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Rural Energy Services

Best Practices

Nexant

Revised May 2002

RURAL ENERGY SERVICES

BEST PRACTICES

Prepared for

United States Agency for International Development

Under

South Asia Regional Initiative for Energy

Lalith Gunaratne
NEXANT SARI/Energy

Revised May 2002

List of Acronyms

ADB	Asian Development Bank
ADB/N	Agricultural Development Bank of Nepal
APERC	Andhra Pradesh Electricity Regulatory Commission
BREB	Bangladesh Rural Electrification Board
BPDP	Bangladesh Power Development Board
CEA	Central Environment Program
CBOs	Community Based Organizations
CEB	Ceylon Electricity Board
CEO	Chief Executive Officer
ESAP	Energy Sector Assistance Project
ECS	Electricity Consumer Society
ESD	Energy Services Delivery
GS	Grameen Shakti
ITDG	Intermediate Technology Development Group
IPP	Independent Power Producer
IREDA	India Renewable Energy Development Authority
LAN	Local Area Networks
MIS	Management Information System
MFI	Micro Financing Institution
MNES	Ministry of Non-Conventional Energy Resources
NEA	Nepal Electricity Authority
NGO	Non-Governmental Organization
NRECA	National Rural Electric Cooperative Association
PTA	Performance Target Agreement
PBS	Palli Bidyut Samities
PVMTI	Photovoltaic Market Transformation Initiative
PV	Photovoltaic
RKM	Ramakrishna Mission
RECS	Rural Electric Co operative Society
REB	Rural Electrification Board
REDP	Rural Energy Development Program
Rs	Rupees
SARI/Energy	South Asia Regional Initiative/Energy
SAARC	South Asia Association for Regional Cooperation
SEB	State Electricity Boards
SEEDS	Sarvodaya Economic Enterprises Development Society
USAID	United States Agency for International Development
UNDP	United Nations Development Program
WB	World Bank
WEC	World Energy Council
WBREDA	West Bengal Renewable Energy Development Agency

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Executive Summary

Introduction

The rural electricity market is very complex in South Asia. This is due to fact that the traditional model of utility-based centralized grid extension cannot cover the entire population for demographic and economic reasons. To some extent the gap in providing rural electrification has been filled by the private sector, non-governmental organizations and cooperatives that have successfully developed alternative models with decentralized technologies like solar PV, micro hydro systems and rural grid extension. Other technologies such as wind, biomass and biogas also have a role to play in providing rural electrification. These are demand driven, customer centered and more sustainable. The rural electric cooperative approaches in Bangladesh and India are a variation of the utility grid model where the difference is having the rural communities participate actively in the process.

However, these initiatives have only served a small minority of the rural population of South Asia. For example, 18,000 villages in India and 2 million households in Sri Lanka yet do not have access to electricity. Similarly, close to 70% people in Bangladesh and about 82% of the Nepal's population also do not have access to electricity.

Rural Electrification Scenario

Based on the in-depth study and analysis, grid-connected rural electricity distribution and off-grid integrated rural supply systems have been found to be the most successful and sustainable systems.

It is also evident that off-grid decentralized systems using solar PV, off-grid centralized systems with micro hydro and grid connected delivery services, such as that of the Bangladesh Rural Electrification Board and the Rural Electric Cooperative Societies in India, have a role to play in the South Asian rural electricity sector.

Various rural electrification approaches and prevailing models in India, Bangladesh, Nepal and Sri Lanka are tabulated as below.

Rural Electrification Approach	Relevant Models in South Asia
1. Central Grid based Rural Electricity Distribution Systems	▪ Bangladesh Rural Electrification Board ▪ Rural Electric Cooperative Societies in India ▪ Private sector utilities such as NOIDA Power Company in India ▪ Lamjung Electricity Association ▪ State Electricity Boards in India ▪ Ceylon Electricity Board (CEB) ▪ Nepal Electricity Authority (NEA) ▪ Bangladesh Power Development Board (BPDP)

2. Central Grid based Rural Electricity Generation	▪ Mini Hydro IPPs selling power to NEA (Nepal), CEB (Sri Lanka) ▪ Diesel power IPP selling to REB (Bangladesh) ▪ Sugar Co-generators in India
3. Off-Grid Centralized Rural Electricity Supply Systems	▪ Pico and Micro Hydro in Nepal ▪ Micro (Village) Hydro mini grid schemes in Sri Lanka and Nepal ▪ Solar PV and Biomass Mini Grids operated in Sundurbans by West Bengal (WBREDA) state government, India
4. Off-Grid Decentralized Rural Electricity Supply	▪ Solar PV private sector/NGO initiatives in India, Bangladesh, Nepal and Sri Lanka ▪ REB (Bangladesh)/private sector installing Solar PV systems in off-grid areas

Key Recommendations

From the rural energy practices, currently operating in the region, the following best practices is recommended to be considered for further developments to sustain or replicate in other countries of the region:

1. Grid-connected rural electricity supply, based on Bangladesh Rural electrification model.
2. Off-Grid centralized electricity supply, based on Micro Hydro mini grid systems in Sri Lanka & Nepal.
3. Off-Gird decentralized electricity supply, based on Solar PV systems operating in Sri Lanka and Bangladesh.

Challenges Ahead

Some of the major challenges documented that are likely to be faced during the effective implementation of the rural energy services can be outlined as below:

- The rural population is dispersed in remote areas. Due to this, providing centralized services maybe difficult and costly
- The relatively higher costs of decentralized technologies such as solar PV
- The transaction costs of providing services to rural areas is high resulting in higher prices
- The poor affordability as many rural people live in poverty due to low-level of economic activity

Section 1 Background

This report complements the activity, ***"Rural Energy Services – Legal and Regulatory Review"*** and studies best practices in rural electrification programs developed and successfully operating in the South Asia region. The review examines programs in Bangladesh, India, Nepal and Sri Lanka.

As a part of the review, a field mission was undertaken to examine the operations of the Rural Electrification Board/Palli Bidyut Samities and Grameen Shakti in Bangladesh, the West Bengal Renewable Energy Development Authority's Chottomollkhali Island Gasifier Power Plant and the Ramakrishna Mission's Solar PV Program based in Kolkata. Meetings were also held with various government agencies, non-governmental organizations, financing institutions, and research and private sector organizations based in New Delhi and Kolkata. The study also relies on the author's intimate knowledge and understanding of the private sector driven solar PV program, micro (village) hydro developments as well as of the general energy sector in Sri Lanka. In addition, inputs from Nexant's consultant engaged in preparing the ***"Rural Energy Services – Legal and Regulatory Review"*** that examines rural electric cooperatives in Andhra Pradesh (India) as well as Nepal's micro and mini hydro developments, complement the work of this author.

Over **50%** of South Asia's rural areas still do not have access to the grid. Most countries of the region have been aggressive in trying to electrify rural areas in the last two decades. These efforts have brought the level of the rural population without access to electricity down from **80%** to the current level of **50%**. However, in many countries because of the economics of rural electrification and the financial constraints faced by the national/state –owned utilities, this effort is expected to slow down considerably.

Rural electrification has been traditionally supply driven. A combination of factors motivates governments to extend the grid, even if it is at a higher cost than other infrastructure projects and/or social programs. First among these other factors is the need to raise the general standard of living in rural areas as a part of meeting overall economic development objectives. Rural grid extension is also politically motivated, as rural populations have made electrification a powerful tool of leverage for obtaining their votes. However, many rural electrification programs are not financially viable for utilities. When electricity demand assessments should be typically based on the size of the community and use a national standard consumption pattern for each household, they are ignored in favor of political and/or social reasons. When non-economic factors drive the supply of rural electrification, the costs to the country can be very high as the return on investments are often not enough to cover the full cost of supply/operation by the respective utility. This has resulted in the slowing down of utility-based grid extension programs in the region.

Starting over a decade ago, this gap in rural electrification requirements has been met through a demand-led process, driven essentially by entrepreneurs and non-governmental organizations. The large number of local battery charging centers and battery based 12-Volt lighting and television systems have thrived in South Asia as a result. These are commercial market led operations. Many initiatives have developed from this base. Rural populations have proven their ability to take the steps needed to invest and move away from usage of the traditional kerosene lamp.

This and other demand led initiatives have evolved into a participatory style of development where the rural consumers, with the inherent knowledge they have of their needs, capabilities and limitations, participate in project development from the consultative phase, through assessment and analysis, to project design, and finally to implementation and management.

The organizational approaches to rural energy supply studied in this review have been essentially demand led activities, which require different levels of participation from the beneficiary.

The Study has mainly identified the following three organizational approaches to rural energy practices in the South Asia:

- Central Grid based Electricity Distribution Systems
- Off-Grid Centralized Rural Electricity Supply Systems
- Off-Grid Decentralized Rural Electricity Supply Systems

Based on these experiences, this study will focus on the grid-connected rural electricity distribution and off-grid centralized & decentralized rural supply systems. During the last decade these models have emerged as most successful and sustainable one.

Specifically, the study examines the off-grid decentralized systems using solar PV, off-grid centralized systems with micro hydro and bio-mass, and grid connected delivery services, such as that of the Bangladesh Rural Electrification Board and the Rural Electric Cooperative Societies in India.

The study also attempts to put technology in perspective where it is treated as a means of getting energy services to the people. Often, technology becomes the centerpiece of an analysis. This study will attempt to look at rural energy dissemination approaches from the point of view of the end-user or the customer and the people who deliver the service. The centerpiece of this analysis is the benefit people get from the kind of energy services they receive. However, due to the various economic and demographic constraints different approaches have been developed to deliver energy services by a variety of promoters in rural South Asia. In addition to Government's initiatives, it is seen that the private sectors have also been actively promoting the rural electrification by developing commercial markets on their own with technologies like solar PV. Non-governmental organizations with rural social networking capabilities have promoted off-grid micro hydro (known as village hydro). However, it is also interesting to note that governments in the region have introduced off-grid technologies through pilot demonstration projects

over two decades ago, but many of these projects have not been followed through. Nevertheless, there has been some government intervention in the alternative approaches.

India has been most proactive in looking at alternative approaches and the special ministry for non-conventional energy sources is proof of that. The study also examines the area of public - private partnerships that is required in order that the customer's risk in obtaining electricity services, through whichever approach or technology, is minimized.

As such, technology cannot be ignored in a study like this; therefore, it will be used in a manner to illustrate the best practices in this study.

Section 2 Objective of the Study

The objective of this study is to examine the various organizational approaches and identify best practices in rural electrification from an institutional, technical, marketing, financing and human resources point of view. Success and the sustainability of these programs have resulted from a combination of factors; prime among them has been the focus on customer satisfaction.

Success stories are not confined to any one type of organization. Government (utilities), non-governmental organizations and the private sector have all developed successful models in rural electrification. As such, it is now timely to examine the various approaches and to try to develop and present some coherent, consistent and rational policies that will enable a mix of approaches that lead to a holistic framework and/or model for rural electrification. A sound legal and regulatory framework is a key success factor, not to create more bureaucratic blocks for facilitators and customers, but to protect them as markets grow, as well, to attract mainstream investors into an area that has largely been ignored so far. The ultimate aim is to provide opportunities to rural people to improve their quality of life.

Increased mobility and communications have exposed rural populations to the levels of service offered to inhabitants in urban areas. This has created higher expectations when it comes to quality of service. This change in attitude has also resulted in rural electrification becoming a key political issue in South Asia in the last two decades. As such, the business of providing rural electrification, given the economic constraints central governments are facing to extend the electricity grid to the entire population, is a complex process.

