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Institutional Framework and Financial Instruments for PV Deployment in Developing Countries

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Implementing Agreement on Photovoltaic Power Systems

Task 9
PV Deployment in Developing Countries

Institutional Framework and Financial Instruments for PV Deployment in Developing Countries

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[1] - Innovation Energie Développement for ADEME (French Environment and Energy Management Agency) for France and G. Collins, CIDA, for Canada

CONTENTS

The photograph on the front page of this document was taken in June 2001. Regional Solar Pumping programme (PRS), Mali. Copyright IED.

Foreword

The International Energy Agency (IEA), founded in November 1974, is an autonomous body within the framework of the Organisation for Economic Co-operation and Development (OECD) which carries out a comprehensive programme of energy co-operation among its 23 member countries. The European Commission also participates in the work of the Agency.

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

The overall programme is headed by an Executive Committee composed of one representative from each participating country, while the management of individual research projects (Tasks) is the responsibility of Operating Agents. Currently activities are underway in five Tasks.

The 21 members of IEA PVPS are: Australia (AUS), Austria (AUT), Canada (CAN), Denmark (DNK), European Commission, Finland (FIN), France (FRA), Germany (DEU), Israel (ISR), Italy (ITA), Japan (JPN), Korea (KOR), Mexico (MEX), The Netherlands (NLD), Norway (NOR), Portugal (PRT), Spain (ESP), Sweden (SWE), Switzerland (CHE), the United Kingdom (GBR), and the United States (USA).

The objective of Task 9, which started in May 1999, is to increase the overall rate of successful deployment of PV systems in developing countries, through increased co-operation and information exchange with developing countries and the bilateral and multilateral donors.

Thirteen countries[2] participate in the work of Task 9, which is an international collaboration of experts appointed by national governments and also includes representatives of the World Bank and United Nations Development Programme. Developing country representatives are invited to participate.

This report has been prepared under the supervision of Task 9 by:

A. Shanker and L. Bertarelli of IED for Ademe, France and G. Collins, CIDA, Canada in co-operation with experts of the following countries: Canada, Denmark, Finland, France, Germany, Italy, Japan, Sweden, Switzerland, the UK, and the United States of America. The views expressed in this paper represent a consensus of opinion amongst the Task 9 experts.

This document is one of a series being published by Task 9. The complete series of documents comprises:

- PV for Rural Electrification in Developing Countries – A Guide to Institutional and Infrastructure Frameworks.
- Summary of Models for the Implementation of Photovoltaic Solar Home Systems in Developing Countries.
- PV for Rural Electrification in Developing Countries – A Guide to Capacity Building Requirements.
- Financing Mechanisms for Solar Home Systems in Developing Countries: The Role of Financing in the Dissemination Process.

[2] Australia, Canada, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Sweden, Switzerland, the United Kingdom, the United States of America.

- The Role of Quality Management, Hardware Quality and Accredited Training in PV Programmes in Developing Countries.
- 16 Case Studies on the Deployment of Photovoltaic Technologies in Developing Countries.
- PV for Rural Electrification in Developing Countries - Programme Design, Planning and Implementation.
- Sources of Financing for PV Based Rural Electrification in Developing Countries.

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Scope and Objective

This guide describes the institutional and financial aspects that need to be addressed to ensure that a long term sustainable (and profitable) PV market is established in developing countries. This guide aims to provide support to decision-makers be they bilateral and multilateral institutions, host governments in developing countries, PV project developers and sponsors, PV producers and suppliers, entrepreneurs, or NGOs.

The guide details:

- The main fundamental functions that need to be performed.
- The agents needed to perform the functions and their differing roles within the framework.
- The relationships (contractual or code of conduct) between the agents.
- The financial instruments available.

The majority of the aspects recommended in this guide can be adopted to two main PV deployment models: (1) direct sales and (2) rural electrification and development programmes. It should be noted that both approaches will have to be tailored and adopted to local conditions.

Although the focus in this document is on PV, much of the discussion applies to other rural, decentralised energy systems.

Keywords

Keywords: developing countries, PV, deployment, financing, institutional, infrastructure, rural electrification.

Acknowledgements

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Abbreviations and Acronyms

ADER	Agence de Electrification Rurale
AFD	French Aid Agency
EC	European Commission
ESCO	Energy Service Company
ESMAP	Energy Sector Management Assistance Program
EU	End-User
G8	Group of the 8 Leading Industralised Countries
GEF	Global Environment Facility
GVEP	Global Village Energy Partnership
IEA	International Energy Agency
IFC	International Finance Corporation
IGCC	Integrated Gas Combined Cycles
kWh	Kilowatt hour
MDG	Millennium Development Goals
MIGA	Multilateral Investment Guarantee Agency
NGO	Non Governmental Organization
MIGA	Multilateral Investment Guarantee Agency
OBA	Output-Based Aid
O&M	Operation and Maintenance
PRSP	Poverty Reduction Strategy Papers
PV	Photovoltaic
PVPS	Photovoltaic Power Systems
REEF	Renewable Energy and Energy Efficiency Fund
RPG	Recommended Practice Guide
SHS	Solar Home System
W	Watt
WB	The World Bank group
Wp	Peak Watt

Summary

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 together have played their part in promoting its uptake to date, widespread opinion across a broad range of actors recognise a clear need to strengthen the institutional framework in support of the long term sustainable market development and deployment of PV services. This report aims to define the key components and mechanisms of just such a framework.

The focus of this effort should be to develop the necessary market rules and incentives to ensure that the market develops in a *self-sustaining* fashion. This requires the adoption of a lifecycle approach and an emphasis on the provision of a sustainable (and quality) service. Attention, during the project initiation stage, on establishing a framework that ensures a continuous and reliable service provision over time is as an important a consideration as the initial installation of a rural electrification PV facility itself. Past PV projects where such equal emphasis has been lacking has invariably resulted in early system failure with inadequate provision for rectification. In such incidences, consumer disillusionment and negative press have been the natural consequence, to the detriment of the wider uptake of PV.

Furthermore, the current trend is toward provision of energy services for rural development, particularly in the health, education and communication sectors. PV must clearly be viewed as one of the technical options for meeting the energy needs for development of these sectors in the rural milieu.

This report therefore proposes a framework to ensure a healthier development of the PV market in rural communities by seeking to address at the institutional level :

- The role of regulation and the Public Authority. The positive role of the Regulator is significant yet requires further development in practice.
- How to create an enabling environment for the key roles of users or end end-user groups, the service provider, and the facilitating agents to act as mutually supportive agents.
- The issue of quality of PV service over time.
- Affordability of the service, financial sustainability and packaging of funding.

and at the financial level :

- Financial services – in the case of a direct sales approach. Where PV is the most economically viable of all the options it often requires significantly less investment on a lifecycle basis but for the individual end-user the initial investment is still high in relation to income and income earning opportunities. Credit (end-user or dealer) and loan schemes remain a necessity.
- Investment subsidies for infrastructure development in rural areas. Throughout the world, rural electrification has been substantially subsidised, at least regarding investment costs. A share of the financial responsibility has to be born by the Governments themselves and the modalities through which the required funds will be raised, level of subsidies calculated and subsequently disbursed need to be specifically worked out.
- Support to private investment and development of private entrepreneurs. Risk analysis and perception is clearly a key component in private investment decision making whether for the local entrepreneurs, the banks having to lend to these emerging companies or for multinationals. Unless the risk spectrum is properly analysed and mitigated, there is little chance that thriving private initiatives will emerge.

1 Introduction

The World Summit on Sustainable Development in Johannesburg, 2002 and the Millennium Development Goals (MDG) have helped recognize at a global level that the provision of a modern energy source such as electricity is an important contributor to many of the advancements made in the emergence of income generating activities, employment opportunities, healthcare provision, education, as well as to the improvements in living standards and the general well being of many of the world's populations. Yet, approximately 1.64 billion people live without electricity, either because they are too hard to reach, too poor to afford it, have no access to credit mechanisms, or are too thinly populated to justify the cost of grid extension.

PV due to its modular characteristic has considerable potential to contribute to meeting some of the energy needs (lighting, TV, radio, refrigeration, pumping, telecommunications) of these rural and remote communities in developing countries. The establishment of a long-term sustainable PV market in developing countries depends, however, primarily on the success in building an infrastructure framework integrating PV as one of many technical options for providing a rural electrification service leading on to a financially viable distribution, financing, installation and after-sales structure. This Guide, therefore, aims to recommend an institutional and financial framework where a sustainable PV market can be established and in turn offer assurance to end-users. Many of the points presented are also applicable to other technical options that may be used for rural electrification.

When grid power systems are installed the means to operate and maintain them is a key component of the planning and design – this is equally relevant and important to PV systems. All forms of electricity generation require financial resources, management, operational structures and a framework that ensures that only power systems of high quality are installed / available on the market. Time and energy are required to establish such frameworks.

2 PV Market Deployment Models

To date there are two main PV market deployment models adopted in rural areas of developing countries (i) Direct Sales Model and (ii) Rural Electrification and Development Programmes. These two main deployment models require differing levels of Government intervention. Figure 1 illustrates the two main PV market deployment models range of approaches as adopted by the Global Environment Facility (GEF) specifically relevant for the deployment of solar home systems (SHS).

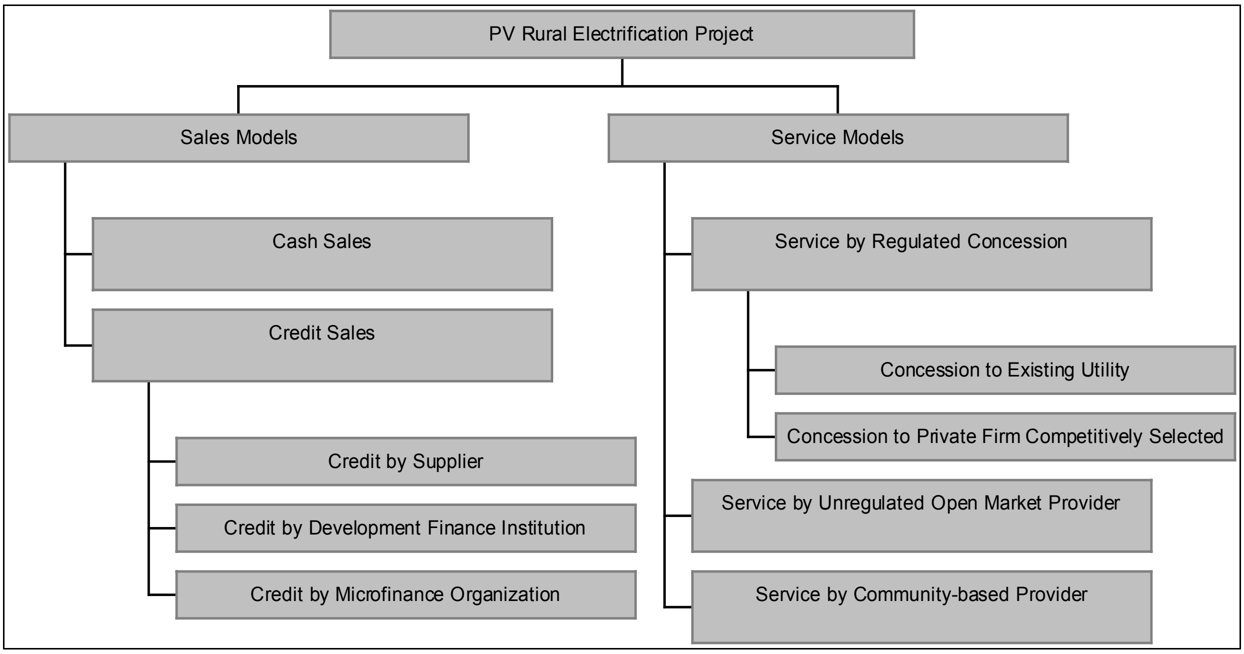


Figure 1: Typology of GEF supported Solar PV Projects [Ref: 29].

It should be noted that to achieve a healthy and long-lasting PV market, these two models should aim to coexist with one another. That is a government led programme should not hinder the development of a direct sales market but strive to facilitate the process by which direct sales occur.

