the region should include efforts to inform the various financial institutions about the RETs appropriate for their finance structure and assist them in establishing criteria for finance of RETs of the various types expected to be applying for finance in their range of operations.

An example of such a program was training provided to the Development Bank of the Philippines (DBP) in wind, hydro and PV technology, the financial analysis of RET projects and case studies of RET implementations in the Philippines and around the world. Direct assistance was also provided the Bank in developing its “Window III” facility that specifically focuses on environmentally friendly finance.

This PIREP report series includes a report on Finance for Renewable Energy in the PICs and a programme for assistance to the finance community is included in that report. However, the focus in that report is on financial support mechanisms and the inclusion of technical assistance support to help financial institutions understand RET technology can be an important part of gaining the confidence of local finance institutions and accelerating the finance of RETs in the region.

# 6 PROPOSED DESIGN FOR A REGIONAL RE TECHNOLOGY SUPPORT PROGRAMME

## 6.1 The ESCAP Regional Training Study and Proposal

Separately from the PIREP process and at the request of the PICs, the Economic and Social Commission for Asia and the Pacific (ESCAP) commissioned a study of the renewable energy training and capacity support needs of the PICs and the design of a programme to supply those needs. The document "Renewable Energy Training in Pacific Island Developing States" was tabled at the November 2004 Regional Energy Meeting (REM) and approved by the PICs for funding and implementation. However, ESCAP is not a donor agency and is able only to develop the programme proposal. External funding must be provided to carry out the activities. The following project outline is taken almost verbatim from the ESCAP project proposal.

## 6.2 Rationale

**Table 6-1 – Methodology for barrier reduction for renewable energy training**

| Barrier | Barrier reduction mechanism |
|---|---|
| **Rapid turn over of personnel** | Training for types of personnel present in larger numbers (e.g. local service technicians) available continuously or with a delay not to exceed a few months. |
| **Small size of the PICS** | The programme would utilise existing institutions, there would be no creation of new entities for training. Local educational institutions would be used to maximum advantage. USP distance learning facilities would be used where local facilities are inadequate. The regional programmes would continue to provide highly specialised training external to the countries but in a coordinated fashion to take maximum advantage of training opportunities and to fit as closely as possible with the timing needs of the countries. Sub-regional facilities would be developed where appropriate to cover the advanced training for several nearby PICS. |
| **Cost of access to the PICs** | Emphasise local training development and distance learning to minimise the need for international travel to or from PICS for training. Develop sub-regional training centres specialising in renewable technologies suitable for sub-regions. For example, a biomass development centre serving Melanesia or a solar rural electrification centre in RMI to serve FSM, RMI and Kiribati development of outer island electrification using solar home systems. |
| **Variety of technologies** | Include full time staff specialists in the primary renewable technologies for the region (biofuel/biomass, solar/hydro, Grid connected wind and solar). Arrange training to fit only the technology needs of each country. For example Tuvalu would probably develop training for solar and biofuels while Niue may develop only training for wind power. Typically, the larger the country the more types of renewable energy resources there are to be tapped but also the more training institutions there are for development of that training. |
| **Limited personnel for trainers** | Use virtually all training institutions available in a country to support renewable energy training by developing programmes for training of trainers for all classes of educational institutions. Utilise USP's distance learning facilities to the maximum to allow effective training without locally present trainers. Utilise DVD based training courses for specialist material that will be used over and over. Provide access to Internet information data bases. |
| **Unique physical and cultural conditions** | The programme staff will be resident in the region and will have the time to understand the unique requirements for Pacific training processes. Bringing in short term experts will be reasonable for technical component development, e.g. course modules for trade schools, but resident experts will be needed to make the decisions regarding overall content and delivery mechanisms that fit the needs and resources of the PICS. |
| **Lack of planning for training both at the regional and at the local level** | A primary activity for the first year of the programme will have to be a detailed training needs assessment and forecast for each of the countries and for the region that is further developed into a comprehensive training plan. This plan is expected to be a "rolling" plan that is reviewed periodically and extended. |

Table 6-1 lists the primary training barriers and indicates how the proposed programme intends to reduce each barrier to a manageable level. It is emphasised that the concept is barrier reduction, not barrier removal. The complete removal of barriers is almost never possible except at unacceptable cost. Barrier reduction to the point where their effect is acceptable is the approach taken here.

### 6.3 Programme Structure

The overall goal of the programme would be to set in motion a renewable energy training and capacity building process that, once fully established, could continue to operate with minimal external expertise or funding. This process is expected to take an absolute minimum of three years and a five- year programme is proposed as the optimum.