Some of the factors that complicate the process are:

- different organizational approaches adopted as identified above
- host of technologies providing different levels of service are available (12 Volt DC to 230 V AC power)
- differing levels of user involvement are required (from maintaining and managing own system to just paying the bill at the end of the month)

All this requires a variety of delivery mechanisms and people with special talents, skills and knowledge in technical, management, marketing, financing, human resources and leadership areas.

To promote understanding of the approaches to rural electricity supply in South Asia as a means of addressing rural economic development, SARI/Energy, under its Technical Assistance component has identified two rural energy activities: ***Identification of Best Practices*** **&** ***Legal & Regulatory Review***. This report addresses the first activity.

The Objectives of the ***Rural Energy Services - Best Practices Study*** are to:

- Understand the South Asia rural electricity supply situation
- Identify various organizational approaches to rural electricity supply in South Asia
- Examine three successful and sustainable approaches to rural electrification in South Asia (off-grid decentralized systems using solar PV, off-grid centralized systems and grid-connected delivery services)
- Study the organizational structures and operational procedures of each and determine how they provide a quality service to customers. Factors to be looked at include;

    - management and the institutional structure
    - handling the technology
    - marketing of the service
    - human resources, leadership and motivation of its people
    - accounting and finance
    - accountability and discipline
    - relationships with external stakeholders and partners
    - legal and regulatory aspects

- Examine the replicability of these models in the other South Asian countries

Under the SARI/Energy Rural Energy Services component, supply of all forms of commercial energy required for sustained rural economic development is considered important. When considering the existing practices in rural energy supply in South Asia, in practical terms, this means rural electricity supply. With the possible exception of special rural subsidies for petroleum fuels, particularly kerosene, electricity supply represents the only commercial energy form that has induced a variety of approaches through non-governmental organization, private sector and government initiatives. The study will also not look at bio-fuels for cooking, for instance, as it has a marginal impact in the rural energy sector, even though there are concerns such as health and deforestation. Electrification has the potential to impact rural economies the most. Therefore, the review objectives have been framed in terms of rural electricity supply.

Governments in South Asia have set ambitious targets for national electrification levels as has been tabulated in the Executive Summary of this report.

Table 2-1 Projected National Plan Electrification Levels

Nation	Projected Level Of National Electricity Grid – Percent	Projected Completion Date
Bangladesh	85	2020
India	100	2007
Nepal	30	2020
Sri Lanka	90	2010

Source: F. Karlson, Consultant, Nexant-SARI/ Energy

Given the shortage of generation capacity for instance, in India and Sri Lanka, it would be difficult to achieve these targets in the conventional manner. However, government policy documents in South Asia, except India, do not presently acknowledge the role of off-grid technologies and renewable energy.

For instance in Sri Lanka, the National Planning Department's Plans for the Future in rural electrification only mentions grid extension, when 20,000 off-grid electricity users already exist in the country.

Therefore, the ultimate aim is to encourage governments in South Asia to accept non-conventional approaches to electrification as a part of the mainstream energy mix.

Section 3 Summary of the Three Models

3.1 Central Grid Based Rural Electrification

The governments in South Asia have increased rural electrification levels from less than **10%** to about **30%** in the last decade. Government owned utilities have done this with donor funds. However, a combination of politicization, mismanagement, and corruption, compounded by the high cost of rural electrification has left most of these utilities bankrupt. Therefore, the ultimate losers have been the rural customer who is plagued with poor service and the national economy that suffers from the poor utilization of funds with no tangible benefit. It is generally accepted that among the benefits of rural electrification are a rise in the standard/quality of living, economic and commercial development in rural areas, and greater success with poverty alleviation efforts. However, a good quality of service is essential for these purposes.

The Government of Bangladesh established the Rural Electrification Board (REB) of Bangladesh with support from a USAID funded initiative where the National Rural Electric Cooperative (NRECA) International has played the role of consultant from the concept stage. NRECA continues to be a partner in the project in addition to the many other international donors. Therefore, the project itself has created 67 rural electric cooperatives known as Palli Bidyut Samities (PBS).

A PBS is formed as a rural electric cooperative in a selected rural area consisting of about 4 to 6 Thanas (sub-districts) by the REB under a set of strict rules and guidelines. The REB finds suitable people from the area to be a part of the voluntary Board of Directors and this establishes the foundation for the link between the community and the REB. The REB then invests in establishing the PBS utility with the necessary transformers; transmission and distribution lines to link up the selected customers. These customers will be the members of the PBS. The customer is treated as the most important stakeholder in the process. This is a shift away from the normal utility's indifferent attitude towards, especially, rural customers.

The success of this approach can be judged by the fact that the PBSs operate in a financially sustainable manner. There are low distribution losses, no reported thefts of electricity and nearly **100%** success in bill collections. There is also a strict system of 'checks and balances' in the area of procurement and there is no apparent corruption in the system. The REB instills strict discipline into the process through comprehensive training in areas of management, rules and regulations. REB also hires the executive management of the PBS and has the power to terminate their employment with the PBS board approval for non-performance. There is also a Performance Target Agreement that is signed every year to improve on the previous year, based on criteria such as increasing revenue, decreasing system losses, increasing number of connections etc. (See appendix A for more details).

The management process could be deemed "martial" and it is not a coincidence that the CEOs of REB have been former military persons. REB, in effect, controls every PBS. This is acceptable as they have made the initial investment (acting as a bank) to establish and operate the PBS. The PBSs that have developed over the years may resent the tight control as they grow. The REB says it tries to strike a balance on this by providing autonomy as PBSs become profitable and self-sufficient. However, none of the PBSs are yet free from the grip of REB, as they are not yet self-sustaining. As the customer base grows and commercial/industrial entities join the grid, they are expected to become profitable.

This successful approach has come about with a large amount of donor-led financial assistance. NRECA International has committed to this process from the inception and has played a very crucial role in making this a success.

Another rural electric cooperative model exists in India where there are 33 operating Rural Electric Cooperative Societies (RECS). Nine of them operate in the State of Andhra Pradesh. This may be because the State Electricity Board (SEB) in Andhra Pradesh and the State government there is more open to different models of grid electrification. The SEB sells electricity at bulk rates to the RECS. Usually, the SEBs being large utilities like to keep control of the entire process of generation, transmission and distribution. Even where cooperatives have been formed, SEB support has been minimal, except, it seems to be operating well in Andhra Pradesh. These RECSs are registered under their respective State Cooperative Societies Acts. They are mostly funded by the Rural Electrification Corporation, which acts as a bank for RECSs.

Unlike the REB/PBS model in Bangladesh, RECSs do not have the overhead costs of the REB. It operates independently. The records show that the two RECSs (The Co-operative Electric Supply Society Ltd., Sircilla in Andhra Pradesh & Singur Haripal Rural Electric Co-operative Society, Ltd., in West Bengal) studied by the Nexant-SARI/Energy team are well run rural electricity distributors. They meter most of their consumers, maintain and keep meters calibrated, have computerized billing systems that provide printed bills to each consumer, collect on-time better than **90%** of the amounts billed, disconnect members for failure to pay the bills, have progressively expanded the members served, have negligible illegal connections and theft, and provide new connections with short waiting periods.

Financially, both societies run positive margins; revenues exceed expenses including debt servicing. These two examples indicate that it is possible to accomplish a successful rural utility operation in this manner. The study team did not have an opportunity to go into the intricate details of management, institutional arrangements and the people issues, but two decades of operational success is notable.

However, one issue is the fact that only 33 RECSs operate in a vast country like India with **70%** of the population living in rural areas. This number may increase with the dismal performance of SEB's when it comes to rural electrification.

The cooperative culture is well and alive in the region. The most successful cooperative movements have been supporting community-based agriculture for the last 50 years. These have provided assistance in developing land, fertilizer supply, information dissemination, education, training and micro financing areas. However, over the last two decades most of these movements have got politicized and face disintegration as people get divided along party lines.

There are two examples in Sri Lanka focussing on micro financing that warrants highlighting. They are the Thrift and Credit Cooperative Societies (SANASA) established in 1907 with over 5 million members and the Sarvodaya Economic Enterprises Development Society, (SEEDS) which began as a social welfare organization in 1957.

SANASA operates at the grass root level as a membership driven cooperative and joins together with the regional apex body operating at the provincial level. These apex bodies join together at the national level to form one main body. They have had donor support to develop the institution and SANASA has evolved into a development bank also, but the rural level operations continue.

SEEDS have also evolved into a development bank and has participated in the energy area by acting as the micro financier for solar PV. Both these organizations are well led and managed with excellent systems in place to support the operation.

This illustrates that with proper management systems in place, with good human resources and leadership, rural cooperatives can operate effectively. There should also be support from outside catalysts as facilitators to provide technical and management assistance. Funds are also required to provide this assistance. Therefore, this approach has the potential to be replicated in the region in the electricity generation area.

3.2 Off –Grid Centralized Rural Electrification

Micro Hydro has been the most prominent technology in this approach. Successful projects operate in rural areas of Nepal and Sri Lanka. Initially, many of these projects have been developed through non-governmental organization initiatives. Intermediate Technology Development Group (ITDG), a United Kingdom based NGO has been pioneers in introducing the “Village Hydro” concept using simple micro hydro technology in Sri Lanka and Nepal. ITDG developed the model centered on a rural community and in the process created a cooperative called Electricity Consumer Society (ECS). There is sufficient evidence that rural cooperatives can be run successfully with proper systems and management practices in place. ECS is another good example of this.

The important feature of this approach is that a rural community has required project facilitation from experts in technology and project management. Initially, sociologists who looked at rural community participation, leadership and teamwork in the process of establishing and operating an ECS also provided inputs. This is a demand driven approach where an off-grid community, who has a water source, requests organizations like ITDG to facilitate a project. In Sri Lanka, about 110 village hydro projects exist.

Nepal is known to have about 950 micro hydro schemes and out of that about 170 have electric generators to primarily mechanical energy turbines. About 120 schemes are dedicated electricity generation schemes. These are typically 1 kW to 100 kW systems.

Both in Nepal and Sri Lanka, donor projects have catalyzed the sustainable development of these schemes. In Sri Lanka, the Energy Services Delivery project (ESD)[1] funded by the government, the World Bank and the GEF have supported as a project facilitator (essentially a private or NGO consulting organization) to work with rural communities to develop projects. Under the ESD project, 25 schemes have been funded (260 kW installed capacity and powering 1,200 households). Nepal has had the Rural Energy Development Program (REDP) funded by UNDP and the Government of Nepal. This project also funds other renewables and has established Rural Energy Service Centers in rural areas to assist communities to develop and manage projects. There are complementary projects such as the DANIDA funded Energy Sector Assistance project to build capacity to encourage commercialization.

Rural communities do have some sort of organization at the village level for welfare. Therefore, it is usually easy to build a society based on this foundation for building a good leadership and a cohesive community. People also mobilize for a common cause, which will benefit them. Electrification is a good motivator to bring a community together. The project facilitator would assess the water availability and the generation capacity to see whether the community can be served sufficiently with the available resources (usually 100 to 200 Watts of power per household). In the present scenario, the facilitator would assist in creating the ECS and either incorporate it or register it as a legal entity. The facilitator will also develop a feasibility study, technical design and business plan in order to access funds from commercial sources such as development banks. The facilitator assists the ECS to get the necessary land use and environmental approvals. The facilitator also coordinates the in- kind and equity contribution from the community. They could supply the project with the labor for the civil work and construction, bricks, wood, cement etc. Once the project is complete the ECS takes over the management of it based on an agreed constitution. A local person is trained and hired to operate the system. It becomes the responsibility of the ECS to meet all the statutory and environmental reporting requirements. Management and accounting systems are put in place and ECS members are trained to operate the project as well as meet the commitments.

