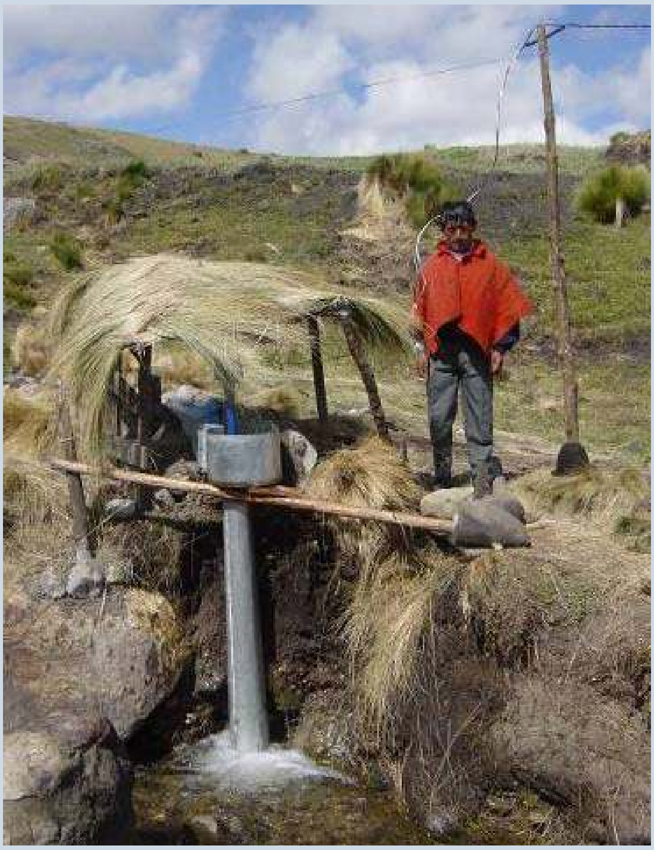
IEA INTERNATIONAL ENERGY

RENEWABLE ENERGY SERVICES FOR DEVELOPING COUNTRIES

In support of the Millennium Development Goals: Recommended Practice & Key Lessons



PVPS

PHOTOVOLTAIC
POWER SYSTEMS
PROGRAMME

Report IEA-PVPS T9 – 09:2008

Renewable Energy Services for Developing Countries

In Support of the Millennium Development Goals: Recommended Practice & Key Lessons

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Executive Summary

Almost 1.6 billion people currently live without electricity in developing countries. These people live in either remote rural areas that have no connection to electrical power grids, or urban areas with inadequate utility systems.

The demand for energy in these countries is expected to grow with increases in population and living standards. The International Energy Agency (IEA) estimates that developing countries will need to double their electrical power output by 2020.

Despite the growth in energy consumption, the number of people disadvantaged by a lack of modern energy services has remained relatively unchanged.

The focus of the international donor community is clearly aimed at poverty alleviation in general, and specifically at achieving the targets known as the Millennium Development Goals (MDGs).

Renewable energy technologies have a tremendous potential in providing energy services to developing countries and in helping achieve the MDGs. This document highlights how meeting the MDGs can be facilitated through a sustainable energy supply, and provides case studies from around the world to demonstrate that these technologies are applicable in real-life situations.

Based on these cumulative experiences and in order for energy services to be delivered effectively, key lessons and recommendations are put forward with regard to policy, finance and implementation.

Glossary

AC	Alternating Current
DAC- POVNET	Development Assistance Committee Network on Poverty Reduction
DFID	UK Department for International Development
DC	Direct Current
EC	European Commission
ESCO	Energy Service Company
ESMAP	Energy Sector Management Assistance Programme
IEA	International Energy Agency
IPP	Independent Power Producer
OECD	Organisation for Economic Cooperation and Development
MDGs	Millennium Development Goals
NEET	Networks of Expertise in Energy Technology
PV	Photovoltaic
PVPS	Photovoltaic Power Systems Programme
PVSDC	Photovoltaic Services for Developing Countries
RE	Renewable Energy
REEEP	Renewable Energy and Energy Efficiency Partnership
RESDC	Renewable Energy Services for Developing Countries
RPG	Recommended Practice Guides
SHS	Solar Home Systems
UN	United Nations

Introduction

Energy is vital to the quality of our lives. It provides us with heat and electricity, and powers our industry, transport and modern way of life. Energy consumption is steadily increasing and this trend is set to continue due to rises in the world's population and living standards. The demand for energy is predicted to increase by approximately 60% on current levels by 2030, with the developing world accounting for two-thirds of this increase. With approximately thirty percent of the global population not having access to modern energy services and against a backdrop of depleting fossil fuel reserves and climate change concerns, one of the main challenges of our time is to meet our energy needs and in a sustainable manner.

At the United Nations General Assembly Millennium Summit in 2000, the international community adopted the Millennium Development Goals, which aim to improve the living conditions of the world's poor and have an ambitious target of 2015 to realise these goals. Although there is no MDG related to energy, the availability of energy is a prerequisite for the realisation of many of these goals.

Addressing the energy needs of the developing world is a complex and multidisciplinary challenge. With support from the Renewable Energy and Energy Efficiency Partnership (REEEP) this publication expands on the current International Energy Agency (IEA) "Photovoltaic Services for Developing Countries (PVSDC)" document on PV in support of the Millennium Development Goals, to include wind and hydropower as Renewable Energy Services for developing countries. In addition Recommended Practice Guides (RPGs) for implementation of energy services with a focus on electricity or services that use electricity (such as water supply, health care, communications and other productive uses) are also outlined.

This document does not attempt to address all aspects of the challenge, but seeks to give an overview of the role that three power generating renewable energy technologies – photovoltaics, small wind and small hydro – can play in providing electricity in rural communities. The document does not cover cooking and heating energy needs.

The document takes off with an overview of the Millennium Development Goals (MDGs) and then goes on to discuss the linkages between the MDGs and renewable energy. Next key technologies (PV, small wind and small hydropower) are presented, and support mechanisms to increase the use of these technologies are described.

To conclude a number of relevant case studies are presented to demonstrate real-life applicability, and key issues to be kept in mind when developing and implementing renewable energy technologies are listed.

The Millennium Development Goals

At the Millennium Assembly of the United Nations (UN) in 2000, the international community, including all 191 members of the UN, adopted the UN Millennium Declaration, committing each nation to a global partnership to eradicate poverty and establishing a set of targets to be met by 2015. These targets are the Millennium Development Goals (MDGs) and are outlined in Table 1 below.

Many development agencies are helping to facilitate the MDGs, not necessarily through direct involvement in their management, but, for example, in the financing of market studies and the development of business plans to assist private sector interests in establishing and operating energy services for rural people.

Table 1: The Millennium Development Goals

Eradicate extreme poverty and hunger

- Reduce by half the proportion of people living on less than a dollar a day;
- Reduce by half the proportion of people who suffer from hunger

Achieve universal primary education

- Ensure that all boys and girls complete a full course of primary schooling

Promote gender equality and empower women

- Eliminate gender disparity in primary and secondary education preferably by 2005, and at all levels by 2015

Reduce child mortality

- Reduce by two thirds the mortality rate among children under five

Improve maternal health

- Reduce by three quarters the maternal mortality ratio

Combat HIV/AIDS, malaria and other diseases

- Halt and begin to reverse the spread of HIV/AIDS;
- Halt and begin to reverse the incidence of malaria and other major diseases

Ensure environmental sustainability

- Integrate the principles of sustainable development into country policies and programmes; reverse loss of environmental resources;
- Reduce by half the proportion of people without sustainable access to safe drinking water;
- Achieve significant improvement in lives of at least 100 million slum dwellers, by 2020

Develop a global partnership for development

A number of objectives, including:

- Address the special needs of landlocked and Small Island Developing States
- In cooperation with the developing countries, develop decent and productive work for youth
- In cooperation with the private sector, make available the benefits of new technologies- especially information and communications technologies

Renewable Energy and Millennium Development Goals

Energy is essential to economic and social development. Modern energy sources light our homes, schools, hospitals, businesses and streets; help to irrigate our crops; preserve and cook our food; power our industry and commerce; enables us to communicate and generally reduce the burden of everyday life. As energy consumption rises with increases in population and living standards, the challenges of expanding access to energy, particularly to those in the developing world, must be addressed.