The intent of the project is to develop capacity within local and sub-regional training institutions and not to create institutions where none exist. Training of participants will take place under the programme but mainly to provide on the job experience for the training institutions that are to carry on after this programme ceases. The personnel attached to the project will be responsible for ensuring that the necessary components are developed to allow the local institutions to take over and continue to provide renewable energy training with a minimum of added effort or cost. Because years of effort will be necessary to overcome the bureaucratic and operational hurdles that exist in attempting to carry out local training development in each PIC, the specialist personnel will need to be able to focus full time on the project. Contracting for external expertise will only be practical for short term tasks such as development of training modules, informational packages, etc.

It is clear that this will need to be a major effort with its own budget and personnel and is not a programme that can be easily fully integrated into existing regional efforts.

### 6.4 Programme Outputs

For large scale, sustainable development of renewable energy in the region, focused training programmes that specifically meet the targeted needs of each country will be vital. For this to happen, it will be important to:

- develop a long range plan for capacity development intended to facilitate the large scale integration of renewable energy into the mainstream energy economies of the PICs;
- provide for a regular assessment of country needs for training and the development of an ongoing regional energy training plan always extending at least two years into the future;
- have an ongoing review of the effectiveness of training activities and include ongoing upgrading of efforts as a result;
- develop a clearinghouse for external training programmes in energy that can bring together the persons in the region needing specific training, the organisations providing that training and the funding sources to support the training;
- prepare high quality information packages and presentations for policy makers and high level decision makers explaining the role of renewable energy in development, climate change, private enterprise and national security. Since these persons frequently change and technologies change, the information services will have to be continuously available and kept up to date;
- prepare information packages and curriculum components for general educational use over the long term (expanding existing public school energy information programmes);
- provide advisory services to assist project developers and private enterprise in obtaining independent expert advice regarding renewable technologies, project structures, business methods and other information not readily available to governments and businesses in the

region. The important technical areas that need to be covered presently include rural electrification with solar PV, solar thermal systems for water heating, small hydro for village electrification, grid connected wind systems, grid connected solar systems and the use of agricultural energy products including biomass combustion, biomass gasification and biofuels;

- assist PIC trade schools through the curriculum development process in order to allow them to provide both short term training and renewable energy content that is integrated into existing trades curricula for local technicians and businesses. This will include actual preparation of course modules, instructor training, provision of essential facilities for renewable energy training and ongoing support for completing the lengthy bureaucratic process for the addition of new content to existing courses;
- assist USP develop courses for USP extension delivery (and local delivery where appropriate educational institutions exist) focusing on business aspects of renewable energy including but not limited to rural marketing of energy technology and services, operations management of Renewable Energy Service Company (RESCO) type businesses, business plan development and financial management for RESCO type businesses;
- locate suitable institutions and develop sub-regional training centres focusing on renewable technologies relevant to that sub-region such as a centre focusing on biomass in Melanesia to serve PNG, Solomon Islands, Vanuatu and Fiji or a centre focusing on solar home system use for rural electrification to serve FSM, RMI and Kiribati;
- develop courses for USP extension delivery (and local delivery where appropriate educational institutions exist) for energy planners including a general course in renewable energy technology as well as specialist courses in energy project development and management, policy development and implementation, economic analysis of energy options and energy survey principles and practices;
- establish a secondment programme to allow countries with successful renewable energy programmes to receive interns from other countries for on-the-job training;
- develop and deliver common training programmes as needed for multiple countries requiring external expertise (e.g. tender evaluation training for the five countries to be part of the EU ACP programme) and not appropriate for development through local or sub-regional institutions;
- coordinate training development with projects planned by donors, regional organisations, international financial institutions and private enterprises; and
- other training related activities determined during programme operations.

It is recognised that almost none of these items can be considered new or untried in the Pacific. Most of these have been recognised for many years as being rational components for PIC training. Unfortunately, the budgets have been small, the regional impact equally small and the efforts have followed no capacity development plan that attempts to ensure that the *"right people receive the right message at the right time"*. Few of these items can provide significant benefit if done in isolation. It is necessary that there be a combination of different capacity building components acting together to result in long term, large scale benefits.

### 6.5 Personnel requirements

Although a great deal of the work will need to be carried out by short term specialists under contract, a permanent expert staff of at least four persons will be required in order to provide the advisory and support services that must be an integral part of the programme. These four experts will be required to spend much of their time in the field since the project is specifically focused on the development of local training capacity. That cannot be done at a distance, each of the 14 countries of the region will require at least one month of field time to develop the training capacity supported by each of the three programme specialists. With one to three months of time needed between country visits, this activity alone requires up to two years from each specialist.

Four senior experts would thus be available to provide direct advisory assistance to businesses and government agencies and would manage the development of the specific training tasks within each of their categories. Three of the experts would focus on working in the field to develop local training capacity and one would focus on planning, coordination, management of short term contractors and administration.