The PV deployment models are further defined in the following Task 9 documents :

- *Summary of Models for the Implementation of Photovoltaic Solar Home Systems in Developing Countries*.
- *Financing Mechanisms for SHS's in Developing Countries: The Role of Financing in the Dissemination Process*.

2.1 Direct Sales Model

The direct sales model represents a market in which PV dealers and developers conduct direct sales (cash sales or via credit schemes) under normal market forces. The product sold is in most cases composed of a solar home system (SHS) and/or solar lanterns purchased for cash or credit by individual end-users, e.g. households, "institutional" customers (religious organizations, schools, …) or commercial (shops, …). Most often, these markets are based on 10 to 100 Watt PV modules and are usually sized to provide energy for two or three fluorescent lamps and a radio/stereo or television set. In most cases end-users will base their purchase on a number of factors including the information provided by the salesperson, whether there is a subsidy available, the price s/he is willing to pay and the payment facilities available.

Sales have to be on a cash basis when there is a lack of credit in rural areas. Cash sales account for an estimated two-thirds of the number of installed SHS's in developing countries [Ref: 25]. The main advantages of direct cash sales are easy financing, low transaction costs, and high flexibility in consumer choice whilst the main disadvantage is that only a very small number of people can afford to purchase a PV system on a one-off payment thus often leaving the majority of the rural population unserved.

End-user credit has been used to some extent, though typically only by consumers with secure occupations (business or government) and income, thus leaving most of the market without access to this facility. Other financial options include the establishment of payment facilities by the dealer (requiring dealer refinancing), leasing arrangements or a revolving fund – where funds are lent to and guaranteed by a community group, which in turn lends, collects repayment, and then lends again. The latter have been somewhat successful because the system often builds on or reflects the structures of traditional (informal) financing making them more recognizable to people who have never had contact with formal banks/ financial markets, however the spreading of this model is also therefore dependent on the existing local social structures and traditions.

Cash sales of PV systems have however developed with little institutional or quality control. Systems are rarely approved, certified or associated to any international or national standard nor are they generally installed by adequately trained technicians. In fact it is usually left to the manufacturer, dealer and installer to ensure that the systems manufactured, sold and installed are of a good standard and that after-sales services are provided. This lax regulatory framework provides an entry point for usurpers to jeopardise the PV market. For example, in South Africa, "dubious" salespersons have sold thousands of substandard SHS's, which failed shortly after installation [Ref: 17].

Problems to date have, in fact, been recorded in both the quality of systems and the provision of an after-sales service. Overall there is a tendency for customers to purchase cheap low-quality systems because the most important factor for customers is cost or sometimes because of misleading marketing information.

It is evident that this approach alone, as it stands, is not sustainable. Not only should the consumer be protected, but this lack of consistency in the quality of PV products and installation, could adversely influence the future of PV by jeopardising the reputation of the technology as a whole, thus creating another barrier to its overall acceptance.

Any institutional framework that aims to progress the long-term market of PV via commercial channels should therefore aim to address these underlying weaknesses. An institutional framework that ensures **reliable quality PV systems** and supports **quality control** all along the delivery chain will strengthen the industry and offer assurance to end-users. In addition, the provision of **public information / awareness campaigns**, **after-sales** services and **financing mechanisms** will prove to be fundamental steps towards protecting the consumer [Ref: 17] and enhancing the PV market growth.

Kenya :

The purchase of an amorphous silicon module purely because it is physically larger (for a given power) is not uncommon in Kenya according to anecdotal evidence. This is typically because rural households: (i) have very small savings and little opportunity to access credit and if they do it is usually at high interest rates, and (ii) are not well informed to compare the relative performance of different module brands and therefore heavily rely on the recommendations provided by dealers. In the case of Kenya thousands of rural households have been unfortunate enough to select seriously under-performing PV systems and have lost most or all of their investment in what is often the most expensive durable good they own. The existence of low quality systems and/or low quality installation may discourage future potential SHS customers [Ref. 17].

2.2 Rural Electrification and Development Programmes

This PV deployment approach refers to Government led programmes where PV systems have a role to play in providing a service, e.g. electricity to rural areas including through micro and mini grids, refrigeration / lighting at health centres, electrification of schools, water pumps, irrigation systems, and telecommunication centres.

The range of products and services offered and prices charged will depend on the project developers (Public Authority) who will make decisions based on a mix of criteria including analysis of end-user needs, land use planning, provision of basic services, available funding, methodology for tariff calculations, political objectives and willingness and capacity of end-users to pay for a service.

Government programmes can either be of a (i) cross-sectoral nature wherein the energy needs of households, commercial activities, the health, education, water, agriculture and telecommunication sectors are all addressed in a holistic manner typically through an energy service model, or (ii) more modular approach wherein for example the programme only focuses on the energy needs of the education sector or water pumping.

PV micro and/or mini-grids will in most cases take the form of a service model (or fee for service) wherein an energy service provider will own (and/or maintain) the system and provide an energy service to end-users across a range of sectors (residential, commercial activities and public services) for a periodic fee. The energy service provider will in most cases be regulated by government and awarded monopoly status for specific geographic regions. The main alternative to regulated energy-service concession is an open-market approach without regulation (see Figure 1), which occurs for example in the Dominican Republic. The service provider model is a relatively novel approach and much is to be learned by doing.

Such cross-sectoral programmes tend to be more complicated to set-up at the onset in that co-ordination and a level of transparency between all the agents involved including the appropriate Ministries (Health, Water, Energy, Education, Telecommunications, etc.) is a prerequisite for long-term success.

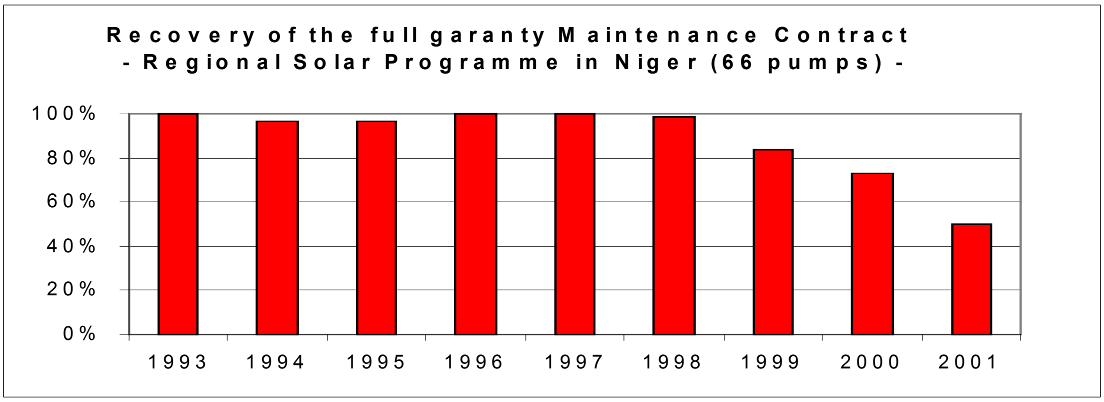
Significant numbers of PV systems have been deployed via more modular Government led programmes (for example: PV for water pumping, PV for refrigeration for the health sector, PV for lighting in schools etc.). World-wide experience has shown that in many cases insufficient budgets and attention has been allocated to maintenance and renewal of equipment, resulting in high failure rates. The project design should also ensure that such programmes be ‘Quality driven’ rather than ‘Quota driven’, i.e. the main performance indicator should relate to the quality of installations rather than to the number of systems installed. Refer to the case study titled “PV Electrification of Rural Schools in South Africa” on page 53 in the Task 9 document “16 Case Studies on the Deployment of Photovoltaic Technologies in Developing Countries”.

The problems associated with institutional and organizational aspects in such modular programmes can also arise after the “project phase” is completed and when there is no longer outside support, Box 1 illustrates one such example where problems were encountered 5 years post project start.

Box 1: Regional Solar Pumping programme in Niger

Figure 2, from the Regional Solar Pumping programme in Niger (funded by the European Commission), illustrates that from 1999, representing 5 years post project start date, payments for the maintenance contract by end-users experienced a significant shortfall jeopardising the continued supply of drinking water. This reduction in payments were attributed to the following factors:

- An increased number of system breakdowns;
- The "Project Management Unit" phase in the project came to an end and no long-term plan had been made as to who would take on the responsibilities assigned to the overall management ;
- The annual maintenance contract cost rose by almost 200% in order to factor in the exhaustion of the stock of spare parts provided on a grant basis during the project phase. This increase led to a doubling of the price of water.



Although all stages of a project development are crucial, whether the programme is cross sectoral or modular in its target, it is the "post installation stage" that is critical to the long-term sustainable operation of the system (Figure 4). The post-installation phase is the stage during which the various institutional and management schemes must operate independently from the presence of a project unit and any subsidies. The effectiveness of the management system put in place is only validated with time.

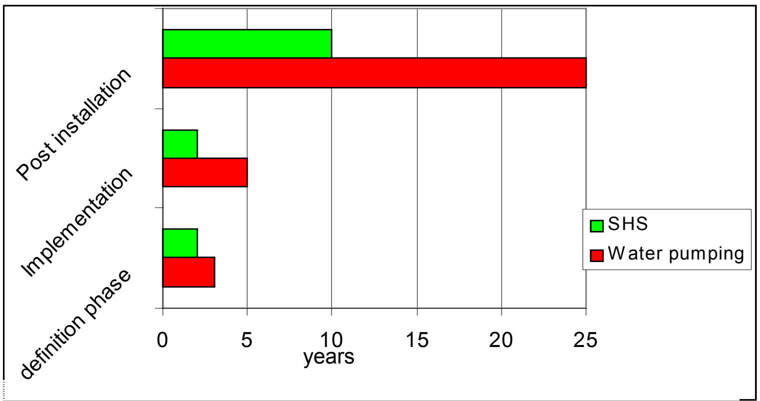


Figure 3: Duration of each programme phase [Ref. 2]

An effective institutional framework is required to help a programmes' long-term success.

It is therefore recommended that during the planning or design stage of a rural electrification / development programme the planners spend sufficient time in identifying the full range of activities (otherwise termed fundamental functions) that must be carried out during and after the programme execution and identify the actors (or otherwise termed as Agents) that will be needed to carry out each of these activities. The planners will in addition need to define the types of relationships that will exist between these different agents to ensure that each agent is fully aware of his/her role and responsibility. A working contract or, where relevant, a code of conduct will need to be defined between each of these agents.

3 Institutional Infrastructure Framework

The institutional framework will vary depending on the deployment approach adopted. For a direct sales model the institutional framework should aim to ensure quality throughout the delivery chain, that information is readily available to end-users so that they can make informed choices, that after-sales services are available and that financing mechanisms are set in place so as to attract a wider range of potential end-users. Direct sales will imply an overall weaker institutional framework to allow for the development of natural market forces.

Government led rural electrification and development programmes on the other hand will require a stronger institutional framework and capacity building activities at all levels. It should be noted that special attention will need to be placed so as to ensure that government incentives will not stifle the market growth of PV direct sales.

The institutional framework described in this chapter will have to be tailored and adopted to local conditions and the deployment approaches adopted.

The main fundamental functions that need to be taken into account when creating an institutional framework for PV deployment *per se* can be grouped into five categories:

1. **End-User Education.**
2. **Regulation and Planning.**
3. **Installation and Maintenance.**
4. **Operation and Use.**
5. **Facilitation of Implementation.**

Figure 4, illustrates the above functions and how these relate to each other. End-user education engulfs all stages of the system.