Although the MDGs do not mention provision of energy specifically, it is an unavoidable and undeniable reality that access to modern energy services is a strong stimulus to social and economic development. As energy services are essential ingredients of all three pillars of sustainable development (economic, social and environmental), it is key to the realisation of the MDGs.

The Development Assistance Committee Network on Poverty Reduction (DAC-POVNET) of the Organisation for Economic Cooperation and Development (OECD) highlights *'a very strong correlation between the use of modern sources of energy and any number of indices associated with development in all countries'*.

In addition about one third of the world's population lives far beyond the electricity networks - largely in rural areas of developing countries - without access to health care, education, communications, and enterprise opportunities that modern energy services can facilitate. Demand for energy by this un-served population is growing much more rapidly than the rate of expansion of the conventional grid.

One of the most pressing challenges of our time is to redress this imbalance and enable the world's poor to achieve their basic rights to a better standard of life - safe water, sufficient food, sanitation, health care and basic education.

Currently, much of the world's energy is produced and consumed in an unsustainable manner from fast depleting resources. Given the demands of human development on energy resources, an even greater challenge is to deliver the MDGs in a sustainable manner. The above formed the framework of the International Conference for Renewable Energies - 'Renewables 2004' - held in Bonn in June 2004. The Bonn Conference was the first dedicated high-level event to fully recognize the role of international actions focused on appropriate applications of renewable energy (RE) in achieving the MDGs, and to formulate a plan to support this objective.

Solar PV can help provide clean drinking water

Watermills reduce drudgery for women

The Declaration and Action Plan that emerged from the Renewables 2004 Conference presented a joint vision of a sustainable energy future and affirmed a commitment to meeting the first MDG to halve the proportion of people living in extreme poverty by 2015 by extending RE supplies and energy efficiency to one billion people.

Similarly, the declaration of the Earth Summit at Rio de Janeiro - the so-called Agenda 21 - calls for the removal of constraints to developing environmentally friendly energy sources to encourage sustainable development, particularly in developing countries.

The World Energy Assessment estimates that between 1970 and 1990, rural electrification programmes reached about 800 million additional people and some 500 million saw their lives improve substantially through the use of better methods for cooking and other rural energy tasks. The United Nations Development Programme (UNDP) suggests that scaling up rural energy services can be a far more effective means of fighting poverty than previously thought. A recent study in Mali in Africa shows that mechanical power can help increase women's income by an average of 50 per cent and create conditions for better health and education.

According to the IEA halving the number of people living on less than a dollar a day will not be achieved unless access to electricity is provided to the 500 million people - mostly in South Asia and sub-Saharan Africa.

RE can make a significant contribution towards sustainable development in developing countries through increased energy independence, reduced air pollution and climate change mitigation. Applications requiring electricity such as lighting, telecommunications, irrigation, health care and cottage industries are ideally suited to be powered by renewable energy.

As energy is to development, renewable energy is to sustainable development.

As is shown in Table 2, RE can play a significant role towards the realization of the MDGs by providing environmentally sustainable energy services. The preparatory process for the Bonn Renewables 2004 presented an extensive discussion of the issues surrounding renewable energy in developing countries. RESDC strongly endorses the 'Bonn Conference Issue Paper', which aligns very closely with the work that the team has been engaged in since 1999. Despite the notable efforts to improve energy services to rural populations (including the use of RE) in the past thirty to forty years, the population without access to these services has not decreased significantly in absolute numbers. The IEA notes that if current trends continue, approximately 1.4 billion people will not have access to electricity by 2030.

Small scale hydropower provides basic services such as rice hulling for food security

The UN have taken the energy - MDGs nexus forward under their 'Millennium Project', which over a period of three years will work on a plan of implementation that will allow all developing countries to meet the MDGs and thereby substantially improve the living standards of the world's poorest by 2015. The document 'Energy for the Poor' published by the UK Department for International Development (DFID) clearly outlines a matrix of energy and the MDGs, drawing on case studies to reinforce the linkages.

Some of the roles for the RE technologies such as solar PV, small wind electricity generators and micro or pico-hydro systems in support of the Millennium Development Goals are outlined in Table 2 below. A more detailed description of what RE services can mean for the provision of water, sanitation and health, is presented in Table 3.

Table 2: Role of renewable energy in achieving the MDGs

1. Eradicate extreme poverty and hunger

- Electric lighting allows increased income generation by allowing activities beyond daylight hours
- Reliable energy supply encourages local enterprise development
- Electricity facilitates clean water supplies for cooking and drinking
- Energy for irrigation increases food production

2. Achieve universal primary education

- Electricity enables access to educational media and communications.
- Lighting in schools allows evening classes and lighting at home encourages home study.

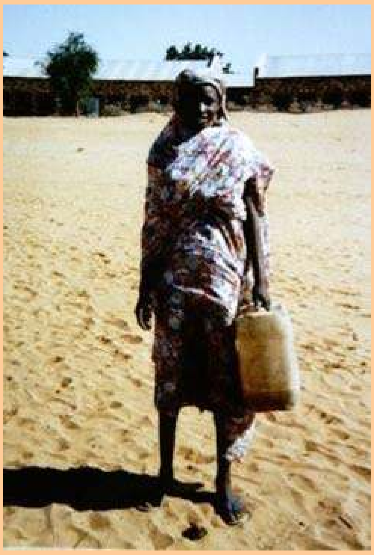
3. Promote gender equality and empower women

- Availability of modern energy means women spend less time foraging for water and wood.
- Reliable energy services offer scope for women's enterprises & agro-processing to develop.
- Energy for mechanical agro processing equipment can be provided through renewable energy technologies such as micro hydro reducing daily drudgery of women’s manual labour.

4. Reduce child mortality

- Electricity for cooking reduces indoor air pollution, increases safety and frees up time for child care.
- Electricity enables water pumping and facilitates water purification (water-borne diseases are the major killers of children in developing countries).

5. **Improve maternal health**



- Energy services provide access to better medical facilities (vaccine refrigeration, equipment sterilisation, operating theatres, and lighting for local health centres).
- Cooked food and space heating through modern energy services contribute to better health.

6. **Combat HIV/AIDS, malaria and other diseases**

- Energy services support the use of better medical facilities and helps maintain the cold-chain essential for vaccine storage.

7. **Ensure environmental sustainability**

- Traditional fuel use contributes to erosion, reduced soil fertility and desertification.
- Electricity can be used to pump and purify contaminated water.
- Using cleaner fuels will reduce Greenhouse Gas Emissions.

8. **Develop a global partnership for development**

- Electricity supply can contribute to the development of information and communication technologies in remote rural areas.

Table 3: The use of Renewable Energy for Water, Sanitation and Health

Renewable Energy for Water, Sanitation and Health

The provision of modern energy services is an overlooked yet crucial concern in improving the health and education of the people living in rural areas of many developing countries. Moreover, energy for water supply can have an important impact as it is well accepted that the consumption of unclean drinking water is one of the biggest killers in the developing world with around 10% of children under 5 dying every year from water borne diseases such as diarrhoea, bilharzia, typhoid and cholera.

Modern energy services in the water sector can also assist in improved agricultural activities through irrigation and providing water for livestock, thereby improving rural livelihoods and promoting income generating activities. Despite the obvious advantages, many people in developing countries do not have access to grid electricity. For example, throughout Uganda, Tanzania and Kenya, there are about 3600 health clinics and 80,000 schools without access to modern energy services.