#### 6.5.1 Programme Manager

The programme manager should be a senior level person with broad experience in renewable energy technology applications in developing countries and have specific experience in the provision of technical training to persons with English as a second language and in a developing country context. Prior Pacific experience is strongly preferred.

The programme manager would be responsible for overall coordination of training activities, development of the ongoing regional training plan, hiring of external specialists for training development and delivery and general management of the resources made available to the programme.

The Programme Manager should have specific expertise in business development in developing countries and will be responsible for business advisory services to the PICs businesses and for the development of long term training programmes for renewable energy business development. The Programme Manager will spend the bulk of work time at the project base.

#### 6.5.2 Utilities Expert

The utilities expert should have a number of years of experience with small utility operations, the use of Independent Power Producers (IPPs) by small utilities and have direct experience in the integration of renewable energy, notably wind and solar photovoltaics, into small utility operations as hybrid generation systems as well as for solar or wind supplementary generation. The utilities expert would be responsible for providing utilities of all sizes with technical advice, management advice and operational advice in the integration of renewable energy into utility operations. Since IPPs and cogeneration will be important components in the large scale use of renewable energy for power generation, the utilities expert must be experienced in IPP/utility interactions including payment structures, contractual arrangements and risk abatement for both the IPP and the utility. Though the PPA would be the obvious location for such a person, there would be many conflicts with the confidentiality of utility information and PPA's member limited services. To be successful, this programme must be open and freely accessible to any organisation that is or aspires to be a provider of grid delivered electricity including such "utilities" as the outer island power systems of the Cook Islands, the community operated power systems of the Ha'apai group in Tonga, the Community-Centre operators of PNG, the PWD operating the Provincial Centre power systems of Fiji and existing and potential IPP operators from the private sector.

#### 6.5.3 Biomass Energy Expert

For the large scale replacement of fossil fuels by renewable sources, biomass is one of the most important resources available to Pacific countries. In particular biofuel development holds great promise for fossil fuel use reductions and the provision of major GHG benefits. Therefore a senior expert with broad expertise to develop local training capacity and advise countries in biomass based technologies including gasification, combustion and biofuels will be needed both to provide direct advice to governments and private enterprise and to develop a locally and sub-regionally focused, long term training programme sufficient to maintain the needed skills for implementing biomass technologies in the Pacific sustainably.

#### 6.5.4 Rural Energy Expert

For about half of the PICs, rural energy development remains a development priority. A senior expert with experience in the development of rural energy through photovoltaics and small hydro will be needed to establish a local training capacity and provide advisory services to private enterprise and governments as well as to develop local and sub-regional long term training programmes for maintaining the capacity to implement and maintain rural energy systems.

#### 6.5.5 Support staff

It is anticipated that some of the support activities, notably financial accounting and travel arrangements, will be handled by the regional organisation hosting the programme.

*Contracts and Administrative officer*

Because most of the actual course and information development processes will have to be contracted to external developers who are professional educators and information delivery specialists, a number of contracts will need to be prepared and managed. This will be the primary task of the contracts and administrative officer. Additional tasks will include office management and administrative support to programme staff and liaison with the host organisation's administrative system.

*Short term staff*

It is likely that in the early years of the programme, there will be a need for additional support staff due to the high level of development activity that will be taking place. After the first 12-18 months of operation, this can be expected to decrease and as the programme shifts more and more of its operations to local organisations, the activity level of the programme can be expected to gradually decrease.

### 6.6 Indicative Budget (USD)

This programme represents an estimated total cost of US$3,209,000 spread over five years, about the same as the Lomé III capacity building programme that was of similar breadth of scope but was directed mainly at utilities. It is assumed that some of these costs would be co-financed by donors, such as the EU, France, Australia, New Zealand and Japan, to provide training support for their projects. Though there is no way to predict the acceptance by donors of this regional training development concept, the EU has indicated a continuing and large scale support for renewable energy activities in the Pacific directed toward the signers of the Cotonou Agreement[3]. Without the provision of substantial training, the risk of project failure

[3] Cook Islands, Fiji, FSM, Kiribati, Marshall Islands, Niue, Nauru, Palau, PNG, Samoa, Solomon Islands, Tonga, Tuvalu.

| Table 5 – Indicative Budget (US Dollars) | | | | | |
|---|---|---|---|---|---|
| **Activity** | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Year 5** |
| **Staff** | $520,000 | $480,000 | $480,000 | $350,000 | $300,000 |
| **Contractors** | $300,000 | $250,000 | $100,000 | $75,000 | $50,000 |
| **Travel** | $65,000 | $40,000 | $40,000 | $35,000 | $20,000 |
| **Communications and overhead** | $24,000 | $20,000 | $20,000 | $20,000 | $20,000 |
| **TOTAL** | $909,000 | $790,000 | $640,000 | $480,000 | $390,000 |

will be high. The EU will therefore need to spend substantial funds in the development of European supported training activities associated with their hardware projects if there is no local capacity for that training. That burden could be shifted to a Pacific regional programme for the same or lower cost. With the further promise of long term availability of training, France also has historically provided major funding for capacity development through S.P.I.R.E., SPC and other Pacific agencies and has indicated a strong interest in local capacity development that addresses the goal of poverty reduction – something that local training capacity development can accomplish.