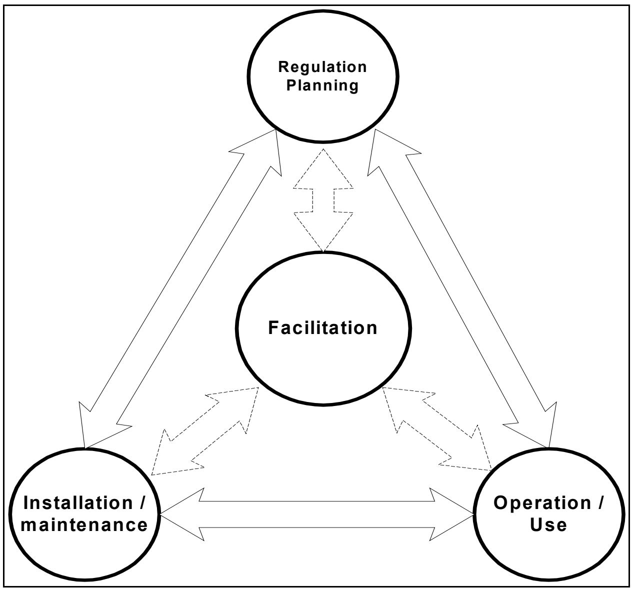


Figure 4 : Main Fundamental Functions [Ref: 2]

Whilst the agents that are needed to fulfil each of the defined functions are defined in Table 1.

Table 1: Fundamental Functions and the Agents Needed

Fundamental Function:	**Agent:**
1. End-User Education	Service Provider and/or Public Authority.
2. Regulation and Planning	Public Authority and also possibly an independent body contracted by the Public Authority to carry out regulatory functions which includes evaluation and feedback.
3. Installation and Maintenance	Energy Service Provider (private, public, local, NGO, …). The service provider will provide a service over an agreed period of time and geographic region.
4. Operation and Use	End-users federated in a form of loose or tight end-user association (cooperative, local council, etc.).
5. Facilitation of Implementation	A private entity needs to be contracted by the regulator or the public authority, with or without delegation of some regulatory responsibility; the function can also be carried out by staff from the regulation office itself. The objective of this function is to oversee and ensure that the programme develops as smoothly as possible.

Each agent will have to assume a share of responsibility and risk within the system and in exchange must receive returns and rewards. Tariff and payment modalities will have to be designed to ensure that adequate returns are provided to all concerned yet remain affordable (refer to Appendix II for a note on Tariff calculations). Payments must be sufficient to ensure sustainability of operations as well as maintain the continued motivation of the agents; these criteria determine the level of tariffs and charges needed, given what end-users can afford and the level of public funds available to pay for investments.

The agents need to work in collaboration and assist in developing a fair policy environment, sufficient human capital (particularly local dealers, developers and technicians) and adequate investment capital to nurture a healthy PV industry. Figure 5 illustrates the relationship between each fundamental function and agent. Figure 5 acts as a figurative summary of the institutional framework described. The fundamental functions and the agents responsible for these functions are described in more detail in sections 3.1 to 3.4.

The development of this framework is a new area and much is in the nature of learning by doing. Allocating sufficient time for the formulation of the contracted relationships is essential to ensure local ownership (a key to project success). This approach will need to be adjusted and adapted depending on the local context and a large amount of capacity building at all levels will be required. A programme can be successful only if every part of the institutional framework is functioning properly : if one part is weak, the entire programme may fail.

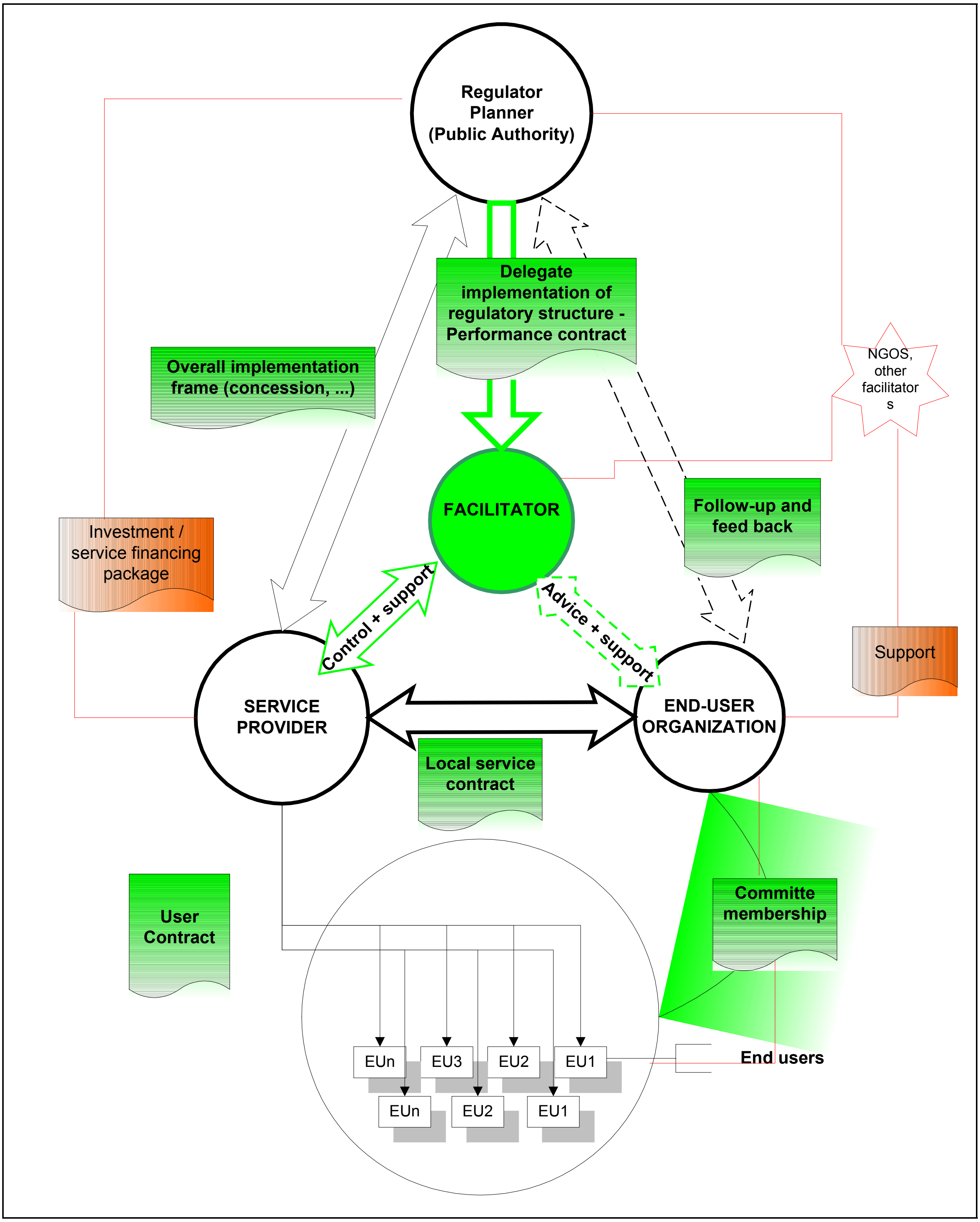


Figure 5: Functions, Agents and Relationships

3.1 The Public Authority

The Public Authority must demonstrate a commitment to rural electrification – integrating all technical options (both on and off-grid) including PV and remove explicit and implicit subsidies in order to guarantee sound market conditions.

Intervention efforts by a Public Authority also includes financial matters such as subsidies, tariffs, domestic taxes, value added taxes, regulations of the utility grid connection and standards and safety and quality. The Public Authority can also be a sound source of investment in research and development and in the establishment of product manufacturers and producers.

There is a strong case for subsidy to support rural electrification and/or rural public services (drinking water facilities, lighting for administrative, education, health centres, refrigeration etc.), governments will need to assess whether the state should provide these services or should create incentives for the private sector to do so.

3.1.1 The Planning Function

National electricity sectors have been structured, generally, around interconnected electrical supply networks[3] to capture the economies of scale inherent to this technology. However, this very capital intensive model has proven its limitations in financially constrained contexts and particularly in countries with very low rates of electrification. To increase public access ratios to modern forms of energy the current system must evolve. It is the role of the public authority to facilitate this evolution towards integration of all technical options, while incorporating least-cost planning and leveraging of funding sources.

The role of energy in addressing poverty reduction is the subject of much study[4], work, and initiatives, and it is in this context that energy planners need to apply their effort. The Global Village Energy Partnership (GVEP) (Secretariat assured by ESMAP) ([5]), the European Union Energy Initiative for Poverty Eradication and Sustainable Development, and Poverty Reduction Strategy Papers (PRSPs) at the country level have clear pointers to this (see Box 2).

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[3] It should be noted that this has been the preferred approach to energy planning in developing countries. This differs from developed countries who have, in time, evolved to this approach – in that at the beginning initial electrification started off with micro grids and slowly evolved to national grids. In industrialized countries stand-almone/ micro grids are reputed as having been the starting point to development whilst stand-alone systems/mini-grids are usually associated as "second class" in developing countries.

[4] For further information on the contribution of renewable energy technologies to the MDGs the paper "Energy for the Poor : Underpinning the Millennium Development Goals" (August 2002) published by the Department for International Development (DFID) can be downloaded from the following web site: http://enpov.aeat.com/ENPOV/pdf/DFID2web.pdf

[5] Information can be found on the energy poverty linkage on the ESMAP and GVEP web sites (see references).

Box 2: Some extracts from PRSPs

"The lack of electricity supply affects household welfare directly, and also indirectly, in that lack of guaranteed electricity is a major disincentive for the development of business in the regions" [pp.26 State Programme on Poverty Reduction and Economic Development 2003-2005, Republic of Azerbaijan]

The lack of reliable energy supplies is considered a major problem by the rural population. It limits employment opportunities and limits opportunities for investment. [pp.15 State Programme on Poverty Reduction and Economic Development 2003-2005, Republic of Azerbaijan]

The dynamics of rural electrification and rural employment creation should be maximized to generate alternative incomes for the poor. [pp.99 national poverty Reduction strategy, 2003 – 2005 Kingdom of Cambodia]

The need to secure future energy supplies is recognised as critical to sustained economic growth and development. All necessary steps will be taken to ensure the availability of energy to boost industrial growth and production. The provision of electricity is essential for developing communication technology in the rural areas and establishes, where they exist, more reliable electronic communications access including Internet access. This will facilitate the expansion of local and regional markets and help in both job and wealth creation. Further, it will allow for the extension of basic services such as the provision of telephone and support productive enterprises. [pp.105 Ghana Poverty Reduction Strategy, 2003-2005. An agenda for growth and prosperity]

The use of ecologically pure non-traditional and renewable energy sources would provide remote areas with electric and thermal power, and to restore village infrastructure (schools, clubs, bathhouses). [pp.76 Comprehensive Development Framework of the Kyrgyz Republic to 2010 Expanding The Country's Capacities]

Electricity is also an essential input to improved social services and mass-communication through television. [pp.59 Malawi Poverty Reduction Strategy Paper April 2002

In the rural areas, where the incidence of poverty is greatest, electrification not only makes it possible to respond to the energy demand for vital needs such as dewatering and drainage, irrigation, conservation, processing of agricultural products and creation of SMEs/SMIs, but also to raise the population's living standards. Development in synergy of rural electrification in conjunction with sanitation and water supply will thus be a priority. [pp.34 Poverty Reduction Strategy Paper 2002, Republic of Senegal]

It is recognised that access to energy is necessary for development to occur but access itself is not sufficient : energy planning needs to be integrated within the development plans of a country, region or community and across sectors : agriculture, water, education, enterprise, agriculture and health. Some countries, for example South Africa and Namibia, have already integrated such energy cross-sectoral policies.

The role of the public authority in planning for rural electrification should include the following elements :

- Develop a coherent strategy for the energy sector, based on the availability of resources and the co-ordination, as far as possible, with plans in other sectors. Establish a means for collecting relevant socio-economic, geographic, and resource data, in unserved areas.
- Increase access to modern and commercial energy in rural areas, and ensure economic efficiency in supplying and utilising energy at affordable prices.
- Establish the technical option approach (grid extension, mini grids, off grid) to be used to electrify unserved areas and co-ordinate plans with grid extension planning. The Public Authority should ensure that electrification plans are clearly defined and accessible so that end users and/or investors know where the grid will be extended and where it will stop so that they can plan accordingly.
- Establish the funding modalities – mix of national and foreign funds, level of subsidy required, etc. It is the role of the Public Authority to take care of the good use of the public

funds intended for rural electrification, through a mechanism of transparent and professional allocation of resources.
- Ensuring that rural electrification project staff are technically competent and that projects are implemented in accordance with the appropriate standards.
- Defining the framework for the private sector.
- Reduce pressure on wood fuel through use of improved equipment and alternative fuel sources.