At the current level of development, there is minimal capacity in rural communities to develop this process on their own. This requires outside intervention. However, there is

[1] The Energy Services Delivery project was established in Sri Lanka by the government and World Bank with GEF assistance in 1997 for 5 years. The US $ 55 million project finances grid connected mini hydro, off-gird solar PV and off-grid micro hydro projects (with GEF grants). It also has a Demand Side Management component and funded the Ceylon Electricity Board to install a pilot 3 MW Wind plant. The project also has funds to technical assistance and has funded the establishment of the Solar Industries Association as well as general promotions of off-grid projects, as well as other capacity building. The project is deemed a success after nearly 5 years.

no reason why this capacity cannot be created in partnership with provincial or regional governments.

In Sri Lanka, the provincial councils[2], who have got the power vested in them to provide rural electrification services, already fund off-grid projects. They are in the process of developing regulatory and legal frameworks to formalize this. There are still anomalies in the Electricity Act of Sri Lanka, which does not allow any organization other than the Ceylon Electricity Board to generate and sell electricity without their permission. These have to be changed out to make this process completely legal as well as provide the provincial governments with the necessary jurisdiction to operate.

3.3 Off-Grid Decentralized Rural Electricity

South Asia's dominant rural population is dispersed in remote areas. As such, in many areas, even a mini grid may not be feasible. The only option is to have individual systems and the options are limited to either a battery-based system (where the battery has to be recharged few times per month), kerosene or diesel generator or a solar PV system. A solar PV system operates on 12 Volt DC and has to use lamps and accessories that need DC power.

Even though governments initially introduced solar PV in South Asia in the 1980s, it has been through private sector and NGO initiatives that this approach has been developed. Sri Lanka, India, Nepal and Bangladesh have various commercially led initiatives that use principles of marketing and management to satisfy customers. The success of this approach is to keep customers happy. For that, the organization has to stay close to the customer. This business is about building relationships. Existing customers become the source of demonstration to develop the market. The good word spreads, but the bad word spreads faster and wider. Therefore, the only way to build the market and keep customers satisfied is by establishing the infrastructure to market, sell, design, finance, install, train customers and provide after sales service close to the market. This, however, makes it an expensive operation, but there is no other way. To keep operational costs low, organizations have to empower the front-line team to take decisions and take the business forward. In the situation where the main offices are typically based in urban areas, this is a challenge. However, examples of successful operations in Sri Lanka, India, Nepal and Bangladesh show that it can be done with a commitment to train, lead and motivate people to perform based on both monetary rewards and other forms of recognition.

Therefore, the organizations have to hire talented people who can be technically competent, also market and sell systems by building relationships.Electrifying a rural home changes people's lives. This brings about gratitude from the customer that also is a positive motivator. There is a certain amount of altruism in the people who are in the

[2] The provincial councils in Sri Lanka have been provided with the responsibility to provide energy to people in provinces through the 13th amendment of the Constitution. It states under List 1- "development, conservation and management of sites and facilities in the province for generation and promotion of electrical energy". Under List 2 – "Extension of electrification within the province and promotion and regulation of the use of electricity within the province". Yet the central government has not made a clear demarcation of responsibilities, but this will be addressed soon.

solar PV business. This has to be the case, as it is a physically demanding business, as customers are few and far between. But the businesses, whether its Grameen Shakti or private companies in Sri Lanka are growing from strength to strength by bringing people light with solar power. So, it is possible with a commitment to customer service.

Financing has been one of the biggest barriers to developing markets. Grameen Shakti has in-house financing and this is a clear advantage. Grameen Shakti has also got a vision and that is to use solar PV to bring about an information revolution to rural Bangladesh. Already, they have invested in computer training centers. Connectivity comes from a strategic partnership with Grameen Telecom[3], a cellular phone company, where they sell solar powered telephones to rural businesses that are establishing village communications centers.

In Sri Lanka, there is a vendor/Micro Financing Institution (MFI) partnership. Therefore, when a company sells, the MFI finances the customer. The vendor and the MFI (Sarvodaya Economic Enterprises Development Society - SEEDS) have an agreement, which ensures that the system operates well to the satisfaction of the customer, so that the loan will be repaid. If not, the vendor takes over the system. This minimizes the risk to the MFI. At the moment in Sri Lanka, the ESD project assists the vendor or the MFI with a US $ 100 GEF grant per typical 35-40 Watt system. There is also support for technician training and promotions through technical assistance funds. One province, which has the lowest rate of electrification in the country, the Uva Provincial Council has taken a bold step to provide a Rs. 10,000 (US $ 107) subsidy to the end-user who invests in solar PV.

These funds were diverted from grid extension funds and in 2001, 4 vendors in the area have installed 3,000 solar PV systems. Next year, they hope to fund another 5,000 systems. This maybe emulated by other provinces and this is the beginning of a public/NGO/private sector partnership that will be the way things will be in the future. The central government has to take note of these and adjust policies to incorporate these approaches to the mainstream energy mix.

Therefore, this approach has also got an important role in remote regions of South Asia where the grid will not reach in many years. (Solar PV as a technology has a potential urban role in the future. A Sri Lankan initiative is highlighted in Appendix C).

[3] Grameen Bank launched Grameen Telecom in 1997 linking bank's expertise in micro enterprise and micro financing with latest digital wireless technology. Grameen Telecom's focus is rural areas and is using this initiative to provide telecom access to remote people, create income-generating source, catalyze an information revolution in rural Bangladesh and to ultimately alleviate poverty.

Section 4 Energy Situation in South Asia

South Asia contains **20%** of the world's population at 1.2 billion and is growing rapidly. Out of this population, on average about **40%** live in poverty.

Agriculture dominates the national economies in the region and with increasing population and diminishing land area, the focus of development has been to enhance agricultural productivity by introducing modern technologies. This is complemented by efforts to improve quality of life through infrastructure development by building roads, improving communications systems, education and health facilities. Increasing commercial energy consumption and greater access to electricity are common factors that positively affect all these areas.

According to the World Energy Council[4]**,** two trends can be seen for the South Asia region:

- The more rapid the economic growth the faster energy intensity will decline as old equipment is replaced by new equipment and the economic structure shifts towards less energy-intense activities.

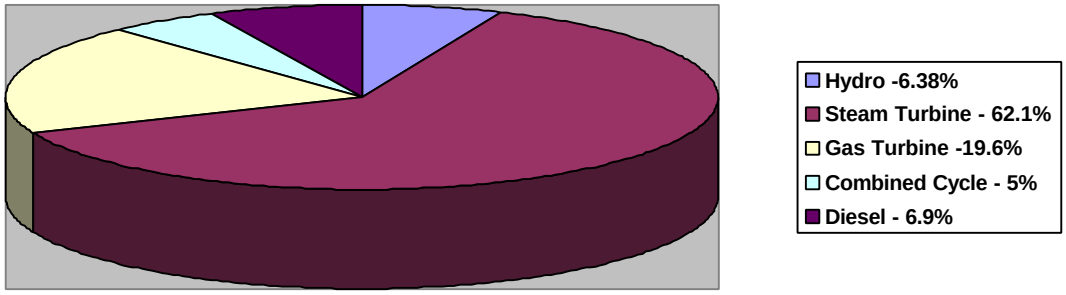
- The lack of purchasing capacity of the poor will result in continued use of traditional biomass over the next 20 years, although, with technological advance in renewable energy systems, a larger contribution by new and renewable energy devices may be possible.

Additionally, institutional deficiencies are a high priority concern, and the region's prospects for strong economic growth in the future will largely depend on how quickly and successfully it is able to address this issue.

4.1 Bangladesh

The power grid serves less than **30%** of Bangladesh's 130 million people (as per the year 2000 estimates). Only about **10%** of the rural population has access to the grid. Total installed generation capacity is 3603 MW. Even with this capacity, Bangladesh Power Development Authority (BPDB) has had to resort to load shedding from 1998-2000.

[4] The World Energy Council (WEC) and South Asia Association for Regional Cooperation (SAARC) held a Regional Meeting on Renewable Energy on 12-14 June 2000 in Colombo, Sri Lanka. This information was taken from the "Renewable Energy in South Asia – Status and Prospects", published in November 2000.



Source: Bangladesh Power Development Board

Figure 4-1: Electricity Generation in Bangladesh

The per capita oil consumption is 16.67 litres. Biomass meets **73%** of the final energy consumption where **59%** is used for domestic purposes and **13.5%** for small industrial uses. With **85%** of the population inhabiting rural villages, meeting their electricity needs with conventional means is an economic challenge, especially with a per capita GNP of US $ 300. Therefore, there are several alternate models that are being developed with support from donor agencies to complement the successful rural electrification program of the Bangladesh Rural Electrification Board. Grameen Shakti (GS) has pioneered the marketing of solar PV systems, modeled after their vast network of Grameen Bank operations.

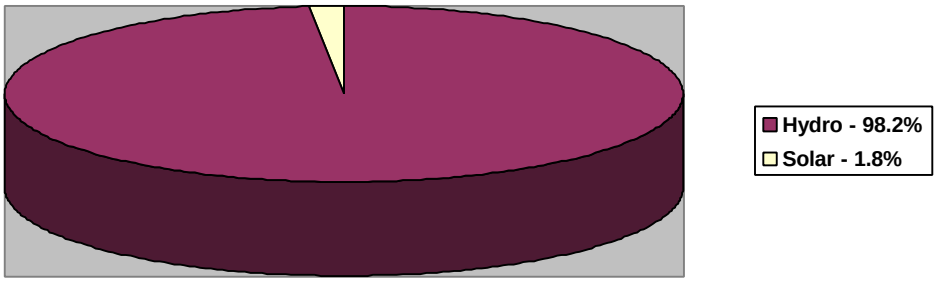
Table 4-1: Best Practices in Bangladesh

Model	Comments
Rural Electrification Board (REB)/Palli Bidyut Samithi (PBS) model of rural grid electrification	This is a utility grid model done in partnership with rural communities. 67 such schemes are operating successfully and the potential for replication in South Asia is high.
Off-grid decentralized solar PV programs	Grameen Shakti and BRAC (what is BRAC?) are marketing solar PV systems in rural areas through rural based solar centers and offer in-house financing

4.2 Nepal

With **88%** of the population based in rural and remote areas, nearly **18%** of Nepal's total population has access to the grid. The Nepal Electricity Authority (NEA), the parastatal utility, is responsible for power generation and distribution. Most of the electricity generation is from large hydropower projects. Various alternative energy sources are being promoted in Nepal where mini and micro hydropower and solar PV systems are the most popular. The NEA operates 39 of its own isolated small hydro grids with a total

capacity of 19 MW. There are over 1,000 solar PV systems mostly for domestic use and community systems.



Source: India News & World Resources 2000-2001

Figure 4 -2: Electricity Generation in Nepal

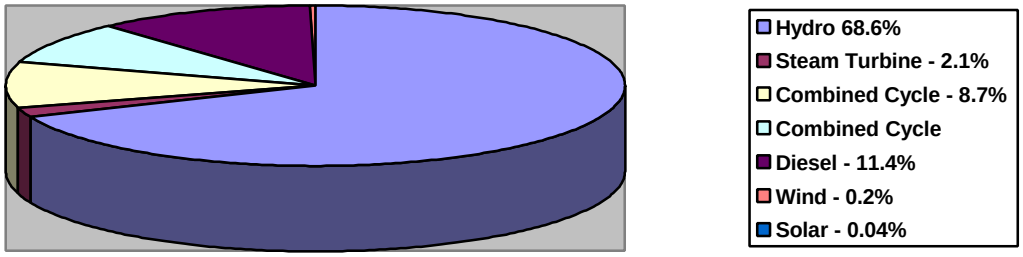
The country has the potential to develop 45,000 MW of hydropower from fast flowing rivers in the Himalayas. About **50%** of population could benefit from the decentralized development of small hydro projects. There are over 800 micro hydro projects mostly powering agricultural processing equipment such as rice mills and domestic lighting.