### 6.7 Programme results

After the completion of the programme, there should be continuing and sufficient renewable energy training made available through USP and other universities, trade schools, NGOs and regional organisations to provide the capacity needed to support large scale renewable energy use. Since once the initial hurdles of preparation and facility development are over, the great majority of these training activities can be self-funding; external support will be needed mainly for overseas training activities, scholarships for high level training and upgrading of course materials on about a five year cycle. Those tasks can be handled under existing regional programmes with the level of fiscal support currently in place. With the development of sufficient capacity to manage most if not all mid to low level training, the support agency should be able to carry out the other tasks, such as updating the regional capacity development plan, assessing needs for training, reviewing the effectiveness of existing training, maintaining a clearinghouse for overseas training, continuing its personnel secondment programme and continuing to provide specialist courses that cannot be provided locally in a manner that fits into the long range capacity development plan.

However, the advisory services for the support of project developers and businesses will be lost with the closing of the programme, and five years will not be sufficient time to develop the necessary local expertise though certainly the experience gained will help close the gap. A much smaller but still vital follow-on project should be developed as part of this programme to provide at least an additional three to five years of support for the continued provision of independent advice to project developers and business through an existing regional programme. The follow-on project could be expected to use external experts not necessarily resident in the region and paid on the basis of need for their services rather than retained under long term contract.

# 7 ANNEX

## 7.1 Review Of Regional And Global Experiences With Technology Support For RE Activities

There have been many technology support activities for renewable energy, often associated with a programme including demonstration or equipment installation. A few of these have been regional support programmes, although the vast majority have focused on one country or on a limited target group. Examples of technical assistance in other SIDS and developing countries is outlined below. The examples show successful outcomes as a result of technical assistance targeted at different stakeholders for varying projects.

### 7.1.1 Regional Training Initiatives

**PACIFIC REGION**[4]

*European Community Lomé II Pacific Regional Energy Programme (Lomé II PREP)*

The Lomé II PREP of the European Community acted primarily as a programme to demonstrate various renewable energy technologies throughout the Pacific region. Commencing in 1982 and spanning over 14 years, the PREP was hardware oriented and provided training only directly in association with specific hardware implementations. The exception was the final major project of Lomé II, the five country PV-Follow-Up Project (Kiribati, Tuvalu, Fiji, Tonga and PNG) that spanned 1993-1995. The project was conceived by S.P.I.R.E. as a "final exam" for the long series of PV training efforts carried out in conjunction with PEDP and FSED. In that project national renewable energy implementers participated in all phases of project design, component specification, tender evaluation and on site implementation. Several international courses were held during the programme ("PV Project Design and Management", "PV Project Tender Processes") that included all the PICs and the French Territories.

*Pacific Energy Development Programme (PEDP)*

The first regional capacity development programme, PEDP, was developed and managed by ESCAP from 1982 - 1993 with funding largely from UNDP. The programme was based in Fiji and was intended to assist the Pacific nations develop the capacity to create energy policy and carry out energy projects from inception to sustainable operation. PEDP operations varied over the years but typically had on staff experts in petroleum, biomass, photovoltaics and policy who were available on call to support the needs of island governments. As a part of the programme, a graduated training process was instituted for solar energy with initially (1987) a "roving" training programme that developed a training process and sent experts to 18 islands (14 countries) to train solar project personnel in installation and maintenance of solar home systems. Approximately 500 persons were trained in basic solar technology during this programme.

In 1989, PEDP fielded a larger expert team to visit the countries to train trainers to provide a local capacity for field technician training of the type provided by PEDP in the 1987 programme. The expert team remained in each country for one month and worked with existing training institutions to develop a photovoltaic technology training capacity within the institutions. Institutions included a telecom training facility (Solomon Islands), trade schools (Palau, Maldives, RMI), energy offices in government (Kiribati, FSM, Cook Islands,

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[4] The Pacific component of this section is excerpted from the 2004 ESCAP study "Renewable Energy Training in Pacific Island Developing States" tabled at the November 2004 Regional Energy Meeting of the PICs.