The tasks of the public authority can extend to drafting electricity laws and possibly accompanying decrees and reduction of taxes and custom duties on PV modules and components if considered relevant by the national authorities.

3.1.2 The Regulatory Function

The regulator should ideally be an independent (public) entity in charge of the power sector in general and never specific to rural electrification, renewables or PV. Regulation is a function that brings balance to the complex and formalised relationships between the agents involved in providing the energy services and must not be considered as natural, nor automatic.

In most national contexts, the regulatory framework and rules have yet to emerge and be formulated[6], particularly for services in rural areas. The responsibility of this body should lie in the formulation, monitoring and enforcement of an integrated and optimised energy service supply framework. Regulation will also consist of technical and financial supervision. The responsibilities of the regulator should encompass:

- Establishing the legal and regulatory framework, monopoly organization or not, defining the scope and roles of the private sector (concessions, franchises, services, etc.) and their related contractual frameworks which would define amongst others the service obligations, time frame, remuneration structure, etc.
- The enforcement of the above – which implies the power to revoke contracts or impose penalty payments.
- Establishing the guidelines for the tariff structure and ensuring that there is consistency in the method in which tariffs are calculated.
- Ensuring customer protection in terms of tariffs and discrimination between geographical locations.
- Institutionalisation of the necessary arbitration mechanisms to resolve disputes between agents.
- Ensuring adequate earnings so that service providers can develop and expand in accordance with end-user demand.
- Ensuring that environmental standards are adhered too.
- Information dissemination to all stakeholders.
- Final contract formalisation.
- Defining the guidelines, rules and criteria for calculation and disbursement of subsidies.
- Monitoring the functioning of the system and guide remedial action when necessary.
- Ensuring quality control all along the delivery chain as illustrated in Figure 6. Refer also to the Task 9 document "*The Role of Quality Management, Hardware Quality and Accredited Training in PV Programmes in Developing Countries*".

[6] The following document should be referred to as an example of the regulatory frameworks adopted in a sectoral drinking water programme in Mali. : Programme Régional Solaire : Hydraulique villageoise et pompage solaire au service du développement durable dans du Sahel.

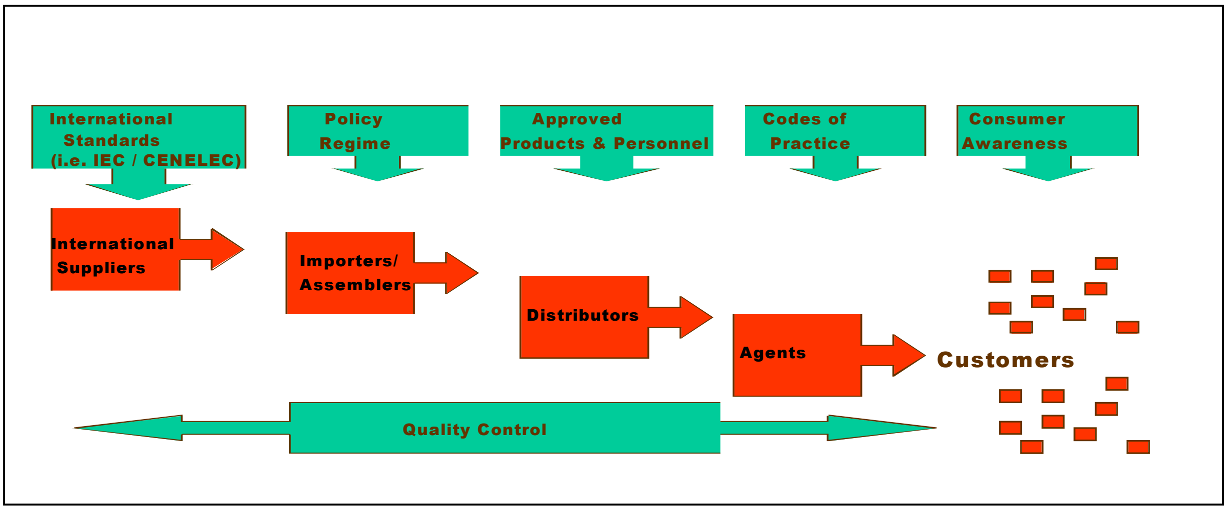

Figure 6 : Quality Control in the PV Delivery Chain

Some of the responsibilities of the regulator can be delegated to a "facilitator".

3.1.3 Information Dissemination and Capacity Building Function

The importance of information dissemination cannot be overemphasised. It is the responsibility of the Public Authority to make sure that un-biased information is disseminated and capacity building initiated as needed and at all levels of the delivery chain:

- End-users (individuals).
- End-user organizations.
- Installers, maintenance organizations and various service structures.
- Suppliers / system integrators.
- Financial intermediaries.
- Local institutions as relevant (municipalities, regions, …).
- National level institutions (Ministries, Agencies, …).

Energy is a cross cutting sectoral issue, relevant to many departments and disciplines (such as agriculture, resource planning, health, environment, telecommunications, etc). Links should be developed between ministries and departments to inform and disseminate knowledge regarding the use of PV systems – and its comparative advantages and drawbacks to other energy sources - in the delivery of power for services such as education and health, and in improving the performance of other sectors such as agriculture, water supply, etc. The power industries also need to consider and develop decentralised and sustainable options. Successful examples of cross sectoral applications of PV technology are the provision of community lighting, lighting and water pumping for rural communities, schools and hospitals, and the refrigeration of vaccines and medicines and sterilisation of surgical supplies and instruments in remote health centres. There is a need to develop awareness and build "energy expertise" into the various sector organizations and / or make specific expertise available into which the various sector organizations could tap into. Schools, universities and other educational institutions should be an integral part of this development.

Professionals and policy-makers across sectors, who presently do not think of themselves as being affected by the 'energy sector' should be informed about the role of energy in their work. Policy makers should be aware of the options available to them and the benefits obtained from PV systems.

Besides providing information to the operators on the proposed plans and frameworks being prepared and financial schemes, there is an essential upstream task in working with the financial community to adapt their conventional financing instruments in order to make them more appropriate and eligible for PV financing. Depending on government priorities and budget availabilities, some countries also offer preferential schemes for renewables including PV.

End-users will need to have unbiased information to make informed choices and understand the limitations about the services being offered so to avoid possible future frustrations. Only some of the target end-user groups will have used a form of credit, so leasing, group loans, and other potential financing mechanisms must all be explained, along with the advantages and disadvantages of each method. Hence, it is essential that the Public Authority set aside specific budgets and foster the formulation of information and training activities to ensure a framework for capacity building: the Task 9 document: *PV for Rural Electrification in Developing Countries – A Guide to Capacity Building Requirements* provides further information on this particular aspect.

3.2 The Service Provider - Installation and Maintenance Function

The service provider has as an objective to provide an energy service in return of a fee. They will act in accordance with both their own business imperatives, and the public's aspirations for better living conditions.

The required functions related to providing a service are wide ranging (depending on the contract negotiated for) and can include:

- Installation of the equipment.
- Collection of payments.
- Ensuring consumer satisfaction.
- Maintenance and ensuring the proper functioning of the equipment over time.
- Possibly ensuring equipment renewal and service expansion.

There is no hard and fast rule as to the nature of the service provider. More often than not, the main problem is the availability of structures with the appropriate level of skills, organization and financial strength. The energy service provider can be of a large variety of sizes and nature, for example:

- A utility (international or not).
- An equipment supplier / installer diversifying into the energy services business.
- Private investors.
- A end-user organization – cooperative, etc..
- A local not for profit organization, etc.

It is important that whoever decides to become an electricity service provider has an understanding of what it means to run a profitable business. Effort should be placed in training the service provider on all aspects (technical, administrative and managerial) that are required to run a business of this kind. Being a service provider can be a capital intensive activity requiring different levels of technical and managerial skills, depending on the nature of the obligations in the service contract, which may range from simple operation and management (O&M) services to a full concession, requiring fund mobilisation for service expansion to be covered. Hence, developing this business requires a long-term engagement. Agents will involve themselves to the extent justified by market size, viability, returns and risk.

3.2.1 Contractual Frameworks

The services' contract and its modalities have to be worked out and negotiated with the: (i) end-users at the local level which could be a municipality, a end-user organization and/or with the individual end-users wherein the terms and conditions of payment and of the service are defined and (ii) regulator - a variety of contractual frameworks with the regulator can be envisioned, from a global concession agreement (including responsibility for investment) managed by a single concessionaire (the service provider) who can then subcontract all, some or none of the functions; to a simple operating contract (ownership of the infrastructure remaining public).

The overall contractual framework will be guided by the legal and regulatory structure established by the regulator who will also monitor and control the system. In addition the exact split of functions between the service provider and the end-user organization can differ and will ultimately depend on the capability of the end-user organization.

Two basic (and extreme) contractual frameworks are described here: a **concession agreement** and an **operating contract**, representing two ends of the spectrum in terms of the financial risk taken by the operator and the related financing package required. The contractual framework will eventually be tailored to best suit the local conditions and priorities.

Concession agreement

The *concession agreement* covers the case where a third party (other than the state or local community) becomes responsible for the raising of funds, design and construction of equipment, installation, operation, maintenance, connection and billing for electricity services in a defined area. Generally, at least part of the renewal and expansion costs must be refinanced through the actual tariffs (see Appendix II).

A few principles of a concession agreement are [Ref: 1]:

- *The concession area* is defined ideally through a rural electrification planning process, with the concessionaire having progressive coverage obligations in terms of number of consumers served and geography; this has to be governed and monitored by a regulatory function (it should be noted that the service provider may also operate competitively without any explicit monopoly status);
- The *Term of the Concession* should match the expected technical life of the equipment, the obligation of the concessionaire is to leave the installation in a good condition at the end of the concession and thus to undertake the required investments during the term in order to meet this obligation.
- In terms of tariffs or more broadly *end-user fees*, the concession often fixes a ceiling fee, taking into account the indexation also included in the agreement. These levels must be approved by the regulator for the duration of the agreement, before the concession is signed. Another option is "cost plus" - an allowed return on investment. This option reduces the incentive to control costs and increases the responsibilities of the regulator. The regulator should ask for a cost breakdown and monitor it over time, in order to better understand the risk premium which has been incorporated.
- The essence of a concession contract in terms of *payment modalities* is that the concessionaire mobilises the funding for all the initial investment costs and is paid only when the services are provided. Concessionary finance –in various forms is made available: a number of new instruments are being developed to this effect as explained in Chapter 4.

It should also be noted that in the case where subsidies are available for energy service providers the design of the subsidy disbursement should be addressed in a separate agreement between the Public Authority and the concessionaire, called the Subsidy contract. Without being restrictive, the following issues should be addressed in the subsidy contract:

- The amounts and the objectives of the subsidy.
- The rights to the assets established or partly established through the subsidy.
- The conditions that the concessionaire must meet to qualify for the subsidy.
- The obligation by the government to provide the subsidy once the concessionaire has met the obligations.

The potential advantages of the concession approach are:

- Can attract larger, better organised private companies with their own sources of finance.
- Has the potential to serve a large number of customers in just a few years.
- Has the potential to reduce equipment costs (through volume discounts), transaction costs, and operation and maintenance costs (through economies of scale).
- Ensures service to customers over a long period of time.

Ultimately, the service provider will be interested in bidding for a concession agreement depending on :

- The size and financial viability of a given concession. This is particularly sensitive in the case of international investors who typically want to minimise the term of their risk exposure and want a premium towards the range of risks that they face (foreign exchange, political, etc.).
- Whether the requests for tenders contain clear, concise and reliable information and the means of evaluation are described, this is a key factor in building confidence and ensuring transparency.
- The availability of agents with appropriate skills and financial strength.
- The size of the contracts and the perceived risks, the most significant of which will relate to confidence in the regulatory system and the ability of end-users to pay.