Table 4 - 2: Best Practices in Nepal

Model	Comments
Off-grid centralized systems with micro hydro	Promoted by non-governmental organizations and private sector. Nepal also has a manufacturing base for small turbines and other equipment for small hydro.
Off-grid decentralized systems with solar PV promoted by the private sector companies.	There are several private companies doing commercial business marketing and selling solar PV systems. Lotus Energy is one of them.

4.3 Sri Lanka

Sri Lanka, with a per capita GNP of US $ 900 per annum, has 19 million people and only **54%** have access to electricity. About 2 million households do not have access to the grid. About **75%** of the population live in rural areas where biomass is the largest energy source, mainly used for cooking (about **57%** of total energy consumption is biomass). Sri Lanka has an installed generation capacity of 1,657 MW and about **60%** are large hydro. Electricity demand grows by **8%** annually. Currently there is load shedding, as generation capacity has not kept up with the demand.



Source: Sri Lanka Energy Balance & DFCC Reports on ESD Project

Figure 4 - 3: Electricity Generation in Sri Lanka

Already there are about 20,000 solar PV systems sold by the private sector to power rural households. About 3,500 households benefit from 110 off-grid micro (village) hydro projects initially developed by NGOs, but now supported by the provincial level governments as well, developed commercially with government, World Bank and GEF funded Energy Services Delivery project (ESD).

The highlight for the Sri Lankan renewable energy scene has been the ESD project established in 1997. This US $ 55 million project has catalyzed the private sector to actively develop the solar PV market with micro financing and micro (village) hydro projects.

The project also has funded the development of about 20 MW of grid-connected mini hydro by Independent Power Producers (IPP) and a pilot 3 MW Wind Farm for the Ceylon Electricity Board.

Table 4-3: Best Practices in Sri Lanka

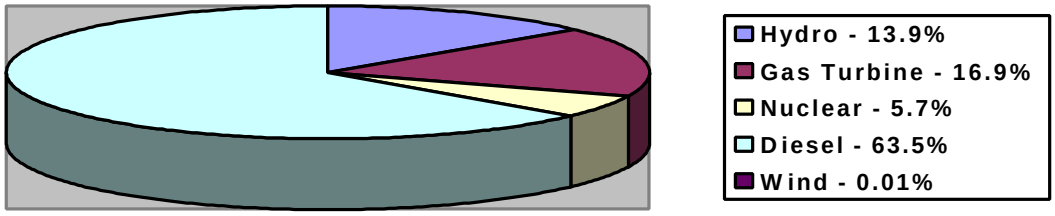
Model	Comments
Off grid centralized projects with micro (village) hydro	These are promoted through non-governmental organization initiatives, but now developed on a commercial basis where the community based organizations known as the Electricity Consumer Societies (ECS) are incorporated or registered as an NGO so that they can access commercial credit from banks as a part of the Energy Services Delivery Project. Out of a total of about 110 projects, about 20 are commercially developed. About 5,000 households benefit.

Off-grid decentralized initiatives with solar PV mostly developed by the private sector	The private sector entities such as Shell Solar, Selco Solar Sri Lanka, Alpha Thermal and Access Solar. These companies are complemented by SEEDS, a micro financing organization that operates at a rural level. Over 15,000 systems are in Sri Lanka.
Grid Connected Mini Hydro & Solar PV **(The first grid connected solar PV system is described in Appendix C)**	The government utility, the Ceylon Electricity Board (CEB) has a power purchase agreement with private sector developers to buy electricity produced from projects ranging from 500 kW to 10 MW. Currently, 30 MW feed into the grid. These projects have been catalyzed by the Energy Services Delivery project of the Sri Lankan government and World Bank.

4.4 India

India's energy scenario is complex with various sources of energy meeting differing requirements. With over **70%** of the 1.0 billion populations being rural, the big challenge is to reach the people with services. State Electricity Boards have been aggressively electrifying rural areas of the country. However, even though officially **86%** of the villages are supposed to be electrified, most of the households away from the center of the village do not have access to the grid. Therefore, it is difficult to assess exactly how many households actually have grid electricity.

India is unique in having a special Ministry of Non-Conventional Energy Sources (MNES) to develop the alternative energy resources. The Ministry works closely with State Electricity Boards, NGOs and other local and village level institutions to support grass roots level renewable energy projects. It administers special grants for technologies like solar PV, biomass, wind power and small hydro projects. MNES also supports research and development to find other suitable technologies to meet future energy needs of the country.



Source: India News & World Resources 2000-2001

Figure 4 - 4: Electricity Generation in India

India also has a separate financing institution called Indian Renewable Energy Development Authority (IREDA) under the purview of MNES to finance renewable energy projects.

IREDA has obtained funds from donors such as the World Bank, ADB, KfW (Germany) and OECF (Japan). The solar PV industry for domestic use and water pumping as well as the larger wind power industry has developed as a result of these programs. IREDA has funded an aggregate capacity of 1,265 MW up to year 2000 where the majority has been based on wind power.

MNES is currently promoting some interesting solar PV projects (with subsidies) and biomass initiatives for off-grid mini grid applications. According to Dr. E.V.R. Sastri, Adviser attached to the Ministry, the state governments, the private sector and NGOs have installed over 175,000 solar PV systems through government-assisted programs.

Table 4 -4: Best Practices in India

Model	Comments
Off Grid Decentralized projects with solar PV	India has private sector and NGO-driven initiatives. The most successful is Selco India that operates on a commercial basis in partnership with banks such as Syndicate Bank and Malaprabha Bank in Andhra Pradesh. The Ramakrishna Mission (RKM) based in West Bengal has also developed projects on a sustainable basis. However, in keeping with the objective of the mission the project does not make profits. RKM has a partnership with SRIE, a financing company based in Kolkata, to provide consumer credit. This is being developed as a Photovoltaic Market Transformation Initiative (PVMTI) funded by the IFC.

Rural Grid Extensions	There are Rural Electric Cooperative Societies operating in India (especially in Andhra Pradesh and West Bengal that are known to be successful) that purchase electricity in bulk from SEBs and operate independently. The Bangladesh's REB model is being replicated in West Bengal.
Grid Connected Wind Power Developments	The MNES and IREDA initiatives have made India the third largest wind energy producer in the world with close to 1,000 MW. These subsidy initiatives have also created a vibrant wind power manufacturing industry in India. However, inconsistencies in the subsidy program have affected industry growth, but it is picking up again.

Section 5 Opportunities and Threats in the Rural Electrification Sector; South Asia

With such a complex demographic and socio-economic situation, South Asia faces a great challenge of providing the conventional electricity services to its population. While on the other hand, there are huge opportunities to develop these markets and bring a large number of people (about 500 million) into the mainstream national economies.

It is clear that the conventional grid electrification model is severely hampered in terms of trying to provide services to the entire population given the fact that well over **70%** in South Asia inhabit in rural areas and that Governments do not have funds to either extend the grid or in many cases invest in new generation capacity.

The government owned utilities are operating with significant losses, and are under pressure to restructure the sector in order that private sector investments can be attracted to the area. The ultimate goal is to make these utilities financially viable and sustainable. As such, the paradigm shift has already started in the energy sector in South Asia.

The demand for electricity connections from rural areas is very high as a result of the increased mobility of the people and their greater access to communications such as television. However, the actual load demand is low, as these are mostly rural households. As the government is unable to meet this demand, private sector and non-governmental organizations have begun to fill the rural electrification void.

In many cases, this has been done in untraditional ways, opening up new opportunities and new markets, not only in the energy area, but in other business areas as well. The new paradigm driven by the private sector has introduced commercial practices into the field. Therefore, the "customer" has become important, as the customer now has choices or at least has recourse if their expectations are not met. Therefore, the practice of marketing[5], where a wide range of techniques are used to satisfy customer's needs, has become the norm. This approach to business highlights the crucial importance of the customer.

For instance, in the solar PV area, if one customer is not satisfied, news spreads in the area and the promoter cannot sell any more systems. So, a whole new requirement for accountability has been introduced to an area that has traditionally operated on a monopoly basis. Previously, rural customers have, especially, been at the mercy of monopolistic utilities and have had to accept poor service. With technology like solar PV being promoted by the private sector, often the customer now has a choice, even though end-user involvement will be more to keep the system operating.

[5] Definition of Marketing - "Marketing is the management process responsible for identifying, anticipating and satisfying customer requirements profitably" – *Chartered Institute of Marketing, United Kingdom*

With the electrification void in rural areas, non-governmental and community based organizations are also playing a crucial role in promoting technologies such as solar PV, biomass and micro (village) hydro. Community based NGOs are more suited in many ways to provide services in the village, as they know the village best. However, they are more social-welfare oriented, which may get in the way of financial sustainability based on the "bottom line" when it comes to doing commercial projects. There is a balance that is required and that could come with strategic partnerships between these NGOs and the private sector. Rural level NGOs are already playing an important role in adding value to programs in crucial areas such as micro finance.

Financing, given the high up front cost of most of the renewable technologies, is an important part of these alternative delivery mechanisms.

Micro financing in rural South Asia (especially in South India where they have liberalized this area to even attract foreign investment)[6] is booming for the traditional sectors such as agriculture, water supply and housing**.** Adding rural energy to this list will enable the broadening of services to the poorer segments.

The Grameen Shakti model in Bangladesh shows the effectiveness of a "one stop shop" that markets solar PV systems, provides in-house finance and extends after-sales service with priority on excellent customer service as a central theme. In Sri Lanka too, there is an interesting vendor/Micro Financing Institution (MFI) partnership that has helped the solar PV market grow exponentially in the last two years.

The community getting together for a common cause is illustrated by micro (village) hydro projects that operate in Sri Lanka and Nepal. Here, leadership and teamwork are the keys to developing an energy resource into a community-based organization developing and managing a mini electric utility. The successful projects illustrate that rural communities can organize themselves with capacity building and financial support from external facilitators. Non-governmental interventions originally created this concept and now these are becoming commercially sustainable community based organizations (CBOs).

A good example of such a community level operation is the Rural Electric Cooperative Societies (RECS) in India. This study was able to examine two such cooperatives in Andhra Pradesh and West Bengal.

However, successful and sustainable rural energy projects are not only the domain of the private sector and NGOs. The rural electric cooperative model in Bangladesh (the Rural Electricity Board/Palli Bidyut Samiti partnership), for instance, clearly shows that with

[6] MFIs are most developed in the south of India, especially in Andhra Pradesh (with MFI headquarters in Hyderabad). Laws on MFIs have changed recently in India, which make foreign investment easier. This, together with the rapidly expanding number and capacity of MFIs, will pave the way for a MFI boom in India, according to Ms. Hanny Maas of HIVOS Netherlands, a funder of MFI activity in the region.

political will, commitment, discipline and an urban/rural partnership an approach can be created to be both efficient and effective in delivering good electricity service to customers. There are many lessons to be learnt here, as the role of the government in rural electrification cannot be marginalized. It is important to note that the success of this approach may also be attributed to the continuous level of support from donor agencies (mainly USAID) and the crucial partnership USAID brokered in Bangladesh between key stakeholders and the National Rural Electric Cooperative Association (NRECA) of the U.S.

The review has shown that governments alone cannot deliver rural electricity services anymore. It requires partners from the private sector, non-governmental organizations, donors and the rural communities itself. It also requires policies and a regulatory framework that catalyzes and encourages the new paradigm in energy.