Vanuatu, PNG, Tonga) and an NGO training centre (Centre for Appropriate Technology Development – CATD – in Fiji).

*South Pacific Institute for Renewable Energy (S.P.I.R.E.)*

Though initially established in 1983 to support renewable energy in the French Territories, S.P.I.R.E. and PEDP cooperated in developing a training programme for energy officers in the Anglophone countries. The first regional PV technology training by S.P.I.R.E. was held in Tahiti in 1986 and further training programmes in PV Project Design and Management and PV Project Tender Specification and Evaluation were held in 1990 - 1992 respectively. As in PEDP, S.P.I.R.E. retained experts to support Island energy offices on demand with problems of renewable energy implementation. After 1995, S.P.I.R.E. was dramatically reduced in scope and no longer provided regional services.

*Forum Secretariat Energy Division (FSED)*

Until its shift to SOPAC in the late 1990s, the Forum Secretariat maintained an energy group that provided intermittent training for energy offices primarily in energy policy development, energy database development and maintenance, petroleum pricing issues and support to renewable energy projects that were managed by the Forum Secretariat. In the early 1990s, the FSED worked in close coordination and cooperation with PEDP and S.P.I.R.E. in the support of renewable energy capacity development activities in the Pacific Region.

*European Union Lomé III Pacific Regional Energy Programme (Lomé III PREP)*

While the Lomé II PREP was hardware oriented with a small training component, the Lomé III PREP was exclusively intended to provide capacity building through training and technical support with a focus on conventional energy and utilities. The programme operated from about 1993 - 1997 and emphasised capacity building for Pacific national power utilities through training and the provision of external expertise. A small allocation in the programme supported Pacific islanders to attend international training courses in renewable energy technologies but no local capacity building for renewable energy was included.

*Secretariat for the Pacific Community (SPC)*

Formerly the South Pacific Commission, the SPC is located in Noumea. The SPC includes both the Francophone and Anglophone countries of the Pacific. Some renewable energy projects were established in the 1980s and 1990s as part of the SPC rural development effort. Trainings were provided in association with those projects. In the early 2000's, the PREFACE project (jointly funded by France and Australia and managed by SPC) provided village scale photovoltaic projects to Vanuatu, Tonga and RMI and a small wind project to support the power grid on Mangaia, Cook Islands. Some excellent project oriented training was associated with that project as well though the project was not meant to develop any long term training capacity. The SPC also provided one of the few training opportunities for biofuel use and preparation as part of the two coconut oil biofuel pilot projects the SPC funded in Fiji.

In 2003, SPC phased out its energy programme and no longer does significant work in that sector though there remain programmes in forestry and agriculture that could be relevant to biomass and biofuel capacity development.

*GEF Fiji Project*

From 1999 to 2002, the Global Environment Facility (GEF) funded a project at the Fiji Department of Energy that specifically was intended to develop the institutional structure for large scale renewable energy development in rural Fiji. Initially the project focused on implementing hybrid technologies but was expanded to include all renewable energy technologies with emphasis on developing an institutional structure that could partner government with the private sector in the implementation of rural energy systems. Training for renewable energy business development, hybrid technology, renewable energy resource assessment and photovoltaic technology for household solar was included under the project. The business training included trainees from Tonga and the Cook Islands (funded by the PREFACE project) as well as the trainees from Fiji.

*Centre for Appropriate Energy Development (CATD)*

Initially developed and operated by the Hans Seidel Foundation of Germany and presently operated by the Ministry for Fijian Affairs, the CATD has as its purpose the development of rudimentary technical skills for Fijian villagers. Small engine maintenance, basic carpentry, plumbing and other basic technical skills are taught to small groups of men from Fijian villages who, upon completion of the course of study, are expected to each return to their village and act as local "handymen" to take care of the basic technical needs in the village. In 1989, PEDP trained instructors at CATD and provided equipment needed for the training of village technicians responsible for maintaining home PV systems. That programme has continued through to the present. The CATD site has also been the venue of several local and regional renewable energy training programmes, though not taught by CATD staff.

*University of the South Pacific (USP)*

The USP is a regional university with primary campuses in Fiji, Samoa and Vanuatu and facilities in all the Anglophone Pacific Nations except for Papua New Guinea (PNG), Palau and the Federated States of Micronesia (FSM). Courses on renewable energy have been offered by the Physics Department since the early 1980s and more recently by the Technology Department. In the late 1980s an Energy Studies Group emphasising renewable energy was formed and operated for several years doing research into renewable energy for the Pacific and providing assistance to regional programmes in energy. Several regional training courses in renewable energy technology, including one on wind energy sponsored by ESCAP in 2004, have been provided by USP using external funding.