Unfortunately, experience to date is disappointing in terms of private sector participation in rural electrification [Ref: 31].

The operating contract

In the *operating contract*, ownership of the equipment remains with the community. The service provider may be assigned with the responsibility for part of the work, such as the installation and major repairs with or without a framework maintenance contract. The capability and commitment of the community / local authority / utility to organise and operate will be a key consideration in the formulation of the contract details.

The *functions contained in such a contract* can vary from all services including production, operation, maintenance, connection, billing and recovery to a specific O&M contract shorter than the lifetime of the equipment. Often, in order to maximise end-user ownership it is desirable to involve the community in an appropriate organizational form responsible for the general upkeep and day-to-day repairs as well as billing. Ultimately, the allocation of responsibilities and contract length depends on the actual capabilities respectively of the community and the service provider.

Regarding the financial aspects, it is essential to clearly determine who is in charge of extension investments. The payment modalities will naturally depend on the functions that have to be conducted and whether or not an element of performance based payment can be negotiated: variable elements linked, for instance, to the number of clients and fixed elements for a global maintenance contract.

An operating contract involves little risk to the service provider.

3.2.2 Present Bottlenecks

The initial low product volume, combined with the difficulties of developing a consistent supplier-dealer chain, will result in high unit transaction costs that will continue to hinder the expansion of the market. When there is a lack of established high-volume supplier-dealer chains it is very difficult to successfully install and maintain the PV system market in very dispersed villages in the long lifetime of the system. Again the intervention of the public authority could be justified here in order to overcome such delivery problems.

Further, for the service provider, finding appropriately trained personnel may be a problem. In addition, the level of financial returns might also not be sufficient enough to attract interest. Overcoming some of these barriers requires funds, hence the importance of long term market viability and of a clear and transparent regulatory framework.

At the outset the cheapest option may seem to be operation by local communities, yet this still requires development of skills and the emergence of local companies and dealer networks. Though it is highly desirable that certain daily tasks be undertaken locally, this does not waive the need for training and supervision by a professional operator.

Attracting large service providers more often than not is low given the small unit project sizes. Project bundling by geographical area can be a key pathway to resolving this problem, and has shown to have the following benefits:

- Reduce O&M costs.
- Standardize O&M procedures.
- Facilitate the availability of spares.
- Possibility to access insurance schemes for extreme events.

Project bundling however does not reduce project development costs.

The difficulty of reducing risk levels, be they real or perceived, should not be underestimated, and some recent attempts in developing appropriate risk mitigation instruments are mentioned in Section 4.3, although there is little substitute for the need to demonstrate regulatory coherence and an ability for consumers to pay. However, some more extreme risks which are more difficult to resolve in contracts based on very small and growing systems could possibly be mitigated through insurance (typically theft, vandalism, payment default, etc.) [Ref: 1].

3.3 End-User Organizations– Operation and Use Function

End-user participation is an essential element to the sustainability of the system. In the case of PV, the end-user is in direct contact with the technology and hence his/her satisfaction must be considered as being the essential condition for the development of the service ([7]).

The end-user organization has contractual linkages with the electricity service provider, the regulator and the facilitator. The end-user organization can have a formal or informal structure depending on whether the service provider has:

- Individual contracts with the end-users (eg. in the case of individual SHS).
- A global contract with the organization representing end-users (in the case of the provision of a service).

[7] It is important to be aware that end-user load demand in excess of the capacity of the system (e.g., adding high-demand and resistive loads to a SHS), typically caused by the failure of the service provider to educate the customer about the system's use and limitations, is a common cause of system failure. In numerous countries (eg India and Morocco) high failure rates of systems for a variety of reasons have led to the creation of a very poor image of PV and resulted in very low confidence levels in the technology, hence reduced demand.

The exact role of the end-user organization will vary depending on the service contract chosen but it can play a variety of roles including:

- Provision of a vehicle- for- consultations during the setting-up of the scheme.
- Responsible for the billing administration, the collection of payments and dealing with defaults of payment.
- Operate and maintain the system.
- Protecting, with the help of the facilitator, the end-users interests versus the energy service company.
- Providing information and feedback to the public authority.
- Providing advice to the end-users and training (of its members).

The relationship with the public authority can be limited to feedback of field data or as strong as a delegation of authority, for example in the case where the “end-user organization” is a municipality. The latter depends on the countries decentralisation policies and to what degree these laws are implemented.

Ultimately, the allocation of responsibilities will depend on the actual capabilities of the end-user organization.

3.4 The Facilitation of Implementation Function & the role of NGOs

The hands-on involvement of the facilitator in providing advice and support, that can also be formalised in a paying contract, is essential to avoid too much of an imbalance in the contractual negotiations (problems associated with the “principal – agent” issue, wherein one partner is very dominant over the other given his higher level of information and of technical skills).

NGOs with a strong local base and in depth understanding of local circumstances can often be extremely useful and can be contracted by the facilitator and / or the public authority, to provide back-up and support in structuring and formulating an end-user organization. NGOs can serve the needs of the local communities by playing several distinct roles including :

- When the said NGOs are independent bodies: identifying demand in rural areas during the programme preparation phase, training and awareness building or monitoring the activities of operators and financiers.
- The end-users in the community can organise themselves in the form of an NGO, guaranteeing credit or cash sales for group lending, acting as an independent operator of the system.

3.4.1 Roles and Responsibilities

The Facilitator has an important role in the negotiation phase of the programme to ensure transparency between agents, oversee the drafting of the contracts, act as mediator between the different parties, and provide support, particularly managerial, where and when needed. The facilitator has an important role in guiding the service provider who are often new to these kinds of contracts.

The facilitator ensures that discussions take place between the agents during the programme planning /design stage, hence has a crucial role in ensuring that all parties operate fairly between each other and that all agents understand their rights and obligations.

By gathering, exploiting and distributing information to all parties, the facilitator will ensure a degree of balance in the system. It is the conduit for lessons learned and feedback to the public authority to ensure that projects and programmes use latest best practices. The effectiveness of the facilitator will be enhanced if it is locally based as this will give it the valuable understanding of local interfaces.

The functions delegated to the facilitator can include:

- Full role of a regulatory structure.
- A "lighter role" as intermediary and capacity builder.
- Development and provision of tools needed by the service provider and consumer.
- Setting standards, developing contracts, enforcing and adapting them.
- Collecting data and providing feedback to the public authority to ensure that projects and programmes use latest best practices.

By nature, the facilitator can be a private sector based organization or at the other end of the spectrum, a full public sector agency. As illustrated in Figure 5, the facilitator is central in its contractual relationships between agents. The two key contracts which determine, on the one hand its mandate and powers and on the other its responsibilities are:

- "Delegation of authority" from the Public authority to whom the facilitator is accountable.
- Advice, facilitation, control versus the service provider and consumer.

As also shown in Figure 5, local institutions and / or NGOs are potentially key facilitators and may also play a major role in service provision; every effort should be made to identify such competent and experienced organizations in energy, community development or rural finance which are essential in facilitating intermediation.

4 Financial Instruments

A significant proportion of the investment capital for PV projects in developing countries has been provided by multilateral and development banks and bilateral agencies through host governments. Bilateral institutions, in particular, have been active in providing training for PV system installers, project staff for designing and administrating PV programmes and PV equipment for demonstration projects. Bilateral and multilateral institutions often take steps that they hope will make PV projects financially sustainable.

4.1 Mix of Financial Instruments

It must be underlined that there is more support towards renewable energy in developing countries out of national budgets than is generally assumed. Moreover, the level of support and the budgets allocated are rising fast. National financing takes not only the form of soft loans or subsidies, but also that of foregoing public revenue from taxes (eg accelerated depreciation, revenues from investments in renewable energy, waiving of import duties, etc.).

India :
India is an example of a country where many incentives are in place: preferential buy back rates, investment subsidies, tax incentives, a specific Ministry, etc. This has actually led to a situation where there is too much of a bias towards renewable energy to the detriment in some cases of economic viability.

The Table in Appendix III presents a review of some national programmes in Developing Countries, extracted from the G8 Renewable Energy Task Force (2001). For further information on financing mechanisms refer to "*Sources of Financing for PV Based Rural Electrification in Developing Countries*" a Task 9 document.

Developing and financing PV and Rural Electrification programmes of any significant size is likely to require combining multiple sources of financing. Loans (including subsidies or not), grants and equity can take various forms, including:

- Official Development Assistance, whether bilateral or multilateral requires a public sector intermediary; the foreign assistance typically contains a 30% grant element – whether in the form of interest rate subsidies, providing grace periods or extending the repayment term; however, the conditions in which the foreign assistance is on lent from the central ministry of finance to the project or rural investment is a matter of national decision.
- National concessionary finance or subsidy funds are made available from various sources (such funds are increasingly being developed – financed typically through kWh sale levies for rural electrification in general).
- National and foreign exchange commercial loans - the level of interest rates, grace period and loan terms will depend on the credit worthiness of the borrower, the perception of risk and availability of mitigation instruments.
- Private investment (service providers) - mobilisation of national and foreign equity will be needed and the level of returns required will depend on the perception of risk.
- Community investment – from the end-users, local structures, formal or informal institutions and NGOs.

The sources of financing used will depend on each specific programme and the particular Governments' institutional framework. Finance in any country will depend on a number of issues including:

- General financial sector policies and the legal environment (interest rate restrictions, government mandates and financial contract enforcement).
- Financial sector regulation and supervision.

- Economic and social policy (economic stability, poverty levels and government policies).
- Renewable energy policy, if it exists.

Figure 7 provides an overview of the multitude sources of finance that can be tapped. For further information on financing sources, the IEA PVPS Task 9 document "*Sources of Financing for PV Based Rural Electrification in Developing Countries"* on funding sources should be consulted.