Grid extension in rural areas through conventional energy sources is often not cost effective and for many remote areas at least 20 years away. Stand-alone renewable energy technologies could meet the electricity needs of rural communities much faster. Small-scale renewable energy systems could in many cases provide electricity in clinics and schools in rural areas as a least-cost option, impacting directly on the livelihoods of millions of people.

In health clinics, access to electricity will provide safe storage for vaccines, well-equipped maternity facilities and computers, as well as retaining skilled staff through the provision of electricity in accommodation for doctors and nurses. In schools, access to electricity will provide access to modern learning technologies such as computers; lighting to facilitate adult education and literacy classes in the evenings; community access to media such as radio and television; as well as helping to retain teachers in rural areas.

To raise awareness about the importance of energy for sub-Saharan Africa and to strengthen local knowledge in providing electricity in rural areas, IT Power, with partners Stockholm Environment Institute and Transénergie, launched ENABLE: Building capacity in renewables in the health, education and water sectors to help meet poverty reduction targets in sub-Saharan Africa. ENABLE was supported by the European Commission's Intelligent Energy - Europe Programme and aimed to strengthen the capacity to plan for energy services that can improve delivery of health, education and water supply in the rural areas of Uganda, Kenya and Tanzania, with a view to replication in Senegal. More information can be found on www.enable.nu.

A similar initiative is the IMPROVES-RE programme co-financed by the European Commission (COOPENER) implemented in four western and central African countries: Burkina Faso, Cameroon, Mali and Niger, being executed by Innovation Energie Développement (IED), ETC Energy and RISOE and in partnership with national rural electrification agencies. The global objective of the IMPROVES-RE programme is to improve the rural electrification impact on sustainable development and poverty alleviation.

Guide to the Technologies

Energy is used to provide many essential services including transport, heat and electricity. However, this chapter will primarily be concerned with the provision of electricity in rural communities. Renewable energy technologies can provide electrical energy for remote communities that live beyond the electricity network. Several technologies that can assist in achieving the MDGs are available, of which solar photovoltaics, small wind turbines, wind pumping systems and micro & pico hydropower are amongst the most suitable for remote communities. The following sections give a brief overview of the basic operating principles of each of these technologies.

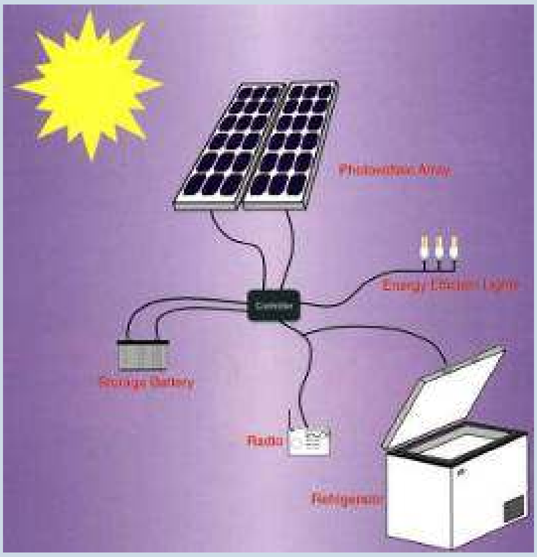
Solar Photovoltaics

The photovoltaic (PV) process converts sunlight - the most abundant energy source on the planet - directly into electricity. PV equipment has no moving parts and as a result requires minimal maintenance. It generates electricity without producing greenhouse gas emissions and its operation is silent.

Solar House System in Sri Lanka

The building blocks of photovoltaic technology are *cells*, which are specially treated materials (semiconductors) that convert light directly into electricity. Electrical connections link a number of cells together and they are encapsulated and framed to form a *module*.

The connection arrangement of the cells governs the output voltage and current of the module. PV modules usually provide electricity in the form of Direct Current (DC) at 12 or 24 volts. The output power of a module is the product of the module's operating current and voltage. Modules can be wired together in series to increase the overall output voltage, or in parallel to increase the overall output current, to match the voltage and power required by the load applications. Modules grouped in such as a way are known as an *array*.



Some uses of a PV system

Modules are given a 'peak' power rating (Wp) according to their output under standard test conditions of 1000 W/m^2 and 25 degrees Celsius. The power output of 1000W/m^2 is roughly the intensity of solar energy at midday in the tropics. At lower light intensity and/or higher temperatures, PV modules will provide less power than their rating suggests. The ideal conditions for generating electricity from PV are clear cold long sunny days.

Batteries are used to store electricity generated during daylight hours for use after dark. Batteries are the weakest component of a PV system with typical lifetimes between 1 and 5 years, although longer lifetimes are now possible. Controllers or charge regulators are required for battery charging systems.

Small Wind Turbines / Wind Pumping systems

Wind energy has been exploited for generations as a source of power for agricultural and production purposes. Wind turbines convert the kinetic energy from wind into mechanical power. This mechanical power can be used for applications such as grinding grain or pumping water, or can be converted into electricity.

Wind turbines are basically made up of four primary components: a rotor and blades, a nacelle, electric cables, and electric monitoring equipment. The rotor blades are connected to a central hub, which is connected to the nacelle. The rotor spins as air flows over the blades, rotating faster as wind speeds increase. The nacelle contains components which convert the spinning motion of the rotor into electricity. They key components include a gearbox which increases the speed of rotation, which is connected to a generator that produces electricity.

Electric cables carry this current to the base of the tower to a transformer located within or near the base. The transformer regulates the electricity voltage. Monitoring equipment measure, manage and optimize the turbine's operation.

Small scale wind turbines are a useful source of renewable energy where the grid is not available or is very expensive to extend. Wind turbines that are not connected to the grid are usually linked to a battery storage facility to provide electricity when the wind is not blowing. Wind turbines can also be used in conjunction with other forms of energy sources (such as solar photovoltaic systems in "hybrid" installations).

Small-scale Hydropower

Hydropower has been in use for centuries around the world as various designs of waterwheels to provide mechanical power to income generating and basic livelihood activities such as milling of grains. Modern use of hydropower is generally based around a water turbine, which utilises the energy contained in flowing water.

A pico-hydro scheme

There are various types of water turbines, but the basic principle of production of hydropower is always the same: water at a higher level passes through a turbine to a lower level (the vertical distance between the levels is known as the "head") imparting the energy contained in it. A water turbine is a machine with a rotor of blades/buckets connected to a shaft, thus producing mechanical power in rotating form.

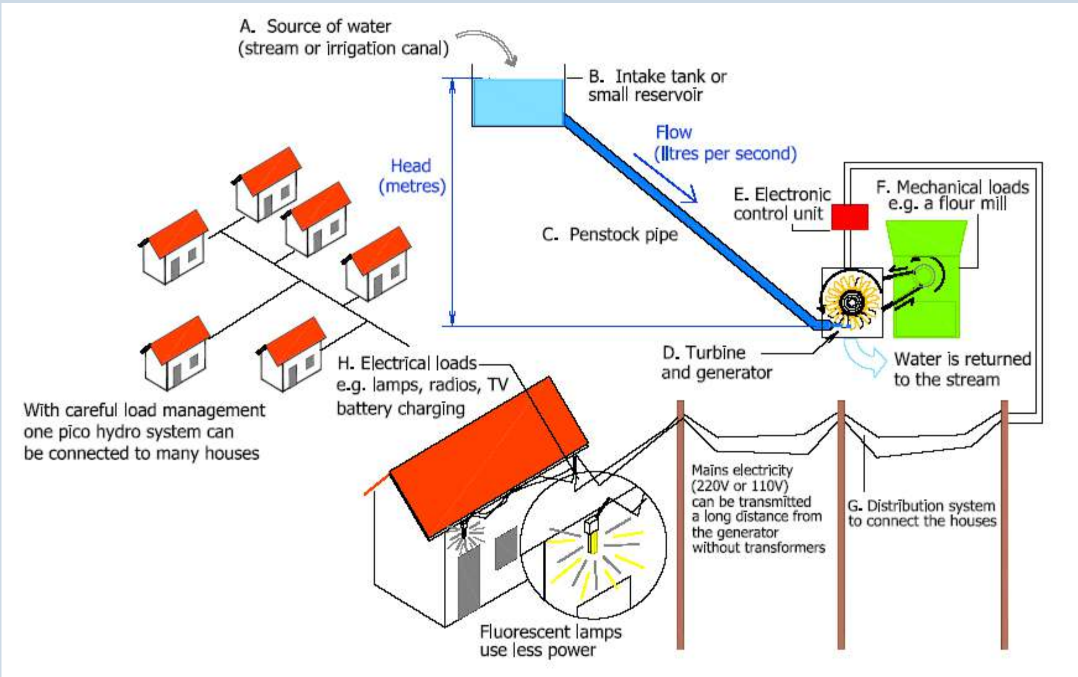
This power can be used directly as mechanical power, or more commonly, the turbine shaft is connected to an electrical generator which produces electrical power.