This new paradigm of decentralization involves the customer in a participatory process. In a solar PV system, the customer becomes an owner, unless the system is given on an energy service basis.Inherently, the customer has to manage and operate the system given its limitations.

In a village micro hydro system, the customer is a key stakeholder and a member of the organization managing the project. For instance, the customer has to be a part of the decision making process to expand the number of connections, spend funds on a repair or to re-elect members of the cooperative. Even in the rural electric cooperatives the customer is a stakeholder and a member of the RECS of India or Palli Bidyut Samithi (PBS) of Bangladesh. Therefore, depending on the technology and the system there are varying levels of customer participation, much in contrast to the situation of urban customers of a utility who merely have to pay a bill at the end of the month.

Yet, this is a dream that Mr. S.K. Mondal, Deputy Director of the West Bengal Renewable Energy Development Authority (WBREDA), is pursuing with their projects. WBREDA has established biomass gasifier and solar PV mini-grid based utilities to serve isolated rural communities of West Bengal.

According to Mr. Mondal, “Rural poor should not be burdened with technology, but provided a good service so that their lives can improve”. However, the economics of grid extension, the energy resources mix available and technology dictate both the level of participation by the rural customer in the process and successful access to electricity services.

The study will take a closer look at three such approaches listed below;

- Central grid based rural electrification
- Off-grid centralized rural electrification
- Off-grid decentralized rural electrification

Section 6 Central Grid Based Rural Electrification

In South Asia, the utility model has been the traditional approach to provide electricity to people. Most urban areas in the region have about **50%** of the population on average electrified in this manner. In rural areas, about **30%** have access to the grid. Over the last two decades as electrification has become a key political issue in the region, governments, with donor assistance (World Bank and ADB), have attempted to electrify as many rural areas as possible. As a result, the electrification levels have been lifted from about **10%** in rural areas to the current level of **30%**. Overall, it has been lifted from **25%** to **50%**, but much of this has also happened in semi-urban areas. The rural constituency, with their current low requirements do not make for a sound investment for the utility, but political pressure has kept the programs going. On the pricing side, the government regulates the utilities to subsidize rural customers. This has resulted in the current crises where most State Electricity Boards in India, the Ceylon Electricity Board in Sri Lanka, the Nepal Electricity Authority and Bangladesh Power Development Board (BPDB) are near bankruptcy.

However, there are two known utility approaches that shine among these and they are the RESC in India and the REB model in Bangladesh. The study has looked at the RECS models in West Bengal and Andhra Pradesh. The REB model is being emulated also in West Bengal, India at the moment. This section will describe and analyze the model to examine whether similar models can be introduced to the other South Asian countries.

The best model in South Asia in terms of an efficient and potentially sustainable one is the Bangladesh Rural Electricity Board (REB). A large donor investment (mainly from USAID) was required to build a long-lasting partnership between NRECA and stakeholders in Bangladesh that helped to establish, develop and sustain the program. The issue for other South Asian nations is whether, a similar investment in funding and technical assistance is required to replicate this approach in other countries, if there is the demonstrated political will to change the existing system.

This study will examine the REB approach in detail to illuminate and distinguish its successful organizational features and operational procedures.

The next best approach appears to be the RECS in India. Two well-managed operations in West Bengal and Andhra Pradesh will also be closely examined and then compared to the REB/PBS model. They operate totally independently and purchase bulk electricity from the respective State Electricity Boards (SEB). These 2 RECS have survived in spite of minimum support and indifference from the SEBs.

Their performance incentive seems to stem from dedication to electricity supply and to their members (consumers) than effective regulation, which is the cornerstone of the REB/PBS model. However, it does lend credence to the cooperative society modality for rural electricity supply. This approach will be given a brief overview in the study.

6.1 The Bangladesh Rural Electrification Board (REB)

The Bangladesh Rural Electricity Board (REB) was established under the Electrification Ordinance in 1977 to specifically implement rural electrification through grid extension.

It established and first Palli Bidyut Samiti (PBS) as the Dhaka PBS in June 1980. Currently 67 PBSs are operating.

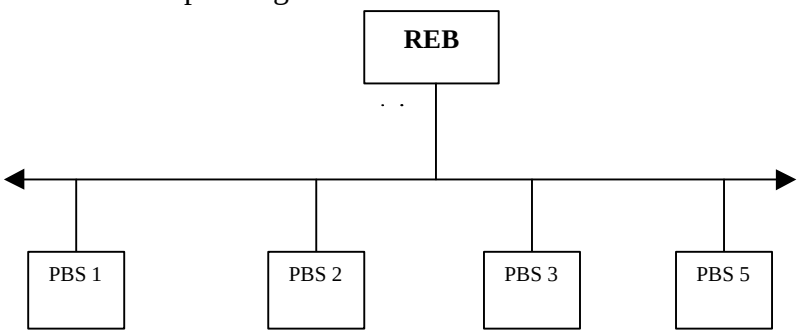


Figure 6-1: The Structure of REB/PBS Model

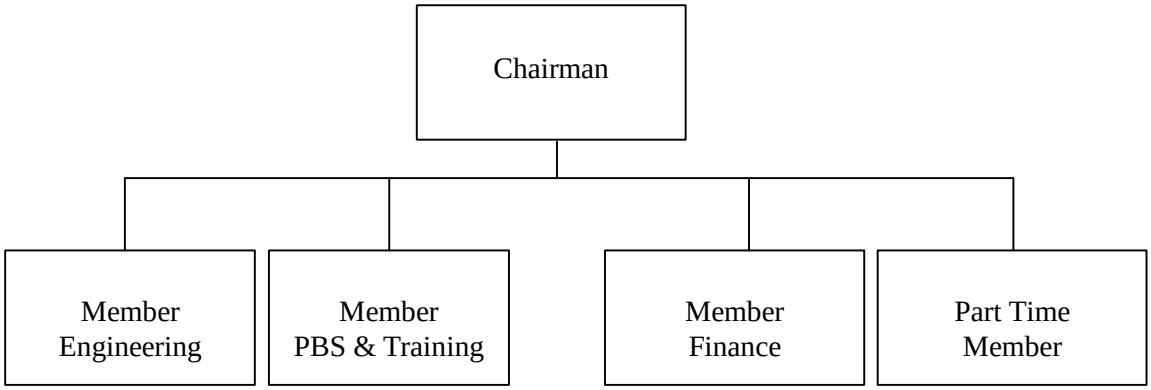


Figure 6 -2: The Management Team of REB

The REB's activities in rural electrification are in line with the government's policies for poverty alleviation and employment generation. The program has grown tremendously to now serve 3.5 million customers through the PBS model. The success of the model lies in the fact that rural people are active partners and stakeholders in the projects. With such local level participation, the system requires it be transparent in the crucial areas of management and operations. This transparency has also required all the stakeholders to adhere to strict financial discipline, as this is where most programs fail to be successful and sustainable.

Therefore, if the REB selects an area for electrification, the first activity is to establish a partnership with a few key individuals from the area. This partnership will develop into a rural based organization, which will evolve into an operating PBS, while all the time being under the strict guidance of the REB. The system lends itself to be accountable to each other, be it REB or a PBS. Further, the stakeholders of this program are recognized for their successes. This is a prime motivator of this program.

The program is modeled after the rural electric cooperatives of USA, which electrified rural areas in the USA during the1930s. The National Rural Electric Cooperative Association (NRECA), under a USAID program, first conducted feasibility studies to establish such a concept in Bangladesh in 1976. Based on these studies, USAID assisted and supported the establishment of the REB.

The REB went on to construct the power distribution system and related infrastructure to establish 13 Palli Bidyut Samities (PBSs) to electrify 54 Thanas (sub-districts) initially. USAID & NRECA have been active partners of the REB from the inception. (See Appendix A for more details on REB/PBS).

6.1.1 Establishment of a PBS - Appointing the PBS Board of Directors

The Thanas (sub-districts) for a potential PBS are identified based on several criteria. The demographics of the area and the potential for economic growth and poverty alleviation with electrification are all examined. The feasibility study also assesses the current economic situation, the ability of the community to support a PBS both financially (sufficient demand for electricity and ability to pay for it) and with human resources (to operate and manage the PBS).

After 3 to 4 Thanas are identified, a REB team visits the area to meet the local leaders. Ideally, the REB would establish a PBS in areas where there are already rural cooperative activities in micro finance and agricultural development. This way, there is already an established structure with some local leadership.

The PBS Board is a voluntary board that will consist of the leaders from the area. The PBS Board will have 10-15 members including 2 women as advisors. These members may represent other unions (such as farming etc.) and associations in the area also. There is prestige attached to being a member of the PBS Board that gives people certain intangible advantages and respect in the community. The REB gives this due attention and recognizes that the Board will not, in most cases, compromise on the responsibility to adhere to the code of ethics by which the REB/PBS operates. The general membership of the PBS will be the customers and the board is expected to serve and look after their needs by creating a good working relationship with the REB. Paid staff of the PBS, whose top management will be selected by the REB, trained and assigned over to the PBS, will run the operation.

The REB devotes much attention to the establishment of the PBS Board as this will be the foundation by which the PBS acts given the strict discipline and integrity that is required to effectively run the operation. The REB screens the leadership of the PBS and appoints them initially. The Board has a 3-year tenure after which an election is to be held to elect a new Board.

The only remuneration Board members get is an allowance for attending meetings. The same Board can be re-elected, if the members are satisfied with their performance. The new Board has to also get REB approval.

The REB, at anytime for legitimate reasons of non-performance or fraudulent practices, can dissolve the PBS board. (i.e. the system losses are increasing, monthly payments are not collected, there is illegal use of electricity, large amount of funds in accounts receivable etc.).

After the PBS board is selected, the REB will facilitate an interactive workshop at the community level where issues related to development of the project, defining the physical boundaries of the PBS operational area, how the village will be electrified and how the project will be managed will be discussed. Each PBS may operate differently from one another given the local situation, but within the same set of basic rules, regulations and controls.

The members of the board are provided extensive training on the policies of the REB as well as rules, regulations and guidelines in the following areas:

- Management and operation of a PBS
- Reporting requirements
- A general technical training
- Accounting and financial responsibilities
- Procurement
- Performance targets

Training is also provided on soft skills in specific areas of leadership, teamwork and conflict resolution in order that the Board is equipped with all the skills to operate the PBS efficiently and provide members with a quality service.

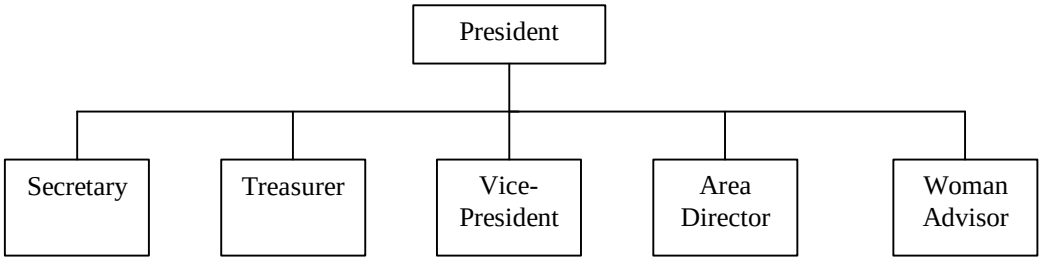


Figure 6-3: The PBS Board

6.1.2 Initiating the Project

As the PBS Board is being finalized, an Executive Engineer is appointed to the area by the REB to work as the interim General Manager to construct and commission the project. This Executive Engineer will report to the REB, but will work with the PBS Board to identify customers, sign them up and plan the grid extension program in the area. The Executive Engineer will supervise construction of the project and after commissioning, hand over the operation to the PBS Board and the Operations Team.