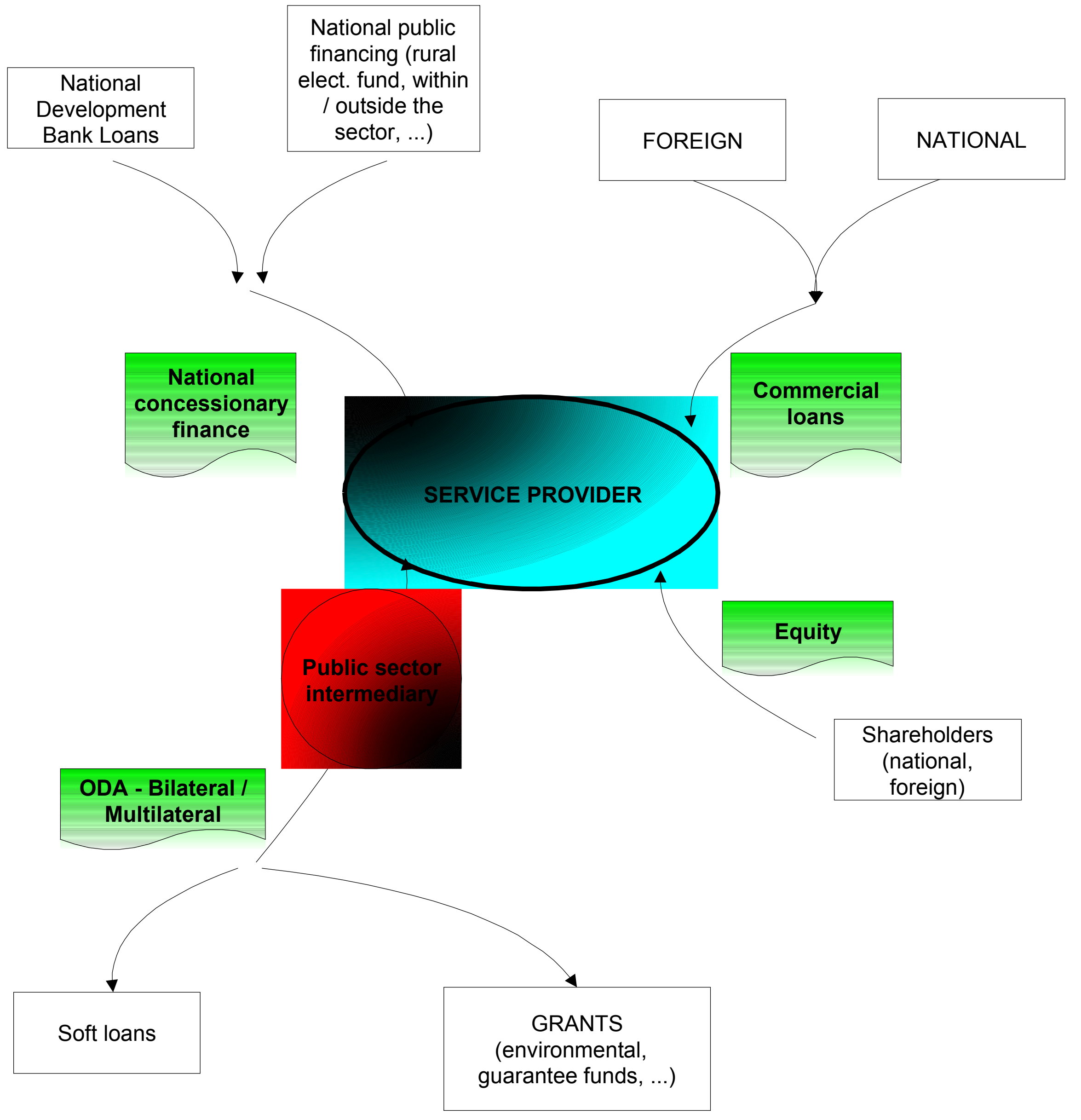

Figure 7 : Example of a Financing Framework for Rural Electrification Programme

4.2 Necessary Subsidising of Rural Infrastructure Investment

It is clearly recognised that the cost of rural electrification in general and even more so for basic services and the poorer rural people cannot be covered through charges alone (refer to Appendix II on tariffs). Without subsidies there is little potential business in remote areas.

However, poorly targeted subsidies have often failed to meet their stated objectives of making services more affordable to the poorest. Cost effectiveness should be sought, meaning that the subsidy needs to achieve social goals at the lowest programme cost while providing incentives to businesses to serve poor and rural populations. Experience shows that subsidies should be directed at encouraging access to services rather than subsidising the operating costs of providing the services. The chief concern over subsidies relate to their use, the methods in which they are set-up and their impact on existing PV markets and competition.

The sources of these subsidy funds come essentially from national sources, and to a certain extent from international sources – earmarked for development, in general, or also for the environment. Clearly, the GEF has, over the past decade, been the key element in the renewed interest for renewable energy for rural development and solar PV in Developing Countries in particular [Ref 30].

Throughout the world, rural electrification has been substantially subsidised, at least regarding investment costs. A share of the financial responsibility has to be born by the Governments themselves and the modalities through which the required funds will be raised, level of subsidies calculated and subsequently disbursed need to be specifically worked out.

Investment subsidies to rural electrification projects have two main roles in Rural Electrification strategies:

- One is to increase the connection rates. By reducing the financial cost, which the utility must recover through its tariff revenue, the average tariff is reduced. This improves affordability. The impact of the subsidy on the connection rate is maximized if - as a condition for receiving the subsidy - investors are required to use the subsidy revenue to reduce the fixed monthly tariffs and connection charges for lifeline consumers. Inserting this obligation in the subsidy contract links the subsidy for an “input” to the achievement of a specific “output”.

- The other main function is to facilitate “financial closure”: to get the financing package (equity + loans + subsidies + consumer contributions) for a project in place. An upfront investment subsidy[8] reduces the required equity contribution and the size of the investment loan. The “upfront investment subsidy” is important for small local project developers. Thus, if the objective is to facilitate locally based investors, the upfront investment subsidy is an important tool. If the objective is to attract larger, professional investors into rural electrification, it may be more appropriate to pay the investment subsidy as an annuity payment during operation.

4.2.1 Supply or Demand-Side Subsidies

In general, demand side subsidies work better than supply side subsidies because they provide stronger incentives for expanding coverage and sustaining services.

- *Supply-side subsidies* – for example to the supplier of equipment are easier to implement but should generally be avoided because they often poorly target intended recipients and the outcomes are not linked to accountability for service delivery. They can lead to raising costs above what they would otherwise be. They often diverge from encouraging service provision to only focussing on the purchase

Supply-Side Subsidies:
Peru:
In Peru, for example, a village without electricity was selected to receive household PV systems which involved 100% subsidies. After several years, a return visit to the village revealed that many households had sold their systems.
India:
Similarly, many PV programmes in India encouraged manufacturers to produce for the government subsidy rather than for the market.

8 The subsidy is paid according to registered progress in construction, with the last payment falling shortly after commissioning.

of equipment. This is an especially important problem for renewable energy, since most of the cost of the service reflects the capital cost of the systems themselves.

- *Demand side subsidies* are disbursed to the service provider upon achievement of service coverage targets. A retailer, or Energy Service Company (ESCo) deploys the system through a fee-based service arrangement to recover the costs, repay the loan, and earn a profit. The approach ensures significant local involvement and consumer choice. The key to this model is a local business that develops a plan to provide electricity service. However, there always is the risk that the service provider will not live up to its contractual responsibilities.

Demand-Side Subsidies:

Argentina:

A concession model, which was tested in Argentina, is providing franchise rights for rural service territories to concessionaires that offer the lowest subsidy to service rural households and community centres. Users pay a connection tariff and a monthly service fee (set by the government) and a declining subsidy is provided to the concessionaires based on the provisions of their contract. The concession model attempts to address the problem of low business potential in remote rural areas by firstly allocating subsidies to the businesses that meet the criteria for serving off-grid markets, and minimizing them through competitive bidding for rights to the concession; and secondly assuring demand in terms of schools and other government facilities, which can be important in the development of commercial strategies for off grid rural areas government subsidy rather than for the market.

4.2.2 Output-Based Aid (OBA)

Subsidies in capital works have failed to produce a sustained flow of reliable services, and the subsidised financing of service providers has failed to translate into improved access by the poorest. In view of this, significant efforts have been made in the recent past to link the payment of subsidies to the outputs or results actually delivered. One such example is Output Based Aid (OBA) developed by the World Bank (WB) group, which links the provision of subsidies to performance: it ties *payment* to *outputs* or *services* actually delivered. Payments may replace or complement user-fees, possibly funded from taxes or donors, including WB loans or grants. The financial flows and the possible financial framework is given in Figures 8 and 9. Work on the design and implementation of output-based aid schemes is in its early stages.

Subsidies can be directed to new connections: for example, expanding coverage obligations[9] under concessions of existing systems or supporting the development of isolated systems using small-scale providers. When directed to consumption, they have to be time-bound to facilitate orderly transition to full cost-covering tariffs or exceptionally can be ongoing for targeted groups who cannot afford full cost [Ref: 10].

[9] i.e. a set increase in the number of connections over a set period of time.

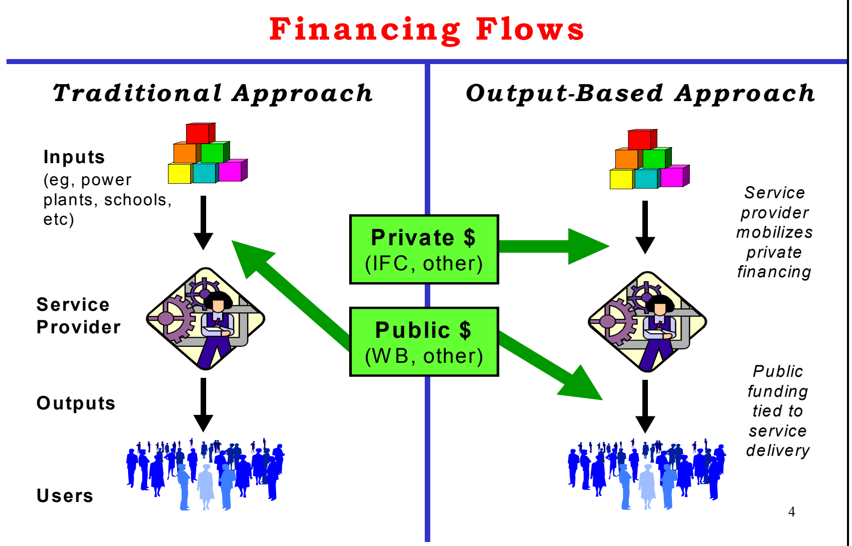

Figure 8 : Financial Flows – OBA
[Ref: 10]

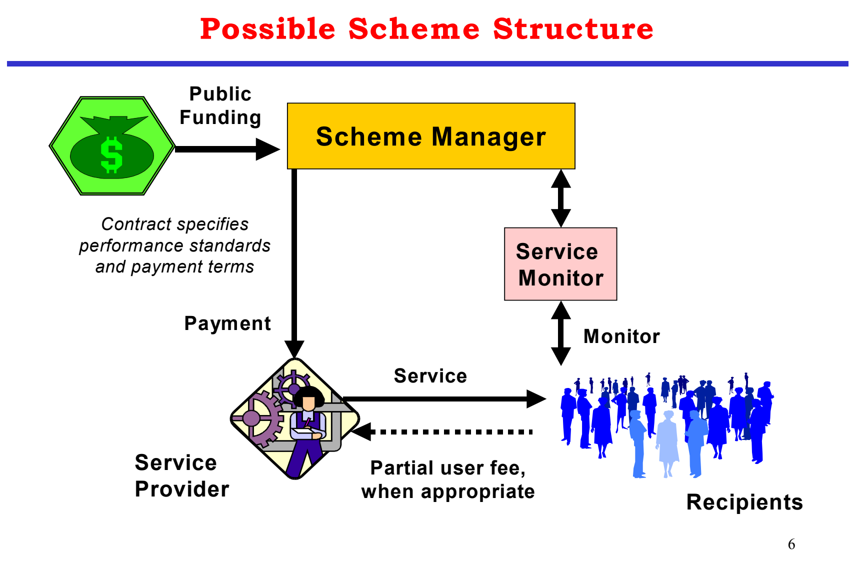

Figure 9 : Possible Financial Framework
[Ref: 10]

4.3 Soft Loans

Another route for applying the subsidy element for infrastructure investments which are by their very nature not financially viable in commercial conditions, is through the terms and conditions of the loans: interest rate subsidies, term of the loan, and grace period. The "subsidy element" is the grant equivalent of these preferential terms when compared to market conditions. For further information on Soft Loans refer to "*Sources of Financing for PV Based Rural Electrification in Developing Countries*" a Task 9 document.

In today's context, there is much controversy on "distorting market conditions" and the preferred option is towards providing an initial grant on the investment rather than offering easier conditions than what is commercially available.

4.4 Mobilising the Private Sector : Risk Perception and Coverage

Private sector institutional investment in PV projects or enterprises in developing countries tp date has been minimal. Private institutional investors tend to view PV projects as too small and too risky. The emergence of a service provider, as highlighted in Section 3.2., will strongly depend on their perception and analysis of risk. But as more projects/services are proven to be successful the perceived risk will also diminish, attracting more investors in to the market.

Aversion of investors or of the financial community at large leads to situations where the cost of finance for the borrower increases, especially in the case of emerging countries. The development of guarantee mechanisms is required in a context where there is a rising aversion to various types of risks:

- *Sovereign risks* can be covered by various bilateral guarantee agencies and at the multilateral level, by Multilateral Investment Guarantee Agency (MIGA) of the World Bank group. In the context of privatisation of the power sector however, the idea is that it has to be private sector led and that National Governments should not provide sovereign guarantees.

- The *commercial risk* in general (default, financial viability, …) is all the more closely scrutinised, leading to situations where the investors and the financial community in general want higher returns and shorter payback periods, which in turn pushes the price of the service up, often beyond the affordability of the clients. New approaches offer counter guarantees on debt servicing which provide the possibility of lengthening the term of loans, which in turn has a direct impact on the cost of power service. This in turn leads to situations where the private insurance market is affected.