There are several classifications in use for hydropower systems. Based on size, they are generally classified as pico, micro, mini, small and large hydropower systems. Typically for remote locations in developing countries, small scale standalone hydropower schemes (typically micro hydropower – up to 100 kW and pico hydropower up to 5 kW) have been providing services to the communities for a long time.

Small hydro uses relatively simple structures and is generally not intrusive to the local environment. The figure below depicts a typical micro hydro scheme lay out, however there are several variations to this layout depending on the site characteristics.

For example in low head pico hydro systems, the penstock (the channel or pipe carrying the flow) may be completely absent. In some cases there may be an intake weir to divert water to the canal, or an aqueduct. There are numerous large and small hydroelectric power systems around the world, the larger hydroelectric power systems generally providing electricity through an electricity network or grid.

Small scale hydro scheme



Small scale hydro – typical system layout

Table 4 gives an overview of the main advantages and disadvantages of small scale hydro, wind and PV systems.

Table 4: Main advantages and disadvantages of small scale hydro, wind and PV systems

Technology	***Advantages***	***Disadvantages***
Small Scale Hydro	• Alternating Current (AC) can be produced directly which can run AC appliances directly • River flow rate is generally predictable, so electricity can be generated reliably • Low cost per kW	• Possible harmful effects on aquatic life • Not portable (unless very small scale) • Plants tend to be driven by run-of-river or relatively small reservoirs, hence highly susceptible to droughts
Small Wind	• Alternating Current (AC) can be produced directly which can run AC appliances directly • Easy to manage as they can be installed for single households (no community mobilization necessary)	• Intermittent - the wind is not always predictable – so power is only available when there is wind – so storage is recommended. • Storage requires a battery with chemicals - potential danger to the environment if not disposed of properly • Only effective in generally windy locations
Solar PV	• Direct Current (DC) can be produced directly which can run DC appliances directly • Portable - can be mounted on or form part of buildings (e.g. widely used on the roof) • Easy to manage as can be installed for single households (no community mobilization necessary)	• Only generates in sunny periods, so storage of electricity is required • Storage requires a battery with chemicals - potential danger to the environment if not disposed of properly • Only cost-effective in sunny locations • Only DC available directly

Support Mechanisms for Renewable Energy Systems

Support mechanisms are essential for RE to fulfil its potential and contribute to meeting the energy needs of communities in developing countries – which is crucial to achieving the MDGs. The International Action Plan arising out of the Bonn Conference process clearly acknowledges that this is not a simple matter of providing technology (hardware), but that success is also reliant upon creating a coherent policy environment, developing appropriate finance solutions and building essential capacity within the target societies to accommodate the process. These three key support ingredients are a prerequisite for renewable energy services to be able to effectively contribute to achieving the MDGs and are reviewed throughout this chapter.

Coherent Policy Environment for Renewable Energy

Local markets are crucial to significantly increase the use of RE in developing countries. Nurturing these local markets requires a strong enabling policy framework; at the very least this implies an environment where renewable energy technologies do not face unfair disadvantages compared to conventional energy technologies.

This requires the following:

- An acknowledgement that *energy services*, as opposed to simple *energy provision,* must form the basis for comparative evaluation.
- A full recognition of the external costs associated with the various energy service alternatives.
- An understanding of the equity involved in energy subsidies. For instance, centralised electricity generation, transmission and distribution systems frequently include a legacy of heavy subsidies (i.e. public investment).
- An enabling environment that includes ensuring equal access to (distribution) networks and to information on rural development and electrification strategies.
- Overarching policies that include establishing a national or regional target or portfolio standard to create necessary signals for investment in RE development, where cost-effective.
- At the same time, a strong regulatory structure is critical to ensure that all energy industry players deliver service that is in line with customers' expectations.
- In order to start to redress the balance, because renewable energy technologies are frequently consumer-led (e.g. pico-hydro) or Independent Power Producer (IPP)-financed (e.g. PV-diesel hybrids), it may be appropriate to use subsidies, carefully selecting only emerging renewable energy technologies.

PV conference in Mongolia, 2003

Developing Appropriate Finance Solutions

One of the main advantages of RE supplies, particularly for small household-scale applications, is their comparatively low running costs (fuel costs are zero) and maintenance costs. This characteristic is becoming increasingly favourable in the current environment of high and volatile oil prices. However, upfront investment for renewable energy can be relatively large. This coupled to the small scale of projects and the perceived technology risk, can pose severe financial challenges. To overcome this barrier and encourage the uptake of RE systems, new and innovative financial tools and finance mechanisms are needed.

For project developers, this might include the following:

- Investment bundling or standardised simple processing for small-scale projects. From the financiers' perspective the issue to resolve is at the consumer / household level and involves considering how to structure transactions to limit the costs of a large number of small individual projects, often amongst populations with limited security to offer.
- Potential revenue from carbon credits could be a useful development, although for small projects it often remains difficult to ensure that the credit is greater than the cost of accessing the revenue-stream. This is further complicated by the fact that some RE technologies may find it more difficult than others to secure carbon investment, e.g. established technologies such as hydropower may find the criteria necessary to define it as a carbon offset project more complex to prove when compared to less mature technologies.

From the users' perspective, the 'best' finance approach is very much dictated by local social and cultural preferences. A wide variety of models - from consumer credit arrangements to energy service leasing structures - have been tested. The details of the key models are discussed in the following section.

It is essential to extend the lessons of these experiences to the finance sector project developers and entrepreneurs keen to engage in the sector. This will assist them to make informed assessments as to how to make the project risks acceptable and improve their prospects for extending affordable finance solutions to the broader market.

Finance Models for Renewable Energy Systems

To overcome the barrier of often high capital costs and encourage the widespread use of renewable energy in rural and remote communities, new and innovative implementation models to finance and operate these technologies are needed.This section offers an overview of the various financing models that have been used for the implementation of small domestic PV systems (also known as Solar Home Systems or SHS) in developing countries. With suitable modifications, these models can be applied to other technologies.

The three main models are:

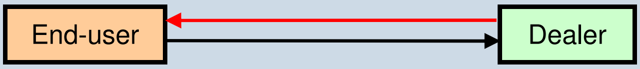
- Direct (cash) sales
- Credit sales
- Hire (lease) purchase and a fee-for-service model

Other approaches can be developed using a combination of these models.

Cash / Direct Sales

In this model, the PV system is sold directly or via a dealer to the end-user. The end-user immediately becomes owner of the system. Such a model is illustrated by the following diagram.

Cash Sales Model: Transfer of cash and ownership



Key:

←	Transfer of PV system
→	Transfer of cash (single tranche)
▭	Ultimate owner of the PV system

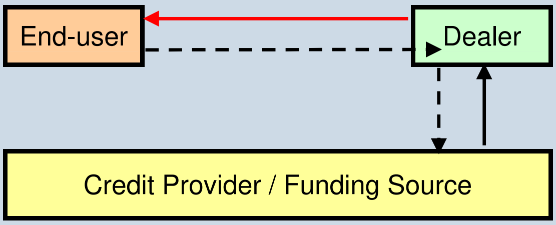
PV panels being sold in a shop in Tibet

Credit Sales

Several Credit Sales models are possible. Some of them are:

Dealer Credit: The PV supplier/dealer sells the PV system to the end-user, who enters into a credit arrangement with the PV dealer. Depending on the arrangements, the end-user immediately becomes the owner of the system, or becomes the owner when all payments are made.