The Operations Team consists of a General Manager and four Assistant General Managers to cover several areas. This team is also selected by the REB and sent to the PBS. The PBS Board has to accept these people and ratify the appointments at a meeting. If there is a conflict with these appointments, the PBS can appeal and if the REB accepts, people can be changed, but the final decision remains with the REB. The REB also can initiate a transfer or terminate services of persons from any of these posts, if necessary with the PBS's approval.

Table 6-1:The Organizational Structure of the PBS

REB		PBS Board	
General Manager			
Assistant General Manager – Finance	**Assistant General Manager – Member Services (Engineer)**	**Assistant General Manager – Construction and Maintenance (Engineer)**	**Assistant General Manager – General Services**
▪ Financing ▪ Budgets ▪ Accounts of PBS	▪ Members and customer relations ▪ Assessing new customers ▪ Household wiring standards	▪ Deals with all construction of power lines and maintenance ▪ Interconnection with BPDB grid or local generators ▪ Customer connections ▪ All technical issues such as standards	▪ Day to day administration ▪ Procurement ▪ Stores inventory ▪ Vehicles

There are other support staff such as Junior Engineers, Administrative Assistants, Meter Readers, Billing Clerks and Minor Staff that come under each of these four areas and that will be hired by the PBS Board and the Operations Team. It is interesting to note that about **50%** of the PBS's employees are women. A typical small PBS has about 150-200 employees and a larger PBS's can have up to 500. By law, PBSs are not allowed to be unionized.

6.1.3 The Construction of the Project

The construction of the project will commence after the feasibility study and approval of the PBS board and membership. The REB appointed Executive Engineer who will act, as the project manager will supervise it. REB provides the funds for construction and the capital cost will become a loan to the PBS.

The loan is repaid in the following manner:

- 30 year loan with 5 year grace period (interest of 0.**75%** during grace period)
- 3% interest for the balance period
- REB invoices the PBS for the interest and principal paid monthly after grace period
- PBSs operating at a loss, but has future potential will be subsidized by the Bangladeshi Government up to 5 years
- If losses are continuing and the PBS has potential, REB makes temporary loans to operate the PBS, but monitors closely (REB operates as a bank)

Most PBSs are operating at a loss at the moment, but the performance is steadily improving as the customer base increases and especially as commercial activities increase in the individual areas.

6.1.4 Establishing the Tariff for Customers

The government sets the price of the bulk electricity sold by the Bangladesh Power Development Board (BPDB) to the REB. The REB in turn sells to each PBS. The REB recommends and with the PBS decides on the customer tariff based on the following criteria;

- Type of customers (domestic, small business, commercial, industrial, irrigation etc.).
- Local economic condition
- Special project areas (for social and political reasons sometimes PBSs are established in very low income remote areas and government subsidizes the project in a special manner)

Usually the PBS tariff is **40%-60%** higher than normal average tariffs charged in urban areas.

If customers default on the payment after one month, the service is temporarily disconnected. Reconnection is made after the arrears are paid. If the payment is not made for three months, the service is terminated. If the customer wants reconnection, a connection payment, service charge and the arrears have to be paid.

The collections of payments of PBSs are well over **95%**.

6.1.5 The Meter Reader and the Collection of Payments

One Meter Reader has between 1,700 to 2,000 customers. There is one Billing Assistant for the said number of customers and bills have to be processed and delivered to all the customers within the set deadline on a monthly basis.

A key area open to abuse in the utility system is the meter reading. The REB/PBS focus a great deal of attention to this area. The Meter Reader is only a contract employee of the PBS and it is renewed on an annual basis. A Meter Reader's area of operation changes every six months so he/she cannot get familiar with any customers.

The Meter Reader can only work on this contract for a PBS for a maximum of 3 years. The Messenger who distributes the electricity bills does random checks on customers.

The PBS customers settle the bill at a nearby bank or if a bank does not exist, there is a local Collection Booth. There are strict guidelines for cash handling from Collection Booths where the money has to be accounted for and banked within the day.

6.1.6 Customer Service

The focus of the PBS is to provide good customer service. PBS establishes Customer Complaint Centers for every 2000 customers. With the development of Grameen Telecom (Mobile Phones) in rural areas, often Customer Complaint Centers have telephone services now. Rural customers have access to telephones with this system, therefore response time to repair breakdowns have improved.

The REB Training Directorate has been conducting training on an ongoing basis to educate PBS Boards, management and staff on customer service skills[7]**.** The customer awareness skills program has been well appreciated by the PBSs as they have learnt to better meet increasing demands of customers to keep them satisfied.

The program also has a training component for PBS members on the role of the PBS, responsibilities of both the REB and the PBS in keeping the process going. They also have annual meetings for the membership where rights and responsibilities of PBS members are highlighted.

[7] There are ongoing training programs under the Rural Power for Poverty Reduction Program (RPPR) implemented currently by NRECA International with USAID funds.

The Member Services Departments of PBSs have been given specific training in order to ensure better delivery of services to PBS members as well as to encourage new members to link up to the system.

6.1.7 REB – PBS Relationship

It is clear that the REB always has majority control over the PBS. It establishes this control from the start, based on its investment in the project.

The difference is that the PBS board members consisting of community-based stakeholders have a sense of being a part of the process. The REB does envision giving more and more freedom to PBSs once they have proven their ability to operate at a profit and have settled all the financial commitments to them.

PBS has a reporting process where monthly accounts have to be sent to the REB. The system for reporting has been installed through Management Information System (MIS) implementation.[8]

Here, the ongoing work continues to improve the following areas:

- Finance and Management
- Management Services
- Computerization
- Operations

The key bond between the REB and PBS is the financial support the PBS receives from the REB. Therefore, there is a continued development and expansion of the Revolving Fund. This mechanism allows REB to continue to provide loans to operate and develop the PBS. Under the Finance and Management area, NRECA works closely with REB to develop systems for business process analysis to ensure that loans are provided to PBSs that are performing well. To monitor PBS performance, an automated system is being developed to utilize the Performance Target Agreement (PTA) Process, which the PBS has to meet on an annual basis.

In the Management Services area, there is work done to create a better understanding of functional roles of the REB and the PBS management. This understanding creates better interpersonal relationships between REB officials and PBS board and management.

Already, computerization has become a key management tool for the REB and many PBSs. USAID & NRECA have supported the implementation of Local Area Networks (LAN). This networking process will improve communications between the REB and the PBSs. It will enable normal communications to be done via e-mail, electronic file transfers, etc. The REB has also developed a computerized payroll system, which is being transferred to the PBSs. Automated systems are also being developed for Materials

[8] Ibid; “Enhance REB and PBS Management”.

Management, which will involve, Procurement, Materials Planning, Standards and Specifications, Movement, Storage and Accounts.

All this will increase the efficiency of the PBSs and improve further the understanding between them and the REB. The REB also assists the PBSs in operation and maintenance of distribution lines and sub-stations. Training is provided in this area on an ongoing basis.

All the above activities indicate that there has to be a delicately balanced relationship between the REB and the PBS for the process to work.

As such, much effort is invested in training, giving people an opportunity to perform and recognizing this performance.

There are four REB Directors who are responsible for different subject areas, but have also the overall responsibility for several PBSs. The 67 PBSs are divided into 4 zones and each Director is responsible for a zone.

The Director develops a good working relationship with the PBS Board as well as the management team. There is an open door policy for PBSs to seek advice or counsel from the Director in any area of the operation. The key here is the development of a sound working relationship.

Even though the REB has absolute authority over the PBS, the Directors have developed a friendly relationship with the PBS Boards and management based on mutual respect.

6.1.8 Annual Performance Target Agreement (PTA)

Every year, each PBS signs a contract with the REB to increase their work performance to an agreed level. The performance targets are developed and mutually agreed to between the PBS Board, the Operations Team and the REB. The PBS President signs the agreement.

Targets are based on 20 parameters (See Appendix A for the list of parameters) covering areas such as reduction of system losses, improving on accounts receivable, increasing number of connections etc. If targets are not met, the PBS can be penalized with salary reductions. If **90%** of target is met, there is a salary bonus of **6%.** If **100%** of the targets are met, the salary bonus is **10%.** If the target is exceeded by **120%**, the bonus is **15%** on an annual basis. This bonus covers all the employees of the PBS and works as a good motivator to achieve the targets.

An annual meeting is held at the REB headquarters to review the annual performance of PBSs. A political figurehead such as a minister or a state minister usually attends this. This provides additional recognition for the PBSs that have successfully achieved their targets. The meeting is also a source for fellowship between the PBSs and the REB and to further build on "team spirit".

6.1.9 Procurement

Procurement is a key area where abuse can normally happen. However, the REB has a transparent process.

REB/PBS Procurement Process

- Local material procurement for the operation of the PBS can be done by PBS following normal procurement guidelines (either tender process for larger items, but purchase on open market for smaller items)
- International material procurement for larger material is done by the REB following procurement guidelines (up to Tk 50 million)
- International material procurement up to Tk 500 million is done through the Ministry of Energy and Mineral Resources
- International material procurement over Tk 500 million, is done through the Parliamentary Committee for Procurement

All the procurement for the REB/PBS is transparent where the process is open to scrutiny

6.1.10 PBS's Moving to Urban Areas

Many of the urban electricity grids in Bangladesh are plagued with poor service, high systems losses, theft of electricity and low revenue for the utility. With the success of the PBS's rural electrification programs, six areas run by BPDBA/Dhaka Electricity Services Authority have been taken over by the REB to establish PBSs. These are Chandpur, Narsingdi-1 & 2, Manikganj, B.Baria and Mymensingh-2.

The most notable development is Narsingdi-1 PBS, which has brought down losses from 56% to 18% in 3 years. On the other hand, Manikganj PBS has been a challenge as it has been difficult to change the attitudes of both the existing people running the operation as well as the customers. Too many fraudulent practices have been entrenched where large customers, who are also powerful politically, have not allowed the system to change. The high losses are attributed to theft of electricity. The operational losses are attributed to the non-payment of bills.

6.1.11 What Makes the Difference

What is the secret to the success of the REB/PBS model?

The key to success is the commitment, discipline, loyalty, and transparency in decision-making combined with the important partnership the REB has created with the rural

community through the PBS Board of Directors and management. This is a participatory process, which gives the community itself the responsibility to ensure that they get a quality service.

The REB's commitment to this excellence is also the driver of the program. It is seen in the pride in which the REB officials take in the success of this program.

These are strong motivators in which there are natural 'checks and balances' between the REB and the PBS.

It is also clear that the REB's "martial" management process has imposed a strong regimented set of rules and regulations by which both parties have to adhere. PBSs cannot be unionized by law. The REB has the ultimate authority and power to dissolve a PBS Board or to terminate services of the top management of the PBS (who they appoint anyway). This power also comes with a tremendous amount of responsibility, which could be abused if not checked within the REB management. However, the success of the 67 PBSs so far suggests that it is not the case.

The REB, in establishing the PBS already puts a tremendous effort into ensuring that credible people from the community are selected to the Board. The REB also ensures through a rigorous training process that they learn the system - the strong discipline and accountability that is put in place through rules and regulations. It is also interesting that the REB focuses on leadership and teamwork, as well as conflict resolution in the training as this, ultimately seems to be what binds the organizations together. Soft skills are, often not taken seriously, but could make a difference between success and failure.

The REB also does not compromise on the technical side, where an Executive Engineer is appointed to construct the project. However, the decision on where the office will be established, where the lines will go, the boundaries of the project, the customers to be connected, are taken jointly with the PBS board. The system will be constructed to high technical standards.