*PNG University of Technology (Unitech)*

Located in Lae, Unitech is the primary university level technical training institution in PNG. Unitech has had small research programmes in renewable energy, notably micro hydro and agriculturally related energy sources, since the 1980s and has provided intermittent training in renewable energy directly and through its Appropriate Technology and Community Development Institute (ATCDI). Outreach is also planned through its proposed Rural Energy Research Group (RERG).

*Pacific Power Association (PPA)*

Organised in 1990 with support from PEDP, the PPA was intended primarily to provide a forum for the exchange of experience among the power utilities of the Pacific. In addition, the association provides the opportunity for training of utility personnel as a group rather than individually. Though the PPA has developed no internal training capacity, it can organise training programmes for utilities if externally funded. Renewable energy has been a subject of discussion at several of the annual PPA meetings and specific training for utility based renewable energy is expected to be offered through the PPA to member utilities in 2005 or 2006. Training programmes have not been opened to non-members of PPA.

*South Pacific Applied Geoscience Commission (SOPAC)*

A wide variety of training programmes are provided though not as a part of a specific capacity development plan but rather when funding is offered by a donor or when associated with a specific project managed by SOPAC. The training may be a "pass through" effort such as the EU sponsored PV training offered in 2002 at CATD where SOPAC only arranged logistics for the training or the training may be directly organised by SOPAC as was the late 2003 ESCAP Pilot Training Programme on Photovoltaic Project Development.

*Pacific Islands Energy Policy and Strategic Action Planning (PIEPSAP)*

PIEPSAP is a Danish funded programme operating under SOPAC that is intended to assist PICS in the development of energy policy and strategies. Capacity building for policy and national strategy development is one important focus for the programme though not specifically for renewable energy. PIEPSAP is being executed by SOPAC but has its own budget and staff complement. The programme began in September 2004 and at the time of this writing had not fully developed its action plan.

*Secretariat for the Pacific Regional Environment Programme (SPREP)*

Formerly the South Pacific Regional Environment Programme, SPREP is the regional programme focusing on environmental issues. Because of the close link between the environment and the energy sector, SPREP programmes include GHG mitigation activities and energy sector waste disposal. Its Pacific Islands Renewable Energy project (PIREP) has as its goal the development of a regional approach to the removal of barriers to the widespread utilisation of renewable energy technologies in the PICs. To date limited training programmes in renewable energy have been implemented but plans for barrier removal include country-specific and regional capacity building components.

*United Nations Educational, Scientific and Cultural Organisation (UNESCO)*

Since 2002, UNESCO has been developing a "toolbox" of training materials for renewable energy development that include texts, videos and other media. The intended audience ranges from high level decision makers, government energy planners, technical personnel who install and maintain renewable energy equipment and the general public. Though the "toolbox" includes generic materials that can be used anywhere, the focus is on the Pacific Islands.

*National Training Programmes for Photovoltaics*

Both Kiribati (Solar Energy Company) and Tonga (Energy Planning Unit) have long term training programmes for field personnel involved with the maintenance and operation of solar home systems. Both have based their training on materials developed jointly by S.P.I.R.E. and PEDP that has been translated into the local language. Since their training programmes are in the local language, they are unfortunately not practical for use by other countries of the region.

## ASIA REGION

*APEC Sustainable Energy Programme*

The Asia-Pacific Economic Co-operation (APEC) Forum, a consortium of 21 Pacific rim economies, implements its activities through ten groups, one of which is the Energy Working Group (EWG). Within this group an expert group has been established on new and renewable energy which provides some training and information exchange: The Energy for Sustainable Communities Program (ESCP). One of the major activities of the programme is a community outreach project in which members of the group:

- profile the energy sectors of selected APEC communities;
- institutionalise a sustainable energy planning (SEP) process in participating APEC communities; and
- identify, help finance and implement SEP-based projects.

The group recognises that sustainable energy planning requires a long-term commitment by the host community / government. It is important that energy planning forms part of the economic development planning process. Therefore ESCP provides technical assistance to those APEC communities without the capacity to integrate energy planning. Support is available over a long period of time. Training is provided to members at ESCP in Hawaii and generally includes five main steps:

1. Identification of an energy manager – course on energy planning, system information etc.
2. Institutionalise an economic-energy data collection system
3. Data analysis – systems, budgets and energy
4. Developing of short, medium and long term plans
5. Monitoring

*Renewable Energy Technologies in Asia*

'Renewable Energy Technologies (RETs) in Asia' is a regional research and dissemination programme sponsored by the Swedish International Development Co-operation Agency (SIDA) and co-ordinated by the Asian Institute of Technology (AIT). It was initiated in 1997 to promote mature/nearly mature renewable energy technologies in six Asian countries. Activities of Phase I (1997-1998) and Phase II (199-2001) mostly concentrated on adaptive research and demonstration of the appropriate technologies suitable to the local condition. Phase III (2002-2004) is aimed at consolidating the gains and achievements made so far, while emphasizing dissemination. RET packages for selected areas are identified / developed, and demonstrated on a commercial / semi-commercial basis. Studies of the barriers to promotion of the selected RETs are being conducted and measures to overcome some of these barriers will be implemented.