Dealer Credit Model: Transfer of cash and ownership



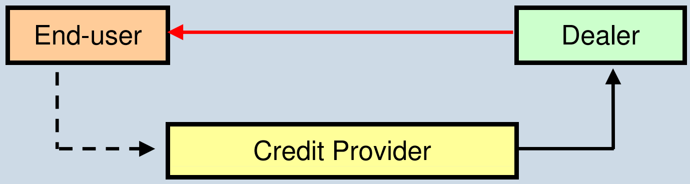
Key:

←	Transfer of PV system
- - →	Transfer of cash (single tranche)
→	Transfer of cash (instalments)
▭	Ultimate owner of the PV system

PV on dealer credit in India

End-user Credit: The PV supplier/dealer sells the PV system to the end-user, who obtains consumer credit from a third party credit institution. Usually the end-user becomes the owner of the system immediately, but this can be delayed until all payments are made. The PV system can be used as collateral against the loan, as illustrated below.

End-user Credit Model: Transfer of cash and ownership



Key:

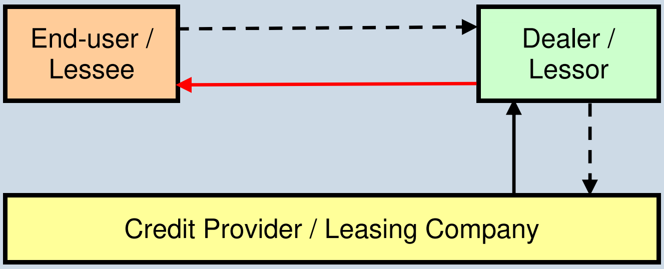
← (red)	Transfer of PV system
→	Transfer of cash (single tranche)
- - - →	Transfer of cash (instalments)
▭ (orange box)	Ultimate owner of the PV system

End-user credit is offered in West Bengal, India. (Source: PVMTI)

Hire / Lease purchase

The PV supplier/dealer or a financial intermediary leases the PV system to the end-user. At the end of the lease period, ownership may or may not be transferred to the end-user, depending on the arrangements. During the lease period, the lessor remains owner of the system and is responsible for its maintenance and repair.

"Lease/Hire Purchase" Model: Transfer of cash and ownership

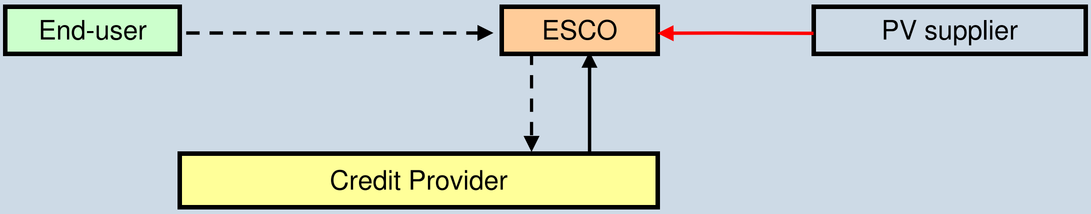


Key:

← (red)	Transfer and ownership of PV system at the end of the hire-purchase term
→	Transfer of cash (single tranche)
- - - →	Transfer of cash (installments)
▭ (orange box)	Ultimate owner of the PV system

Fee for Service: An energy service company (ESCO) owns the system, and provides an energy service to the end-user, who pays a periodic fee (e.g., monthly) to the ESCO. The end-user is not responsible for the maintenance of the system and never becomes the owner, as shown below.

"Fee for Service" Model: Transfer of cash and ownership



Key:

← (red)	Transfer of ownership
→	Transfer of cash (single tranche)
- - - →	Transfer of cash (instalments)
(orange box)	Ultimate owner of the PV system

Essential Capacity Development

The widespread implementation of RE will not be possible if professionals in industry, finance, government and non-profit sector lack the relevant skills to develop policies, evaluate project options and deal with financing. Also planning and design, delivery, installation and maintenance of RE systems require appropriate skills.

In addition, there is little prospect of achieving market development objectives for RE in developing countries if the intended target populations are not aware of the service and finance options. Communities need to be aware of the implications of their new energy services in terms of costs and conditions, lifestyle changes, personal and community development opportunities and service and maintenance arrangements.

Strengthening the capacity of this so-called *brainware* (a term from the Bonn Conference Issues Paper) requires the following:

- Ongoing investment in education
- Development of appropriate training structures (and their accreditation)
- Analysis and adaptation of relevant communication and media approaches and
- Capacity building partnerships between international players.

The same capacity development also needs to be extended to the *orgware,* i.e. organisations or institutions with a critical role in facilitating the appropriate business environment, for example:

- National, regional and local governments,
- Development banks,
- Independent regulators,
- Community groups and
- Non-governmental organisations.

Exchange of information and lessons, case studies and good practice approaches from the international community, down to local level is one of the keys to improve the prospects of success for RE development.

Other Initiatives to Support Renewable Energy

Climate Change, Clean Energy and Sustainable Development - IEA's G8 Gleneagles Programme

At their Gleneagles Summit in July 2005, G8 leaders addressed the challenges of climate change and securing clean energy and sustainable development. Agreeing to act with resolve and urgency, they adopted a Plan of Action.

A dialogue was launched; open to other significant energy consumers. The emerging economies of Brazil, China, India, Mexico and South Africa were also represented at the Summit. The International Energy Agency (IEA) was called upon to "advise on alternative energy scenarios and strategies aimed at a clean, clever and competitive energy future".

The G8 leaders asked the IEA to be a partner in this dialogue and to play a major role in delivering the Plan of Action. It will focus on six broad areas:

- Alternative energy scenarios and strategies
- Energy efficiency in buildings, appliances, transport and industry
- Cleaner fossil fuels
- Carbon capture and storage
- Renewable energy
- Enhanced international co-operation

As part of their July 2005 pledge of concerted action to secure a "clean, clever and competitive energy future", G8 leaders invited IEA to help activate dynamic worldwide networks for energy technology research and development. Building on its existing "Implementing Agreement" programmes, the IEA is linking with the international business community, policy makers, researchers and other stakeholders in many countries. It is working to enhance awareness of existing research, development and deployment networks and to facilitate broader participation.

As part of the dialogue, an initiative called Networks of Expertise in Energy Technology (NEET) was launched. IEA's NEET Initiative stages events where energy technology experts and policy makers can share know-how and experience on technical issues, but also on institutional and market questions. The NEET team plans a series of workshops in various countries during 2008, as well as contributions to key international events. In these workshops and events, IEA's collaborative programmes will be presented, along with their technical and policy findings, on topics such as clean coal, carbon capture and storage, renewable energy and end-use technologies. Stakeholders from government, industry, the research community and academia will have the opportunity to explore possible co-operation through IEA's programmes. To learn more about the NEET Initiative see http://www.iea.org/neet/.

Further details can be found at www.iea.org (click on "G8 Update"). Queries should be addressed to: G8Programme@iea.org

REN21

REN21 is a global policy network in which ideas are shared and action is encouraged to promote RE. It provides a forum for leadership and exchange in international policy processes. It bolsters appropriate policies that increase the wise use of RE in developing and industrialized economies.
Open to a wide variety of dedicated stakeholders, REN21 connects governments, international institutions, nongovernmental organisations, industry associations, and other partnerships and initiatives. Linking actors from the energy, development and environment communities, REN21 leverages their successes and strengthens their influence for the rapid expansion of RE worldwide.