Using the latest technology in Management Information Systems complements all this. Computerization is a key management tool for REB and many PBSs. This also enables good communications between REB and PBSs as well as a sound reporting process. The result is not only consistency but also effective control systems in all areas of the operation without creating a bureaucracy and mounting paperwork.

Procurement is a key area where abuse can normally happen. However, the REB has a transparent process, again with many checks and balances.

As described earlier, another key area open to abuse in the utility system is in the meter reading. REB/PBS focuses attention in this area where the Meter Reader is a contract

employee who can only work for the PBS for a maximum of 3 years. This prevents relationships being made between the Meter Reader and customers.

Also, the PBS being a community level organization prevents illegal connection in the system. This is an inherent advantage in a rural community where everyone knows each other. Also getting an electricity connection in the village is an event significant enough to celebrate. Therefore, sudden lighting of a household without fan fare will be cause for suspicion.

The PBSs also pride themselves as organizations that operate at the community level to meet their own electricity requirements. They also take on the challenge of the Performance Target Assessment (PTA) with a positive attitude where constant improvement becomes a built in process. Most PBSs are reported to achieve the PTA on an annual basis and this is a good indicator of the success of this approach.

Another key stakeholder in the process from the inception has been NRECA International. NRECA, as a partner, has ensured that the foundation was laid in a proper manner and has supported REB all the way to keep a disciplined focus on the goal of creating an efficient utility system. The entire system is geared to provide good customer service at an affordable cost, so rural people can rise above poverty levels.

6.1.12 Problems and Issues

As with any organization, there are problems and issues in this approach. PBSs, as they begin to operate and gather experience with time, do feel that they should get more freedom to operate and manage their own affairs. For instance, currently, they cannot procure anything for the PBS without getting approval from REB. From the point of view of one PBS Manager that was interviewed by the team, it was gathered that they could develop more if there is more autonomy. However, this was only an opinion of a one PBS person. In giving more freedom, the most crucial issue would be in the area of financial control. Once PBSs develop and earn profits, there is a need to ensure that it will be shared with all the members.

There is need to create a system that is transparent where the board does not become too powerful and act against the interest of the members. Without REB's controls, this may happen, unless there is strict control from the government.

6.1.13 Potential for Replication in Other South Asian Countries

Already this approach is being developed in West Bengal. It will be interesting to monitor progress on this project. With a similar culture to Bangladesh, chances are good that the program will succeed, providing there is government commitment and support both at the central and state levels.

This system would be ideal also for Nepal and Sri Lanka. However, the issue is to get the governments to commit to the process. Rural electrification has been a monopoly in both

nations. The utility has been either extending the grid for legitimate reasons or through political patronage. There is also a certain amount of corruption in the process. Both Nepali and Sri Lankan utilities as well as the SEBs in India are highly unionized. It will take strong political will to change this and to adapt this model. The Bangladesh REB model shows that people are willing to be disciplined and be goal-oriented with proper systems in place. There is also committed leadership, which has been consistent in the management of the REB even though Bangladesh as a nation has gone through some very difficult times.

The REB personnel have a certain sense of pride in the success of this model. This pride is well founded as they have broken new ground in an area, which has had a dismal record in the region.

Interestingly, the REB is also looking at off-grid technologies such as solar PV for areas the grid cannot reach. If successful, this would become holistic in the true sense as a rural utility.

As such, this model is replicable in the region with proper support from the government and political levels. With power sector restructuring underway in the region, it is timely to introduce this concept to other South Asian partner countries of the SARI/Energy project.

6.2 The Rural Electric Cooperatives Societies (RECS) of India

There are 33 operating RECSs in India. Nine of them operate in Andhra Pradesh. These RECSs are registered under their respective State Cooperative Societies Acts. They are mostly funded by the Rural Electrification Corporation, which acts as a bank for RECSs.

The study looks briefly at:

- The Co-operative Electric Supply Society Ltd., Sircilla in Andhra Pradesh
- Singur Haripal Rural Electric Co-operative Society, Ltd., in West Bengal.

Both rural electric cooperative societies are well run rural electricity distributors. They meter most of their consumers (cooperative members), maintain and keep meters calibrated, have computerized billing systems that provide printed bills to each consumer, collect better than 90 percent of the amounts billed, disconnect members for failure to pay for electricity, have progressively expanded the members served, have negligible illegal connections and theft, and provide new connections with short waiting periods.

Singur Haripal even operates call centers for notification of system failures and service problems. Financially, both societies run positive margins; revenues exceed expenses including debt servicing. Even if many of India's other 31 rural electric cooperatives do not reach the performance levels of Sircilla and Singur Haripal, these two indicate what it is possible to accomplish through the cooperatives legal modality. It also indicates that

the success of the REB could be transferable to India where this makes the most economic sense for rural electricity supply.

Both the Sircilla and Singur Haripal Rural Electric Co-operative Societies are registered under the Co-operative Societies Acts of their respective States. Sircilla also holds an electricity supply license from Andhra Pradesh Electricity Regulatory Commission (APERC).

Both are overseen by a Board of Directors elected by their members in accordance with their by-laws and the provisions of their respective Co-operative Societies Acts. The Registrar who is part of the State Co-operatives Ministry supervises regulation of administrative matters, including financial reporting and auditing. Technical matters are regulated by the SEB through their supply license. The SEB sets the bulk electricity supply tariff under which both cooperatives purchase electricity. The retail tariff is set by the Society. Both purchase electricity at bulk rates from the SEBs.

These have been operating for over 10 years and serves as a good alternative to the REB model where the cost of establishment has been high.

6.2.1 Institutional Issues

People, leadership, discipline and commitment are key factors of success of these RECSs. However, the question is why there are only 33 such cooperatives in such a large country? The lack of support from the State Electricity Boards to the concept of the RECSs could be one reason. However, given the dismal records of the SEBs, the RECS model may become more acceptable to the policy makers for rural electrification. However, creating such a cooperative requires committed and talented people in the community. This may not be a common factor across the rural areas. Therefore, if can be argued that the REB model in Bangladesh is more effective as it is more proactive in seeking areas to establish PBSs in. The REB does all the work to establish and then funds, develops and essentially manages the PBS. This comes at a much higher financial cost, but lends it self to an efficient operation providing good customer service.

With the existing RECSs, the success factor comes from the fact that the community takes control of their own utility requirement and as with many CBO initiatives, they are managed well. The incentive for this, of course, is the value they give to the efficient supply of electricity. So, there is a natural check and balance system in place. However, more of these RECSs require to be studied to assess the real performance. It is important to note that only such a small number of RECSs are operating in a vast country like India.

6.2.2 Potential for Replication in Other South Asian Countries

Once again, the same principles as the REB model apply here. However, this approach will be much cheaper to replicate, as there is no infrastructure overhead such as with the

REB. The RECS operates as an independent utility purchasing electricity in bulk from the utility. Once regulatory reforms are in place to accept this approach, it would be interesting to examine the potential to replicate by doing some pilot projects.

This process is not much different, however, to the Electricity Consumer Societies (ECS) that are operating in Sri Lanka and Nepal's micro hydro mini utilities. This will be studied in the next section. Again, these ECSs have required project facilitation from the outside, in order to develop and manage their projects. Whether this should come in the model of the REB or from local provincial councils with outside technical support from consultants would be an interesting question that requires further examination.

Section 7 Off-Grid Centralized Rural Electrification

7.1 Background

In rural areas where there are close-knit communities, there are successful mini-grid electricity programs developed mostly by non-governmental and community based organizations. The technology most commonly utilized is micro hydro but biomass power is beginning to be used as well.

In taking a closer look at micro hydro-based developments, Nepal and Sri Lanka are seen to have successful programs.

In order to describe the process, examples of specific developments in micro-hydro in Sri Lanka will be used. Similarly this study looks at Nepal's off-grid micro hydro developments.

The interesting lessons to be learned, is the fact that these rural communities are mobilizing for a common purpose. They are taking control of their situation by meeting their own energy requirements by using a locally available resource. In this case, they become independent and benefit from a quality supply of electricity, which would traditionally be provided by the government utility. People, good leadership and teamwork make these projects successful. The success is also a result of a combination of interventions from urban-based experts (who will be referred to as "Project Facilitators"). These technical, business and sociology experts help create the conditions that enable the community to participate in the process from the inception to project operation.

It is a process of helping the community to help themselves. This requires a delicate balance, as no one community is the same as the next. As such, one template for project development cannot be blindly applied to another. This intervention requires the application of situational leadership[7].

For example one community may already be advanced in having a sophisticated community cooperative dealing in micro financing. The other may not have a formally organized cooperative. Intervention styles will have to differ between these types of communities. One may require a delegating or a supporting style of leadership intervention when the other may need a directing or a coaching style. The investment in time will depend on this situation, as capacity-building requirements will be a function of this. This will significantly affect the cost of doing a project, especially as the locations are far from urban centers.

[7] The leadership style one uses should be based on the level of the follower maturity in a group. According to Paul Hersey and Kenneth Blanchard, " the more the leaders can adapt their behavior to the situation, the more effective their attempts to influence becomes". This is situational leadership.

To understand the process, a brief review of micro hydro developments in Sri Lanka will put the current developments into better perspective.

The Intermediate Technology Development Group (ITDG), a United Kingdom based non- governmental organization with a Sri Lankan office developed a more holistic concept in the 1980s, where the simple turbine and generation technology were matched with the people in a village community. ITDG also has a presence in Nepal. Nepal already had a cottage industry manufacturing small turbines. China and Vietnam have also been manufacturing Pico (under 2.5 to 10 kW) and micro hydro (up to 100 kW) turbines from about 1960s. Therefore, the technology was not an issue and these turbines were selling in the open market to individuals who had a source of water. However, attention to safety was poor. It was common to see exposed cable pulled to homesteads on an ad-hoc basis and people did get electrocuted from time to time.

ITDG saw a fit for the technology in Sri Lanka to fill the electrification void in rural communities with a water source.

ITDG developed this technology to a higher level in Sri Lanka by incorporating new developments like electronic controls and adding safety features. It also encouraged the development of simple turbine manufacturing processes. ITDG also replicated this process in Nepal.

Sri Lanka already had a rich history of micro and mini hydro use since the late 1800s in its tea plantations. About 500 units powered tea factories as well as the management bungalows, but most of these had been abandoned as the Ceylon Electricity Board grid arrived in the 1960s. ITDG used these existing civil works to demonstrate and do field trials with the simple micro hydro technology prior to realizing its longer-term goal of introducing the technology to rural villages.

ITDG, in its efforts, not only tested the technology, it also developed a pool of people who could design, install and maintain these units. It was thus able to analyze the financial viability and economic benefits of micro hydro for rural village applications. The term **Village Hydro** was also popularized in the process.

The Micro (Village) Hydro Technology
The System

- Turbine
- Control system
- Generator
- Transmission
- Civil Works (weir, settling tank, fore bay tank, sluice gate, penstock and power house)

Over the years, ITDG has developed over 60 village hydro projects with funding from various sources such as the international donor funded Integrated Rural Development Project (IRDP), Rotary Foundation and later with provincial council funds for

electrification. Other organizations such as IDEA of Kandy have also developed projects again with donor funds. As such, most of the projects have been developed with some subsidies. The Energy Services Delivery project (ESD) has catalyzed more commercially sustainable projects since 1997, based on the ITDG model.

About 24 projects totaling 251.5 kW and benefiting 1,155 households have been commissioned up to end of October 2001 through ESD project funds. Altogether, there are 110 village hydro projects operating in Sri Lanka.