The major objectives of RETs in Asia - III are:

- Development of selected RET packages and their demonstration on a semi-commercial or commercial basis.
- Review of barriers to commercialisation of the selected RETs, identification of measures to overcome selected barriers, as well as implementation of some key measures.

- Capacity enhancement of NRIs, entrepreneurs, technicians and users of the selected RETs.
- Dissemination of research results in appropriate forums through publications, workshops and seminars.

For each technology a local institute in each country participated and provided training and dissemination activities to local entrepreneurs, installers etc. Manuals were developed for teaching and were translated into the relevant languages.

**OUTSIDE OF THE ASIA / PACIFIC REGION**

*Energy Development and Research Centre – Centre for Regional Excellence*

The Energy Development and Research Centre (EDRC) in South Africa has the following goals:

- to be a leading African energy and development policy research, consultancy, and capacity-building institution;
- to deepen knowledge and understanding of the energy and development needs and challenges in South Africa, SADC and the rest of Africa, and to search for innovative responses;
- to contribute to improved social equity, economic efficiency, and environmental sustainability in the energy sector, through public-interest advocacy and understanding for policy-making and implementation; and
- to educate, train and develop human resources in the energy field.

ERDC is university-based at the University of Cape Town and committed to high quality, targeted and useful research. The centre has over fifteen researchers in engineering, science, and social sciences, supported by an administrative staff and postgraduates. Where required the centre can draw staff from relevant faculties in the university as well as research associates. ERDC undertakes mainly policy research supported by empirical investigations and ensure results are communicated appropriately and is an educational and training resource for the energy and development sector in Africa.

The centre offers the following services within South Africa, SADC and the rest of Africa: Research - improved policies and implementation; consultancy; advocacy and information dissemination; academic supervision and teaching; and training.

*Regional Solar Programme - Solar pumping in the Sahel - Technician and Consumer training*

Between 1991 and 1997 the EC funded Regional Solar Programme (RSP) installed 626 PV water pumping systems and 644 PV community systems, for health centres and schools, in the nine countries of the CILSS *(Comité Inter-Etat de Lutte contre la Sécheresse au Sahel).* The programme included support, training and awareness raising for the villagers and installers.

Villagers were organised into village water committees that took responsibility for tasks such as:

- daily care-taking, maintenance;
- collection of water payments; and
- management of payments.

Once the villagers were well informed, they agreed that the price of water should be sufficient to cover operation, maintenance and renewal costs. This understanding was only possible through strong involvement of the end-users and building a sense of ownership (one way to achieve this was through a compulsory down payment before starting of works).

In-depth analysis showed that recovery levels depend on the efficiency of the local based management organisation, rather than the ability to pay of the villagers. The villagers were more likely to accept paying for a service and will feel more responsible for its maintenance, if they receive information and some basic training.

Particular emphasis on support for the development of local know-how was included through built-in training programmes and by adopting an integrated Quality Control Approach (QCA). This covered training of local installers and an assessment of performance five years after installation. Since the training and quality control testing and monitoring was carried out for the regional programme the cost was very low compared to the PV system costs.

Definition of the QCA: 0.14 Euro.Wp-1 (0.72% of system cost)

Laboratory test for the QCA: 0.25 Euro.Wp-1 (1.3% of system cost)
By carrying out the training as well as adopting the quality approach, the RSP improved the reliability of the PV systems: 5 -10 years after installation more than 95% of the systems were still providing water and mean time between failure averaged six years.

### 7.1.2 Country Support Initiatives

**IN THE ASIA / PACIFIC REGION**

*APACE Training in Solomon Islands and PNG*

APACE works with local partners to build technical and institutional capacity for village hydro power. The role and contribution of APACE to village electrification in the Solomon Islands has changed over the years. APACE helped establish the Solomon Islands Village Electrification Council (SIVEC), established under an MOU with the GoSI in 1997. SIVEC brings together representatives from communities, NGOs and the GoSI, and has an office in the Ministry of Commerce, Industries & Employment. APACE was renamed APACE VFEG (Village First Electrification Group) in 2000 in order to focus on rural renewable energy, devolve considerable management and decisions to local partners, and transfer fund- raising and project submission efforts largely to local entities, such as SIVEC. It assists communities with planning, institutional strengthening and advocacy and provides formal and informal training in micro-hydro systems.