The establishment of a global policy network was embraced in the Political Declaration of the International Conference for Renewable Energies – renewables 2004 – that took place in Bonn, Germany, from 1 to 4 June 2004. Ministers and Government Representatives agree to work within a "global policy network" together with representatives from parliaments, local and regional authorities, academia, the private sector, international institutions, international industry associations, consumers, civil society, women's groups, and relevant partnerships worldwide.

One year later, in June 2005, the Renewable Energy Policy Network for the 21st Century was officially launched in Copenhagen, Denmark. The Network is governed by a Steering Committee of some 30 distinguished and committed individuals. Balanced geographically and by sector, the Steering Committee comprises several key categories, such as Governments, International Governmental Organisations, Non-Governmental Organisations, Industry, Financial institutions, Regional Governments, Local Governments, and At-large Members.

In February 2006, REN21 opened its permanent secretariat offices in Paris. The Secretariat is provided by GTZ and UNEP and supported by IEA. Participation in REN21 is rapidly increasing with many dedicated people taking part in the work for the Global Status Report, the International Action Programme Follow Up and policy issue papers.

For more information about REN21, visit the website at www.ren21.net or contact: REN21 Secretariat - Tour Mirabeau • 39/43 quai André Citroën75739 Paris Cedex 15 France Phone +33 1 44375094, Fax +33 1 44375095, Email info@ren21.net

RETScreen International Clean Energy Decision Support Centre

The RETScreen International Clean Energy Decision Support seeks to build the capacity of planners, decision-makers and industry to implement RE and energy efficiency projects. This objective is achieved by developing decision-making tools (e.g. RETScreen Software) that reduce the cost of pre-feasibility studies, by disseminating knowledge which helps people make the right decisions, and by training people to better analyse the technical and financial viability of possible projects.

The RETScreen International Clean Energy Project Analysis Software is a unique decision support tool developed with the contribution of numerous experts from government, industry, and academia. The software - provided free-of-charge - can be used worldwide to evaluate the energy production and savings, life-cycle costs, emission reductions, financial viability and risks for various types of energy efficient and renewable energy technologies (RETs). The software also includes product, cost and climate databases, and a detailed online user manual. Other tools include a case study based college/university-level training course; an engineering electronic textbook; and its website.

All of these tools are available free-of-charge in English and French, with many of the tools available in other languages. For more information or to download the software and related tools visit:

http://www.retscreen.net/ang/home.php

World Bank RE Toolkit

Based on RETScreen, the World Bank Energy and Mining Sector Board launched the Renewable Energy Toolkit: An Operational Guide for Electric Services (REToolKit) which provides a broad set of tools to assist Bank staff and its developing country partners in improving the design and implementation of RE projects.

The toolkit incorporates best practices and lessons learned from RE projects supported by the World Bank Group (WBG) and others. It is operationally oriented to address practical implementation needs at each stage of the project cycle. Use of this reference tool is expected to result in lower costs and less time for project preparation, and result in more effective and sustainable RE projects.

The REToolKit is a web-based knowledge portal that directly responds to the needs assessment conducted with the World Bank task managers and can be found at http://www.worldbank.org/retoolkit/.

The current version of the REToolKit addresses RE for electric services. This is the first phase of a series of planned knowledge products that are intended to broaden its scope to include RE developers, bankers and policymakers and also address RE for non-electric services, environmental and social assessment frameworks, and monitoring and evaluation in the next phases.

The REToolKit contains six modules:

Three application-oriented modules (presenting the Key Issues, Policy and Regulatory Frameworks, Business Models, Finance Mechanisms and Technology Requirements):

- Grid-connected RE
- Mini-grid RE, and
- Stand-alone RE and three supporting information modules:
- RE Rationale,
- World Bank Group Project Cycle; and
- Project Tools

The Rationale module examines RE economic and developmental justification to convince decision-makers of the importance of RE, and provides tools for RE electrification planning.

The Project Cycle module gives a checklist and relevant documents and examples for RE projects at each stage in the WBG project cycle, as well as for GEF and carbon finance operations.

The Project Tools module provides a library of useful documents and sample material and links to related websites.

The REToolKit can help:

- Identify and design feasible RE projects;
- Determine appropriate policies and regulatory frameworks;
- Identify business models;
- Evaluate financing mechanisms;
- Select appropriate and feasible RE technologies; and
- Utilize the best available project tools, including technical standards, generic terms of reference, and supporting documents.

Case Studies

Case Study 1: Small Wind Power - Mongolia

Renewable Energy Development in Small Towns and Rural Areas in Mongolia - Asian Development Bank (ADB) and Ministry of Fuel and Infrastructure, Mongolia

(Contributed by IT Power)

As part of the Asian Development Bank supported project - *Renewable Energy Development in Small Towns and Rural Areas in Mongolia* - a wind-PV diesel hybrid power system was installed to provide power to the Soum centre of Darvi, Govi-Altai Province between July 2003 and December 2004. A 1 kW wind turbine was installed to supply power to the hospital during periods when the diesel generator is not operating. The installation was carried out by a local Mongolian company.

The major conclusions drawn from the pilot project were:

The key lessons from the pilot project were:

- The potential for energy efficiency in rural Mongolia is considerable. Measures to encourage efficient use of energy should be introduced.
- The distribution of compact florescent lamps (CFLs) reduced the hospital's electricity demand significantly.
- Implementation of energy efficiency measures should go hand in hand with the introduction of renewable energy schemes.
- It is technically feasible to integrate a small renewable energy system with an existing diesel generator and mini grid. However, it is much more difficult to achieve the changes in user behaviour which are essential for making the best use of a renewable energy system.
- Training and capacity building is required to enable local people to maintain their electricity distribution system.

Case Study 2: Small scale hydropower / Pico Hydro - Ecuador

Stimulating the market for pico-hydropower for low-income households – World Bank – ESMAP (Contributed by IT Power)

In Ecuador there are millions of people, mostly in the rural areas, who presently do not have access to electricity. Low-head pico-hydro systems could offer the cheapest and most sustainable option for basic electrification of families living in valleys along small rivers and irrigation canals. The low income of many rural people, the emerging market for energy services and equipment and the significant number of rural households living next to small streams makes the country very suitable for small scale hydropower including pico-hydro.

IT Power, with support from the World Bank – Energy Sector Management Assistance Programme (ESMAP) assessed the extent of existing use of pico-hydro in the Andes. Thirty pico-hydro systems in two regions of the country were installed, with technical training provided to dealers and the end-users. A full impact assessment was carried out on those installations involving Rapid Rural Appraisal. The project has been successful in showing that hydro resources can be tapped efficiently to produced electricity and replace traditional fossil fuel usage by community members.

The benefits of pico-hydro show an increase in economic activities after the introduction of the pico hydro system. In Cosanga, a farm owner has finished building two pools, one to hatch trout eggs and another big pool for mature trout. Since the pico-hydro has been installed, they have installed the oxygenation mechanism needed and will start to harvest trout eggs soon.

In Ozogoche, two cheese factories owned by members of the community are now being powered by the pico-hydro system. Most of the families of the community have cows and the milk produced is sold to these cheese factories. However not all the milk produced can be processed by the factories. The regular

electricity and the lighting have extended the hours of production and all the milk produced daily is being processed. In this way, the community benefited as a whole since more milk is sold as well as cheese.

In Alto Tena, there was a small and poorly set up poultry farm in the community. This was immediately identified as a potential activity aided by the pico-hydro units. A 120 W lamp has been installed to help and speed the hatching process and it is turned on only when the loads of the two households are not being used.

Other benefits include improvement in quality of life as the better lighting system allowed for more communal integration through interactive activities in the evenings. The beneficiaries pointed out that fuel costs were saved and an increase in the productive sector as well as educational and social activities.