Existing instruments for infrastructure financing in this context have to evolve. The World Bank and IFC are, in this context, promoting *partial risk guarantee and partial credit guarantee schemes*, to encourage private sector banks and investors to accept higher risk levels and longer term exposures.

Partial risk coverage can, for instance, be designed to cover the risk of the service provider defaulting on debt service, such as in the case of the Azito Integrated Gas Combined Cycles (IGCC) in the Ivory Coast, as shown in Figure 10.

For projects of a smaller size, with different types of agents, a form of project bundling, wherein a single partial credit risk guarantee could cover a series of projects has also been envisioned, which would go a long way to encourage "large" investors / service providers to get involved in a series of clustered rural electrification projects. These approaches are currently being developed in a number of situations for rural electrification In a number of GEF projects under preparation.

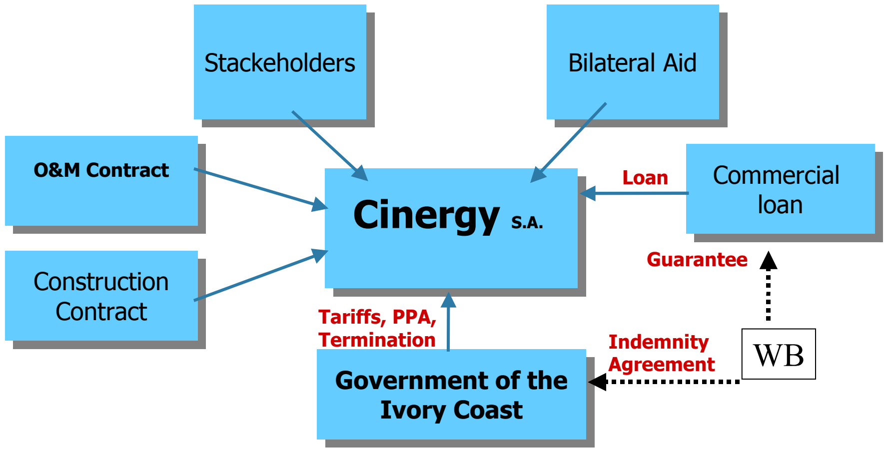

Figure 10 : Partial Guarantee of Risk
[Ref: 9]

Partial risk guarantees can play a particularly important role in emerging markets with little track record. For example in the case of private sector led rural electrification approaches where sectors are undergoing reform, projects present high risk levels and are strongly dependent on sovereign guarantees.

Typically, the following types of risk can be covered by a partial risk guarantee:

- Refusal to accept an increase in tariffs as described in the escalation clause in the contract.
- Public Authority / Regulator interference in a dispute settlement.
- Impossibility of foreign exchange transfer through controls or non availability of foreign exchange.

Figure 11 gives indications as to the impact of risk guarantees (provided by the World Bank) on the contributions of finance made available to emerging countries, in terms of lower interest rates and longer term commitments.

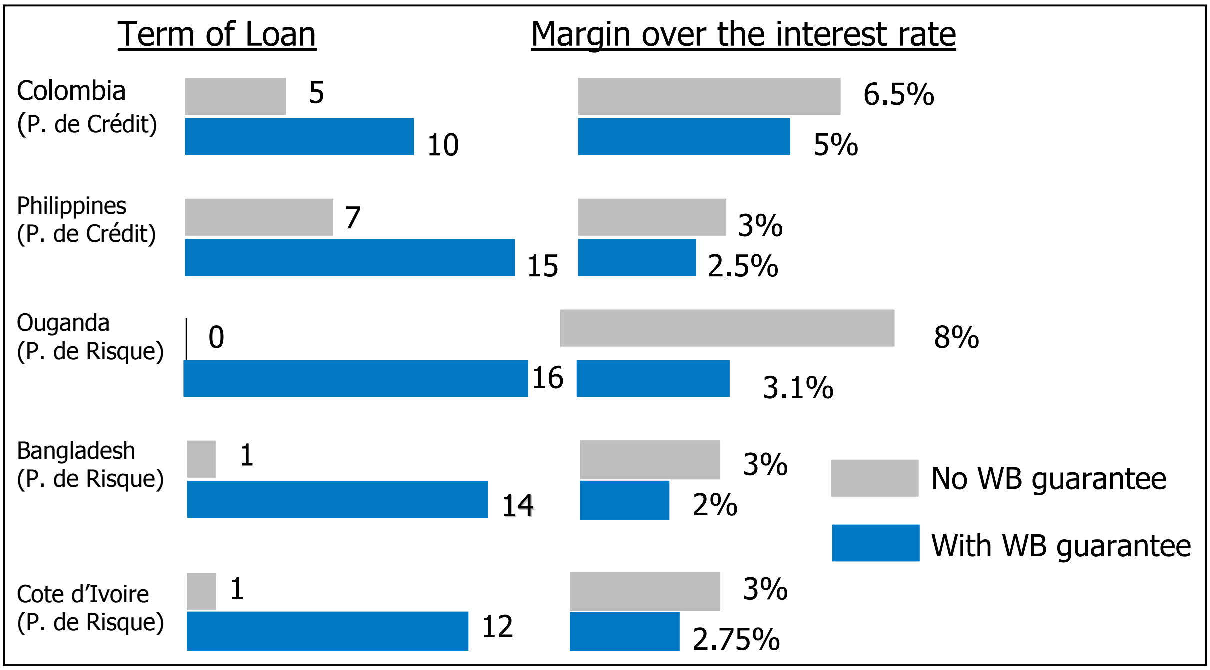

Figure 11 : Partial Contribution of Risk Guarantees **[Ref: 9]**

5 Conclusion

It should not be forgotten that all forms of electricity generation require financial resources, management, operational and management structures and an overall framework that ensures that only power systems of high quality are installed / available on the market – the case for rural electrification, and PV, is not any different.

The establishment of a long-term sustainable rural electrification market in developing countries depends on a number of key factors that include:

- The commitment that the Public Authority demonstrates to rural electrification and poverty alleviation.
- Once a level playing field where all technical options can fairly compete with eachother so as to allow for real best-cost solutions to be integrated in a programme.
- Once an institutional (and financial) framework is established that on one side addresses the fundamental functions, the agents that are needed to perform the functions and the types of relationships that need to exist between each agent and on the other that finance is lodged to ensure that the realization of the programme is possible.
- The level of participation (including financial) seeked from the beneficiary community.
- Once end-users have access to affordable services and they can make informed choices.
- Once a viable business opportunity for service providers is given and where risks are minimized as much as possible.
- Once the system is sufficiently regulated to ensure that tariffs are affordable and justified and quality is maintained at all stages of the delivery chain.
- Once skills are built throughout the delivery chain.

Planners will need to spend sufficient time at the onset of a rural electrification / development programme to identify the full “mechanics” of the framework – that is its functions, agents, responsibilities, relationships, contracts, financial packages etc. as described above. Energy planners can also decide to adopt a learning by doing attitude towards the institutional framework formulation.

This document strives to describe the roles and responsibilities of the agents, the level of transparency and collaboration needed and the actions required to be carried out from programme planning to post-programme phase. Table 2 on page 32 summarises such roles and responsibilities per agent. The document also describes the range of financial mechanisms/sources that can be accessed, however this argument is more fully discussed in the Task 9 document titled “*Sources of Financing for PV Based Rural Electrification in Developing Countries”.*

Table 2: Summary of Functions, Agents, Roles and Contracts Needed

Fundamental Functions:	Agent:	Range of Responsibilities:	Contracts
Planning	Public Authority	▪ Integration of all technical options ▪ Development of a coherent strategy for the energy sector based on availability of resources ▪ Co-ordination, as far as possible, with plans in other sectors ▪ Co-ordinate plans with grid extension activities ▪ Ensure a level playing field between options ▪ Establish a means for collecting relevant socio-economic, geographic, and resource data, in unserved areas ▪ Define the methodology for programme implementation ▪ Establish the funding modalities ▪ Ensure that rural electrification project staff are technically competent ▪ Define the framework and type of role for the private sector ▪ Drafting electricity laws and possibly accompanying decrees and reduction of taxes and custom duties on PV modules and components ▪ Planning and liasing with other Ministries and Agencies. ▪ Ensure that un-biased information is disseminated and capacity building initiated as needed and at all levels of the delivery chain	
Regulation	Public Authority and/or possibly an independent body contracted by the Public Authority. The “regulator” per se, must be an independent (public) structure: it is essential to avoid conflicts of interest that it not be set within or related to a Ministry, incorporated within a rural electrification agency, de facto within the utility, etc	▪ Formulation of an integrated and optimised energy service supply framework ▪ Monitor the functioning of the framework and to guide remedial action when necessary ▪ Define the scope and roles of the private sector (concessions, franchises, services, etc.) and their related contractual frameworks ▪ Enforcement– which implies the power to revoke contracts or impose penalty payments. ▪ Ensure customer protection in terms of tariffs and discrimination between geographical locations. ▪ Ensure adequate earnings so that service providers can develop and expand in accordance with consumer demand; ▪ Ensure that environmental standards are adhered too. ▪ Define guidelines, rules and criteria for calculation and disbursement of subsidies. ▪ Ensure regulation, standards and quality	- Public Authority contract with an independent regulator - Global concession agreement or a simple operating contract with the service provider - Contract with end-user Association
Installation & Maintenance	Service Provider (private, public, local, NGO, …)	Activities will depend on the contract but can include: ▪ Raising of funds, ▪ Design and construction of equipment, ▪ Installation, ▪ Operation & maintenance, ▪ Connection and billing ▪ Ensuring consumer satisfaction ▪ Ensuring equipment renewal and service expansion.	- Service contract with the representative organization of the customers - Global concession agreement or a simple operating contract with the client and regulator

Operation & Use	End-users federated in a form of loose or tight end-user association (cooperative, local council, etc.)	Depending on the model selected a end-user association will : ▪ Provide a vehicle- for- consultations during the setting-up of the scheme. ▪ Protect, with the help of the facilitator, the end-users interests versus the energy service company. ▪ Provide information and feedback to the public authority. ▪ Provide advice to the end-users and training (of its members). ▪ Represent the sole client of the energy service company, the association will then be responsible for the collections of payments from the individual end-users.	- service contract with service provider - relationship with the public authority can be limited to feedback of field data or as strong as a delegation of authority - with the facilitator relationship can be formalised in a paying contract
Facilitation	A private entity needs to be contracted by the regulator or the public authority, with or without delegation of some regulatory responsibility; the function can also be carried out by staff from the regulation office itself. (NGOs, local institutions, regulator)	The functions delegated to the facilitator can include: ▪ Full role of a regulatory structure. ▪ A "lighter role" as intermediary and capacity builder. ▪ Development and provision of tools needed by the service provider and consumer. ▪ Setting standards, developing contracts, enforcing and adapting them. ▪ Collecting data and providing feedback to the public authority to ensure that projects and programmes use latest best practices. ▪ Provide advice and support ▪ Ensure that discussions take place between the agents during the programme planning /design stage ▪ Ensure that the contracts are transparent and well thought through between service provider and end-users ▪ Gather, exploit and distribute information to all parties ▪ Ensure that all agents understand their rights and obligations. ▪ Oversee the drafting of the contracts, and provide support, particularly managerial, where and when needed. ▪ Help define the role of the local community: administer billing, collect payment and deal with defaults of payment; operate and maintain and / or have the capability of dealing with a contractor.	- Delegation of authority" from the Public authority to whom the facilitator is accountable - Advice, facilitation, control versus the service provider and consumer

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APPENDIX II - NOTE ON TARIFFS

In establishing the tariff framework, a few principles and objectives should be kept in mind:

- The price should cover maintenance, operating and supervision costs, also depreciation;
- Match the purchasing power of the target users in order to achieve a sufficiently high rate of penetration. In many rural socio-economics contexts in developing countries, this objective is incompatible with the above without a subsidy. The subsidy must be limited to facilitating access to the service and must not be given under the maintenance, management and supervision headings, with the exception of an indirect subsidy (for example, a tax exemption).
- Simplicity: although the cost analysis underlying the setting of the price is complex, the pricing itself must be simple in order to provide an easily understandable message for the users. It must also be adapted to local contexts: in the case of the Regional Solar Programme (drinking water supply in the Sahel region, funded by the EC), water sold using solar pumped water can be priced per family, per person, per bucket, per litre, etc.