The experiences gained with the first three APACE micro-hydro systems has resulted in more robust (and costly) designs for four subsequent schemes in Manawai Harbour (Malaita, 1997), Bulelavata (New Georgia, 1999), Raeao (Malaita, 2002) and Nariaoa (Maliata, pending 2004). Budgets have been higher, turbo-machinery is better, village representatives were intensively trained for three months and a more rigorous project cycle was developed. As a result, the newer systems have reportedly operated without significant problems, produce more electrical output (about 15 $kW_e$ compared to less than 5 $kW_e$ for the early systems).

In PNG APACE has provided training to village operators of existing micro and pico-hydro systems to improve safety and future designs on Bougainville.

*Other PIC programme training*

Most of the renewable energy projects have included capacity building during the set-up and installation, however there is not any detail in the country reports regarding the capacity building. A couple of projects are listed below:

- EU Lome II PV follow-up project included a major component of capacity building provided by SPIRE in PV technology, PV system design, specification and tendering and project development so local staff were involved in the design of their projects and its implementation.
- Under the PREFACE part of Ha'apai PV electrification in Tonga, island technicians were trained by the Energy Planning Unit (EPU) and then received continued supervision from the EPU technician
- The EU funded Outer Islands PV Electrification Project of Kiribati included technical and financial support for training of Solar Energy Company staff in business systems for project management and for training of technical personnel to install and maintain the PV systems.

*Technical Assistance to the Development Bank of the Philippines for Financing Energy Services*

Renewable energy was introduced in the Philippines more than two decades ago, but adoption has been slow due to barriers that include limited access to financing and traditional financing mechanisms. In many cases, national and local banks are not familiar with or willing to enter new markets, or have limited financial resources and therefore service their traditional clients first.

In recognition of the need for innovative financing programmes to stimulate commercial use of renewable energy resources in the Philippines, the World Bank has provided technical assistance (TA) to the DBP through the FINESSE programme. This assistance will enable DBP staff to develop and strengthen their capability in identifying, formulating, appraising, generating and managing a pipeline / portfolio of renewable energy projects.

A major component of the TA is capacity building of the DBP's new and renewable energy team who will operate the Windows III (Special Credit Facility) programme of the Development Bank of the Philippines (DBP) that offers loans for renewable energy and energy efficiency measures on "developmental" terms.

*China Renewable Energy Development Project - Commerce training*

A major impact of the PV component of the China Renewable Energy Development Project was the significant improvement of the commercial capabilities of local PV companies. Most of the companies were small-scale businesses lacking commercial capabilities, which made it very difficult for them to secure loans from commercial banks. Most of the PV companies also lacked the necessary skills for business plan development.

The project offered tailored business training workshops to all the companies and provided individual business tutor services including advice on financing, accounting and business development plans to companies that were facing specific problems.

As a result, some companies have been offered bank loans from local commercial banks and many companies have seen their Solar Home System (SHS) business grow on a yearly basis.

## OUTSIDE THE ASIA / PACIFIC REGION

*PV Schools in South Africa - Institutional Strengthening*

Between 1998 and 2002, €15 million were allocated to a European Commission programme to supply 1000 schools with PV systems in South Africa. The Technical Assistance component, which comprised largely of capacity building activities, was spread over two years. Capacity building accounted for just four percent of the total project cost or €670 per kW installed.

The Technical Assistance Unit (TAU) was set up to advise the implementation agency (Eskom) and the supervisory Ministry (Department of Minerals and Energy, DME) on technical and project management issues. The TAU worked within the Department of Minerals and Energy.

During the first months of the TAU's existence, technical problems became apparent which resulted in the installation process being halted for some time to enable these issues to be addressed. The TAU developed improved procedures for system installation and commissioning and trained Eskom's Commissioning Officers. The procedures were then implemented in co-operation with Eskom and ongoing liaison with Eskom staff and installation contractors. Further capacity building took place through training emerging contractors. This resulted in the second phase of installations going much smoother and increased the chances of long-term sustainability of the installations.

*Zimbabwe Technician Training*

In a JICA funded pilot PV RESCO project in Zimbabwe it was found that the private company technicians were not installing PV to a high quality – the technicians were not careful when installing the PV systems and were not using appropriate tools. The wiring work was of poor quality, they often damaged the roof and wall and did not set the azimuth or angle for the PV module correctly. Therefore a training facility for local engineers and technicians was established through a local polytechnics school to provide quality training on a continuous basis and training offered to the installation companies thereby upgrading the quality of maintenance and installations.