Case Study 3: PV for Water Pumping

Drinking Water Supply with Photovoltaic Water Pumps (PVP) (IEA-PVPS Task 9 Case Study prepared by R. Posorski, GTZ)

The availability of clean drinking water is a basic human need. Nevertheless, World Bank estimates put the number of people in remote rural areas of developing countries with no access to clean water at roughly one billion. Dirty and polluted water sources have a strong negative impact on health. Getting water from remote sites is troublesome and time consuming.

Poor water supply contributes to the migration of rural people into overcrowded cities. Consequently, government-sponsored programmes dedicated to the long-term improvement of drinking water supplies in rural areas are being conducted in numerous developing countries. Since most rural areas are not and will not be electrified for decades to come, national water authorities have to rely on diesel pumps in most of those programmes. Due to poor maintenance, breakdowns and lack of fuel, they are often out of service.

Here solar energy opens up new options for pumping water. Photovoltaic pumping systems require little service and no fuel. They can offer a reliable and environmentally sound alternative.
Often, they constitute the only reliable solution to the problem of drinking water supply in remote areas. However, a lack of experience with PVP technology, as well as the comparatively high initial costs, has precluded its widespread application up to now.

PV water pumping has been proven to be technically reliable and mature technology with an availability of 99 %.

Case Study 4:
PV for Schools - South Africa

South Africa 1,000 PV Schools Project – European Union (IEA-PVPS Task 9 Case Study prepared IT Power)

Whilst many South African cities and towns are fully developed with modern infrastructure and energy services, a large number of people in the rural areas do not enjoy the benefits of being connected to the electricity grid. The South African government, together with the electric utility Eskom, is working on extending the grid in the rural areas. In parallel to grid extension, PV is used to electrify schools, clinics and also households, mainly in areas where the grid would be least economic.

A project with a view to providing electricity to 1000 schools in remote areas of Northern Province and Eastern Cape Province in the Republic of South Africa, using PV systems was implemented with the help of European Commission. The main components of the PV system installed were an 880 Wp PV array, a charge controller, a 24 V battery bank and an inverter. The systems were designed to generate enough electricity to provide lighting for three to five classrooms and power for the audio-visual equipment.

The project had a significant impact on the education of school children in rural areas of Eastern Cape and Northern Province in South Africa with noted benefits for the respective communities, through adult education and communal use, for instance for functions or for entertainment using the AV equipment.

Case Study 5:
PV for Health Services - Mozambique

PV for Health in Mozambique (IEA-PVPS Task 9 Case Study prepared by H. Tikkanen, NAPS Systems Oy)

Since 1995, Mozambique has been implementing a Health Sector Recovery Programme, and in 1997 the Government of Mozambique received a grant from Norway towards the cost of a Health Sector Recovery Programme project, "Solar Energy for Rural Health Facilities". The project consisted of photovoltaic electrification of approximately 250 rural health facilities in all 10 provinces of Mozambique.

At the time of survey, installations had been carried out at 10 health centres, and eight of these were visited. Every health centre will in principle have 4 independent subsystems; one health centre lighting system, one vaccine refrigeration system, and two staff house systems. All staff interviewed expressed great satisfaction with the lighting system. All 8 vaccine refrigerators inspected were stocked with vaccine, and the batteries were fully charged at the time of inspection, there are thus no concerns regarding the functioning of the vaccine refrigeration systems.

Typically health centres supplied under the project are supplied with two houses for the staff and families to live in. These houses are also electrified in the project, as it is hoped that this will strengthen the motivation of the staff to take good care of the systems and make it easier for the Ministry to recruit qualified staff. The staff house systems provide lighting and are also equipped with a 60 litre domestic refrigerator. In all instances the inhabitants said they valued the staff house systems highly. In particular, they like to have light that is free of charge and smoke and smell-less. The appreciation and awareness of the benefits of the domestic refrigerator appeared to vary more. It appears that the portable solar lanterns have received a more mixed reception that the fixed light installation. The usefulness of the lantern in the context of the total system may be questioned.

Case Study 6: PV for Solar Home Systems - India

Case study from SELCO India

Kumarasiri is a highly skilled carpenter in Ambadandara whose life has been improved by a SELCO lighting system. Kumarasiri has a tiny unelectrified workshop in his house in which he builds high quality wood furnishings. Without electric light, he could not complete the orders in time since he was limited by his daylight working hours. As a result, he had to seek outside employment. Since most of the villagers are farmers and very few of them work in the private and government sector, work was hard to find and he had to travel great distances to seek daily employment. After paying the high travel costs and other expenses, he could save almost nothing. He was constantly looking out for a solution, and found it from SELCO.

Kumarasiri was visited by a SELCO representative and introduced its solar lighting system. Knowing the great benefits it could provide him in extending his carpentry work hours, and with its easy payment scheme, Kumarasiri grabbed the opportunity with both hands and invested in a SELCO system.

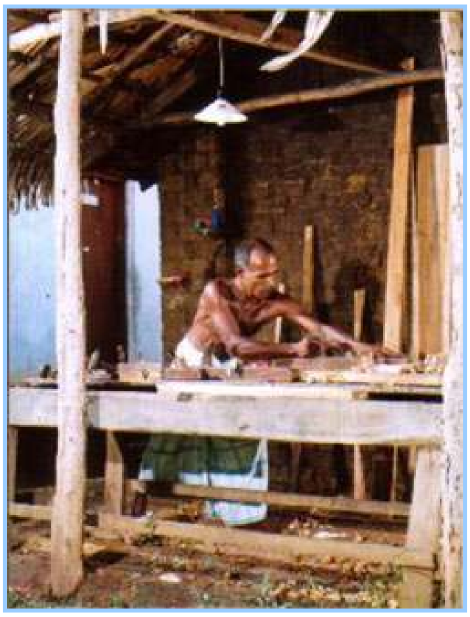


Photo: Selco

With his new solar lighting system, Kumarasiri can now carry out the carpentry work from his own place under electric light. He can work the necessary hours to complete orders out of his own home. In fact, Kumarasiri is now able to complete artistic orders that demand more time and patience but which earn his family more money.

With a regular job and reduced travel expenses, Kumarasiri's family has been able to save a lot of money. He not only has improved his livelihood, Kumarasiri says that the SELCO SHS has given him more free time to assist his wife in household work and enjoy family life. Through its solar lighting system, SELCO has not only helped Kumarasiri in his workshop, but helped him to build a sustainable livelihood.

Key Lessons

Renewable energy technologies have a tremendous potential to provide services to developing countries. The following lessons learnt during the PVSDC project are vital in ensuring that the services are delivered effectively.

These key lessons are 'accumulated wisdom' based on cumulative experiences and case-studies, rather than on absolute findings.

Three main areas are distinguished: Policy, Planning and Infrastructure; Finance and Funding; Implementation, Monitoring and Evaluation and their corresponding lessons are described in Table 5.

Table 5: Delivering Energy Services **-** Key Lessons

Policy, Planning and Infrastructure

- Ensure thorough consultation with end-users and implementing agencies during planning and implementation.
- Undertake awareness raising and where necessary, capacity building for planners and other relevant agencies.
- Allow for appropriate training for the service delivery chain.
- Analyse the skills needed to deliver the programme in its entirety, including the long-term support that will be required.
- Aim to manage and retain the knowledge and skills base that the project will help to create, and draw on existing knowledge/skills where available.

- Communicate and support (including financially) the 'total quality' message.
- Ensure that all parties are aware of their functions and responsibilities prior to the project implementation.
- Establish the criteria and parameters against which the project will be monitored and how these indicators will be gathered / reported.

Finance & Funding

- Undertake a thorough analysis of the costs involved in delivering the programme in its entirety.
- Identify co-contributors and clearly agree financial commitments, timing and availability of funds.
- Avoid donations; projects without some reasonable user/community financial commitment and ownership responsibility are prone to failure.
- Avoid piecemeal programmes.
- Use subsidies judiciously.

- Assess the advantages and disadvantages of financial delivery options in the context of existing financial and community structures.
- Be aware of existing commercial operations. Delayed or false delivery promises can damage even well-established businesses.