The following table provides an example of the cost analysis and related pricing structure of a SHS project in Mauritania (Project run by ADER (Agence de Electrification Rurale) and financed by the French Aid Agency
(AFD))

SHS 20Wp	Full guarantee maintenance contract for 15 years except for light bulbs		
	Tariff1 USD/month	Tariff2 USD/month	Tariff3 USD/month
Subsidy on the Investment (buy down)	**0%**	**50%**	**100%**
Depreciation and renewal			
Depreciation and renewal	1,99	1,02	0,00
Warranty	0,49	0,49	0,49
Sub total 1	*2,48*	*1,51*	*0,49*
Maintenance			
Preventive Maintenance	0,49	0,49	0,49
Repairs	0,24	0,24	0,24
Spare parts	1,94	1,74	1,74
Sub total 2	*2,68*	*2,68*	*2,68*
Operation			
Recovery and control agent	0,72	0,72	0,72
Energy cooperative	0,24	0,24	0,24
Sub total 3	*0,97*	*0,97*	*0,97*
Supervision			
ADER			
Contribution to the fixed costs	0,00	0,00	0,00
Costs directly link to SHS project	0,49	0,49	0,49
Sub total 4	*0,49*	*0,49*	*0,49*
TOTAL- Net of Tax	**6,61**	**5,64**	**4,62**
PROPOSED	**6,59**	**5,70**	**4,58**

APPENDIX III - OVERVIEW OF DEVELOPING COUNTRY NATIONAL DEVELOPMENT PLANS

It should be noted that this list serves as an overall overview of national development plans – this is not a complete list and was compiled in 2001 by G8 Renewable Energy Task force Report, 2001. Task 9 does not take on the responsibility for the contents of this table [Ref: 36].

Country	**RE Plan** (national, regional, timeframe)	**Targets** (installed capacity, people served, rate, by technology, by energy source) *from official sources*	**Targets** *from other sources*	**Incentive mechanisms for implementation** (tax credits, subsidies, etc.)	**Status** (adopted in parliament, national /state level legislation, announced, or seriously considered)	**Assistance** needed from G 8 to implement – investment, capacity building, etc.
Argentina	National / World Bank and GEF Renewable Energy in the rural market		Supply electricity to 66,000 households with SHS, size 50-400 Wp, 1,100 public facilities with PV-systems and 3,500 with hybrid systems	RE market subsidised by government, World bank and GEF		
Bangladesh *(8)*	National Rural Electrification Board and Micro finance institutes using GOB funds and loan from WB & IFC.	Biogas plants 600. 850 SHS Installed by REB and 2000 by Grameen Shakti	Additional SHS service to 16000 households by 2005. Market of 0.5 Million households eligible to use SHS.	Tax exemptions for RE equipment import, investment depreciation favourable	Renewable Energy Policy by the Government is under review for the Sixth Five Year Plan.	Access to international financing will be needed with suitable financing mechanisms.
Bolivia *(9)*	National rural electrification PRONER		Number of new connections 1998-2001: small hydro: 25,000 , PV / wind: 49,000 Investment costs (incl. Grid extension) $103 m		PRONER serves as frame of reference for the Investment Program	
Brazil	National rural by 2005 CEPEL		PV - 50 MW Wind – 1 GW Solar thermal – 3 M m^2 Small hydro – 2.5 GW *(2)*		RE being considered in regulatory proposals for reformed electricity sector PRODEEM created by Presidential Decree *(2)*	Access to international financing and participation of international companies (esp. bagasse co-generation) *(2)*

Country	**RE Plan** (national, regional, timeframe)	**Targets** (installed capacity, people served, rate, by technology, by energy source) *from official sources*	**Targets** *from other sources*	**Incentive mechanisms for implementation** (tax credits, subsidies, etc.)	**Status** (adopted in parliament, national /state level legislation, announced, or seriously considered)	**Assistance** needed from G 8 to implement – investment, capacity building, etc.
China	National Plan (Tenth 5-year plan to 2005)	Targets for 2005: Solar PV: 53 MW; Solar water heater: 64 million m^2; Wind farm: 1500 MW; Off-grid wind turbine- 35 MW; High temperature geothermal generation: 45 MW; *(11)* Middle/low geothermal space heating: 14-15 million m^2; Installed biomass gasification and generation :80 MW; Tidal and wave energy: 2 MW installed capacity (per year) *Source: report of national plan*	Targets for 2010: PV 174 MW (about 28 counties 10,000 townships 1,000 islands w/o electricity); 2.7 billion m^3 biogas; 50 MW tidal power; Small hydro 32.5 GW; Wind 4,900 MW; 13.4 m hectares fuel wood plantation0 Biomass electricity about 300 MW; The total volume of utilization of NRE will increase to 390 million tons of standard coal *Sources: National Plan 1996 –2010, (11), (2)* Proposed 5% renewables as share of annual investment in power generation[10] *(7)*	Competitive solicitation for wind farm concession and PPA, Development of standards, Demonstration projects, RE electrifica-tion program for Western Provinces includes subsidies *(2), (10)*	Interim targets achieved by year 2000: Small Hydro 23.5 GW Wind 344 MW Solar PV 16.5 MW *(11)* Biomass electricity 50MW Standard for improved stoves adopted *(2)*	Investment, assistance in project development and implementation *(6)*
Guatemala	National		Depends on IPPs	Proposed tax exemptions for local inputs, imports (inc expertise), initial operation	State level legislation to be announced *(2)*	Planning a Centre of Information for Renewable Energy and a Fund (with IADB and Winrock help) *(2)*

[10] Annual power increments are running 20,000 MW, so this would be 1000 MW/year, or $1 bil./year (7)

Country	**RE Plan** (national, regional, timeframe)	**Targets** (installed capacity, people served, rate, by technology, by energy source) *from official sources*	**Targets** *from other sources*	**Incentive mechanisms for implementation** (tax credits, subsidies, etc.)	**Status** (adopted in parliament, national /state level legislation, announced, or seriously considered)	**Assistance** needed from G 8 to implement – investment, capacity building, etc.
India	National within 5 year plans (current one to 2002) State level targets and implementation	Improved stoves (>20% efficiency) 120Mpotential 33M achieved @ 3M/yr Family biogas 12M pot., 3.1 M achieved 180k/yr Solar 150 MW by 2002 PV pumps @ 2,000/yr SHS @ 100k/yr -> 0.5 million by 2002 Lanterns @ 200k/yr Wind 120 GW potential, 1267 MW achieved, 1800 MW under discussion Small hydro 10GW pot., 1550 MW achieved Bagasse co-gen 3500 MW,273MW achieved *(2), (1) referring to the Ninth 5-year plan*	Proposed 10% renewables as share of annual investment in power generation[11] *(3)*	Tax concessions such as equipment duties and investment depreciation Subsidies (interest and capital) drive the progs for each technology type. Soft loans available through the Indian Renewable Energy Development Agency (IREDA)	Dedicated Ministry for Non-Conventional Energy Sources (MNES) Interim targets written into national economic development 5-year plans *(2)*	MNES might welcome assistance to accelerate progress towards their long term potential targets
Indonesia	No explicit plan for RE State utility (PLN) accepts proven grid-connected RE technologies		RE most likely option for 6,000 of the villages still to be electrified - Small hydro 60 MW - PV SHS 2M (potential) - Wind 1.4 MW - Bagasse co-gen 100MW *(2)*	Policy to permit IPPs Small Power Purchase Tariffs Low interest loans and credits to help rural consumers get connected		Several donor funded energy projects are already under implementation or in preparation *(2)*
Malaysia			Likely to introduce RE for the 7% of rural households still without electricity *(2)*	Incentives for companies utilising biomass: Income tax exemption of 70%, import duty & sales tax exemption *(12)*		

[11] Annual power increments are running 10,000 MW, so this would be 500 MW/year, or $0.5 bil./year (7)

Country	**RE Plan** (national, regional, timeframe)	**Targets** (installed capacity, people served, rate, by technology, by energy source) *from official sources*	**Targets** *from other sources*	**Incentive mechanisms for implementation** (tax credits, subsidies, etc.)	**Status** (adopted in parliament, national /state level legislation, announced, or seriously considered)	**Assistance** needed from G 8 to implement – investment, capacity building, etc.
Mexico	National RE-based rural electrification plan PRONASOL		Only geothermal considered to be mainstream 335 MW additional geothermal plants under construction *(1)*	Financial support for RE		
Morocco	Government Electrification program PERG		Provide power to almost all households by 2010 through grid extension 80-85% and RE solutions Wind actually 50 MW, planned 200 MW *(1)*		PERG-program for off-grid – Solar Home Systems, Wind, Biomass and small hydro - launched in 2000 *(1)*	
Nigeria	National Rural electrification plan Target of additional 52 million people served		Rural electrification plan / currently 40 % have access, aiming for 85% by 2010, in off-grid regions mainly by Solar		Not adopted by now	
Philippines	National 2000 – 2009 Energy Resources for the Alleviation of Poverty(ERAP)		By 2009: (MMBFOE) Hydro: 19.55 Geothermal: 24.80 NRE: -fuelwood: 49.48 -bagasse: 13.33 -charcoal: 5.33 -agriwaste: 22.05 -others: 2.13 Overall NRE 15% of all electricity by 2025 1,400 communities by decentralised NRE by 2004 (was 2008) *(2)*	Tax exemptions for power generation facilities that do not utilise petroleum fuels (e.g. on imported kit and spare parts) US$30M allocated as a financial facility for private sector participation in NRE projects	Department of Energy, Non-Conventional Energy Division runs NRE programme National Electrification Administration - Alternative Energy Division delivers rural electrification projects *(2)*	Improved climate for investment in renewable energy by eliminating the market-distorting effects of tied aid & donor-driven projects with unsustainable subsidies. The ERAP Program would require at least US$300M, so the Government requests assistance to achieve its target. *(2)*

Country	**RE Plan** (national, regional, timeframe)	**Targets** (installed capacity, people served, rate, by technology, by energy source) *from official sources*	**Targets** *from other sources*	**Incentive mechanisms for implementation** (tax credits, subsidies, etc.)	**Status** (adopted in parliament, national /state level legislation, announced, or seriously considered)	**Assistance** needed from G 8 to implement – investment, capacity building, etc.
South Africa	No specific policy for RE, although mentioned in Energy Policy White Paper 1998		PV targets for 1995-99 met 1.5 million households served by SHS within 10 years 12 Industry proposed target for Wind 7-10% of electricity by 2020 *(2)*	Innovative approaches to reducing the risks to financial institutions "need to be exploited"	Future targets being negotiated, based on funding availability	Standards and codes of practice, based on international practice and adapted for South African conditions and cost efficiency requirements. *(2)*
Sri Lanka	World Bank / GEF		"Energy service delivery project" will electrify 32,000 rural customers with SHS, mini-hydro and wind *(4)*			
Uganda	National (Rural Electrification Strategy and Plan), World Bank, GEF, GTZ (policy) *(10)*	To achieve for the year 2010 a rural electrification rate of 10% (400,000 new consumers including 20% PV) *(10)*	Rural electrification by development of renewable energy sources, including solar PV, biomass, mini-hydro, wind and geothermal with target of 70 MW *(5)*	The World Bank Energy for Rural Transformation (ERT) project with a GEF component will provide subsidies on investment costs Presently, exoneration on RE equipment And sales on a commercial basis *(10)*	Strategy approved by Cabinet in 02/2001 ERT/AFRREI programme in preparation; GEF component approved by GEF council in May 2000 Implementation in mid-2001 *(10)*	GoU and World Bank are looking for other contribution to finance the ERT programme *(10)*
Vietnam	*No specific policy for RE*		National rural electrification program of Vietnam to electrify 90% of rural households by 2005, 10% (175 - 300,000 households) likely by RE *(2), (5)*		In 2000 71% of rural households electrified *(2)*	

12 This means 50% of the potential

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