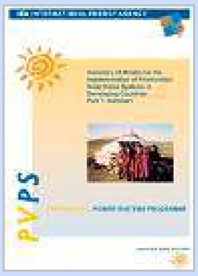
Implementation, Monitoring and Evaluation

- Ensure that all key actors are fully aware of their functions and responsibilities.
- Ensure (at planning stage) that the implementing agency is appropriate and has sufficient, adequately trained staff to deliver the project.
- Ensure / facilitate good communication procedures within and between relevant participating agencies.
- Build-in - and budget - an appropriate maintenance regime.
- Ensure that users are adequately trained in the operation and care of their system/service.
- Make allowance to mitigate against theft (consider appropriate security options).

Annex I: PVSDC Recommended Practice Guides: Summary

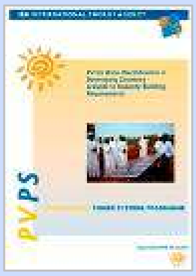
Financing Mechanisms for SHS in Developing Countries (Publication No. T9-01: 2002)

This study has made an evaluation of the experience gained with financing systems for Solar Home Systems (SHS) – implemented via a number of international agencies including GTZ. It looks at how, on the basis of this knowledge, recommendations for future financing models can be formulated. The investigations made into a large number of projects came up with results which, in some cases, differed widely from the commonly held views of the specialists.



Summary of Models for the Implementation of Photovoltaic SHS in Developing Countries (Publication No. T9-02: 2003)

This Recommended Practice Guide attempts, in two parts, to describe, simply and concisely, a variety of implementation models for Solar Home Systems (SHS) in developing countries, and is intended to serve as a tool for SHS energy services delivery decision making. Altogether eight case studies describing implementation models in developing countries are presented in this guide.



PV for Rural Electrification in Developing Countries - A Guide to Capacity Building Requirements (Publication No. T9-03: 2003)

This document identifies capacity building measures that should be undertaken as an integral component of a PV based rural electrification implementation programme. It addresses issues relating to capacity building within the public and utility sector, Financial Community, NGOs, Service Delivery Chain and end-users.

The Role of Quality Management Hardware Certification and Accredited Training in PV Programmes in Developing Countries: Recommended Practices (Publication No. T9-04: 2003)

In order for a PV implementation programme to be successful, it needs to be designed with quality assurance in mind throughout the implementation process, not just when hardware is procured. Quality assurance has important implications for, inter alia, programme design, selection of equipment and supplier, checking compliance of systems/components delivered, installation and commissioning, ongoing maintenance, and training of personnel at various levels. This RPG provides an overview of three important aspects of quality control: Quality Management, hardware certification and training accreditation.

PV for Rural Electrification in Developing Countries - Programme Design, Planning and Implementation (Publication No. T9-05: 2003)

This Recommended Practice Guide (RPG) is intended to provide input to programme developers considering implementing or improving support programmes based on PV energy systems for rural electrification. It sets out to highlight critical factors that must be given due attention during project preparation and design as well as practical suggestions for carrying the plan through to implementation. It also addresses monitoring and evaluation considerations for assessing performance and impact throughout and after completing the programme, lessons from which can be invaluable for future project development.

Institutional Framework and Financial Instruments for PV Deployment in Developing Countries (Publication No. T9-06: 2003)

Photovoltaic (PV) systems represent an interesting option for supplying electricity to dispersed rural communities. However, the emergence of PV as a technology has, in itself, not been enough to ensure its widespread diffusion amongst those who desire electricity. Whilst market forces and government programmes have both played a part in promoting PV uptake to date, widespread opinion across a broad range of actors recognises a clear need to strengthen the institutional framework. The focus of this effort should be on developing appropriate market rules and incentives which can underpin long-term self-sustaining markets. This Recommended Practice Guide (RPG) aims to define the key components and mechanisms of just such a framework.

16 Case Studies on the Deployment of Photovoltaic Technologies in Developing Countries (Publication No. T9-07: 2003)

The 16 case studies summarised in this document cover deployment of PV technologies in 27 countries - Kenya, Morocco, Mali, China, Kiribati, Mozambique, Namibia, Zimbabwe, Zambia, Syria, Chile, India, Argentina, Brazil, Indonesia, Jordan, the Philippines, Tunisia, Burkina Faso, Cape Verde, Chad, Gambia, Guinea Bissau, Mauritania, South Africa, Niger and Senegal. These case studies provide experiences and lessons learnt on the importance of an appropriate institutional and financial framework, of sufficient capacity building and quality assurance and of choosing the right implementation and financing mechanisms to ensure the development of a sustainable PV market.

Sources of Financing for PV-based Rural Electrification in Developing Countries. (Publication No. T9-08: 2004)

PV deployment programmes in developing countries require the procurement of capital resources in order to plan the programme, purchase, transport and install the equipment, and provide training and maintenance for its use. Where does this money come from? This guide will explore various sources of financing accessible to programme developers engaged in off-grid rural electrification. Although this guide focuses on PV deployment, the concepts presented in this guide will generally be applicable to other decentralised electrification efforts and even to rural development efforts as a whole.

These documents are all available from www.iea-pvps.org.

Annex II: Programme Sponsors

International Energy Agency - Photovoltaic Power Systems Programme

The International Energy Agency (IEA) is one of the agencies seeking to address the challenges of delivering rural energy services. In order to encourage collaborative efforts to meet the energy challenges of energy security and climate change, the IEA created a legal contract called an "Implementing Agreement" and a system of standard rules and regulations which allows governments or other organisations to pool resources and to foster the research, development and deployment of particular technologies.

The Photovoltaic Power Systems Programme (PVPS) is one such collaborative research programme whose mission is "to enhance the international collaboration efforts through which photovoltaic solar energy becomes a significant renewable energy source in the near future."

One of the IEA-PVPS projects - Task 9: PV Services for Developing countries (PVSDC) - has been working with a mission 'to increase the sustainable use of PV in developing countries in support of meeting the targets of the Millennium Development Goals'.

The IEA PVSDC task members have surveyed and studied successful and unsuccessful PV projects in a wide range of countries, from which eight Recommended Practice Guides (RPGs) were developed and published. The series of Recommended Practice Guidelines covers the essential enabling policy and finance environments, as well as the 'brainware' (knowledge resources) and 'orgware' (organisations that facilitate the appropriate business environment) to support appropriate and sustainable dissemination of the hardware. These RPGs are summarised in the following table and can all be downloaded from the PVPS website at **http://iea-pvps.org/tasks/task9.htm**

Renewable Energy and Energy Efficiency Partnership

The Renewable Energy and Energy Efficiency Partnership (REEEP) aims to accelerate and expand the global market for renewable energy and energy efficient technologies.

Since 2005, the Task 9 work (PVSDC) has been extended with the support of the Renewable Energy and Energy Efficiency Partnership (REEEP) and the IEA. This new endeavour – **Renewable Energy Services for Developing Countries (RESDC)** – aims to develop and deliver experience-based solutions for successful renewable energy and energy efficient services by carrying out policy formulation, project design, implementation and follow-up, for the benefit of governments and development-focused agencies worldwide.

RESDC expands on the current IEA - PVSDC document on Photovoltaic services for developing countries - PV in support of the Millennium Development Goals, to include wind and hydropower as Renewable Energy Services for developing countries.

The new RESDC phase also includes new work on renewable energy technologies for water supply, health and education delivery, battery charging, village power and mini-grids. Dissemination will continue and be extended to working with the various initiatives and partnerships which have emerged from the World Summit on Sustainable Development (WSSD).

Renewable Energy Services for Developing Countries (RESDC) contributes through:

- Finding mechanisms for cost reduction of renewable energy applications
- Increasing awareness of their potential and value
- Fostering their market deployment by removing technical and non-technical barriers, and
- Enhancing technology co-operation with non-IEA countries, and REEEP partner countries.

Further Information

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