Similarly, in Nepal there are about 4 MW of village hydro in operation initiated by NGOS and run by community cooperatives (similar to Electricity Consumer Societies). These have been funded by donor agencies, the government and with loans from the Agricultural Development Bank of Nepal (ADB/N). The government subsidizes between **50%** and **75%** of the cost based on the remoteness of the project. There is an Energy Sector Assistance Project (ESAP) funded by the Danish International Development Agency (DANIDA) and the government, which is streamlining this funding process, which involves the ADB/N also. The project commenced in 1999 and will end in 2004. Village hydro is also receiving assistance from the Rural Energy Development Program (REDP), which has been spending up to US $ 1 million per year in developments since 1997. This program ends in 2002.

There are seven companies involved in the manufacture and installation of turbines, showing commercial activity in the area. It is projected that by the end of 2002 there will be 7 MW of village hydropower for electrification in Nepal.

Even though, both the Sri Lankan and Nepali projects are growing and the models are sound, there are issues and barriers that have yet to be addressed for commercially sustainable development of the projects. These issues will be elaborated upon in the next sections. Once these issues are addressed, the full potential of the technology can be realized.[8]

In the biomass area, a similar model can be utilized for village level biomass gasifier powered systems. However, where the water resource flows naturally through the system, in biomass power, the resource has to be grown and transported to keep the system going. There is little experience with this technology in the region, except in India at a different level as described in the box.

[8] A recent study done on Small Hydro "An Assessment of Small Hydro Potential in Sri Lanka" – Sunith Fernando, published by IT Sri Lanka in 1999, has identified another 100 such sites ranging from under 44 kW to 100 kW capacity in Sri Lanka. There will be many smaller sites that can produce from 1 kW to 40 kW that could be developed for village hydro.

Biomass for Electrification in India - The Rural Electrification Program of WBEDA:
The West Bengal Renewable Energy Development Authority (WBREDA) has remote island communities powered by biomass based electrification systems. However, these are operated as mini utilities by WBREDA. Even the fuelwood is grown in government owned plantations to ensure consistent supply. There is no community involvement in these except the ad-hoc sale of fuelwood. The only customer involvement is to pay the bill at the end of the month. The community benefits from a reliable source of electricity and it has lifted their standard of living. Electricity is also slowly improving the economic situation of these islands as more and more commercial activities begin and incomes increase. This is a long-term process. This study will not examine this project in detail.

7.2 The Village Hydro Developments

The village hydro projects that are successful, whether developed through private sector or NGO initiative are demand driven. In Sri Lanka, ITDG first studied the electricity needs of a few off-grid communities with water sources. These villages already had a cooperative structure based on what is known as the Funeral Benefit Society.

The Funeral Benefit Society
The rural Sri Lankan's value for after death calls for a dignified funeral and this society is common in most rural communities. It is usually led by a village elder and has a formal structure with a President, Secretary and Treasurer. Some societies practice democracy by having annual elections. There are different levels of democracy practiced by others. These societies have been the foundation for many rural cooperative programs for micro financing, agricultural development and other social development areas. This success has been extended to the Electricity Consumer Societies also.

The Electricity Consumer Society (ECS) is the village utility.

ITDG, in the initial stages, provided much capacity building to establish the structure so; there is community level participation in the project from the beginning. A great deal of time was devoted to training on the technology, project management, and leadership areas as well as in developing teamwork.

7.2.1 Starting a Project

In Sri Lanka, ITDG being a pioneer in the area still gets requests from rural communities inviting them to assess the water resource in the village in order to establish a village hydro project. These requests are also reaching other promoters too. As there are a host of project promoters or catalysts, in this paper they will be deemed "Project Facilitators". The project facilitator in the current context can be a consulting company who obtains funds from the ESD project to commercially develop village hydro projects.

The ESD Project Mechanism for Micro (Village) Hydro in Sri Lanka

- After getting a request from a community the Project Facilitator assesses the project's viability
- The Project Facilitator seeks to develop a village hydro project in partnership with the village community's Electricity Consumer Society (ECS), which has to be either incorporated or registered as an NGO with the government.
- The Project Facilitator can access loan funds on behalf of the ECS through the Participating Credit Institution (an approved commercial bank) based on a bankable proposal.
- The Project Facilitator usually acts as a catalyst to promote the project.
- The Project Facilitator can access a GEF technical assistance grants from the ESD project to help the ECS prepare feasibility studies, a business plan and bank loan documentation. This grant will be provided to the facilitator for independent consulting services in the above area. A sum of US $ 9,000 is available for a facilitator, once the loan is successfully negotiated.
- The Project Facilitator can bundle a group of projects over time and access this grant.
- There is a GEF grant of US $ 400 per kW of village hydro installed with a maximum of US $ 20,000 per project and this will be given to the ECS upon commissioning the project.

Therefore, the project is initiated on the basis of a request from the village. This way it is demand led from the inception. The project promoter will visit the village to assess the seriousness of the interest, the cohesiveness of the community, the existing village cooperative, if there is one, the spatial distribution of the houses and the water resources available. Once a preliminary assessment is made and all these factors are considered favorable, the promoter will convene a meeting with the community. At the meeting, the promoter will gather information from the community on their energy requirements, income profiles, seasonal variations in income, general background and relationships, special skills the people may have (i.e. masonry skills, fabricating skills etc.), what they could contribute to the project, their willingness to donate land to the project if required, etc. After that there will be a discussion on the roles and responsibilities of the community if the project is to go ahead. All the statutory requirements and the requirements from the financial institutions will also be fully discussed. Often the promoter will take to this initial meeting a person from another existing project who can speak, through personal experience, on issues involved in developing such a project. This provides the community with confidence that they can also meet these challenges in order to obtain electricity service.

The Process of Developing a Village Hydro Project (after assessing the water source)

- Check with the CEB (utility) about potential grid extension plans for the village
- Social mobilization of the community to do the project.
- Identifying the site
- Formulation of the Electricity Consumer Society and formalizing it (Incorporating with the Registrar of Companies or registering under the Ministry of Social Services)
- Obtaining statutory approvals (land use, environmental etc.)
- Preparation of technical design
- Developing the technical and financial feasibility study
- Preparation of business plan
- Discussions with the banks
- Developing the bankable proposal
- Opening bank account
- Convincing the Participating Credit Institution of the creditworthiness of the project
- Obtaining funds from bank as well as contributions from the community
- Construction of the civil works and grid
- Procurement of mechanical and electrical hardware
- Installing the system and completion to a stipulated standard
- Ensuring the wiring of households is complete
- Commissioning of plant
- Assist in obtaining GEF grant
- Guide the repayment process to the bank

After the project facilitator is confident that the village community meets all the criteria, the process of developing a technical and financial feasibility study commences. The technical design will be also done (i.e. size of the turbine, generator etc.) at the same time.

Once the feasibility studies show positive potential for the project, the project facilitator will discuss the project with a few of the banks (PCIs) and select one based on the interest in funding this particular project. Based on this interest, the ECS would be formalized (depending on the particular bank's requirements, either through incorporation or by registering as an NGO) and a business plan will be developed followed by a bankable proposal. ECS would have also registered all the members who would get a connection.

There is constant interaction with the bank during this stage to ensure that all the criteria are met for obtaining funding. The process can take up to 3 months and once a proposal is submitted to a selected bank, it could take up to another 3 months for the bank to process the loan application. The project facilitator will also keep in touch with the ESD project Administration Unit who will provide the Consulting fee as well as administer the GEF grant (US $ 400 per kW) after the project's completion.

During this time, the project facilitator will obtain all the statutory approvals such as land and water use clearances as well as environmental clearances. For small projects below

100 kW, the Central Environmental Authority (CEA) has a fast track process, which only requires a questionnaire to be filled.

If the CEA deems a visit is required, they will go to the site, but otherwise they would deal with the Divisional Secretariat (the sub district's government agent) who will assist them at the local level to ensure that no violations will be committed by the project.

All these types of approvals will also take about 3 months and by the time the loan is approved these should also be in place.

Once the funds are approved the construction can commence. By this time the ECS would have obtained commitments from its membership as to who would provide material (such as cement, bricks, granite rock, wood for poles etc.) and who would provide "sweat equity" in skills such as masonry for the civil works, woodwork and general labor. All this would have been quantified in the project's financial proposal also. This way the community becomes fully engaged in the project.

A contractor to install and commission the project will also be selected from the pool of available experts during this period. Members in the community who have a technical aptitude will join the team to install and commission the system. In this manner, a few people will learn the technology and be able to provide general maintenance and manage the system.

The equipment will also be purchased based on the technical design and in consultation with the contractor.

The construction, typically, takes 3-6 months for completion. Usually, a project takes 1 year from concept stage to commissioning.

In the meantime, the project promoter will also work with the ECS in assisting in capacity building, with respect to the general management of the project, accounting, financial controls, deciding on the tariff* or the membership fee, developing a constitution (the constitution of the board, election procedures, rights and responsibilities of members etc.), and issues related to leadership and teamwork.

Once the project is commissioned, it is handed over to the ECS. The ECS hires a technically trained person from the village to operate the system. The grid would be powered on an auspicious date and the community will get electricity. Typically, between 25 and 100 houses are electrified in such projects.

Once the project commences, especially if there is a loan commitment, the ECS has to ensure that the management procedures are adhered to, so that the funds are collected and the loan repayment is made on time. Also, if the ECS is incorporated there are statutory requirements such as regular board meetings, an annual general meeting and submitting of audited accounts to the registrar of companies on an annual basis. If the ECS is

registered as an NGO, it has to submit annual audited accounts to the Ministry of Social Services, registrar of NGOs.

The project promoter may assist the NGO in regularizing these procedures.

The Electricity Act and Off-Grid Village Hydro

The Electricity Act of Sri Lanka, for instance, does not allow any party other than the Ceylon Electricity Board (CEB) to generate and sell electricity to consumers, unless their permission is obtained. This can be done on the approval of the project's technical standards by the Chief Electrical Inspector. In Sri Lanka's case, the Chief Electrical Inspector is housed in the CEB and as such not deemed independent from the CEB. As such, all the village hydro developments are operating outside the Electricity Act. However, as they are community based and operate as a cooperative, instead of the ECS selling electricity to consumers, they give membership to consumers who pay a membership fee. So there is no tariff in these systems. However, this is an anomaly that has to be addressed in the Electricity Act of Sri Lanka.

As these schemes get more popular and as outside investors begin to invest in them, their legal standing needs to be secured. There are other issues such as quality and safety standards that cannot be enforced under the current situation. Also, there are questions related to what happens when the main grid is finally extended to these communities. Can systems be linked, are they made redundant, at what price will electricity be delivered, and how will it be determined? These types of issues need to be considered and addressed in a broader policy setting. Some of these issues are looked at in the complimentary study: ***'Rural Energy Services – Legal and Regulatory Review'.***

7.3 People Issues

The success of off-grid community based projects hinge on the cohesiveness of the community. Cooperation amongst the members of the community is paramount for a project's success. Here, good leadership is required to first interest the community on such a venture and then to commit it to developing the project. The benefits of electricity are a strong motivator for such collective action.

As described earlier, these projects are mostly demand driven, so community participation is the recipe for success in most of these projects. The community working for a common goal then decides on the membership, the leadership, rules and regulations, rights and responsibilities accordingly. Therefore, this common goal prevents problems such as right of way disputes for power lines, usage of the set limited amount of power (mostly 100-200 watts per day), illegal connections, and ensures that everybody pays the membership fee to maintain the system.

7.4 Barriers and Possible Interventions

Even though such projects are being developed both in Nepal and Sri Lanka, there still seems to be a need for outside intervention by a project facilitator. The project facilitator provides a very crucial service at technical, management, financing and project implementation levels. Lack of capacity at the regional level (close to the project areas) means that this intervention is provided from external sources through consultancy services. However, private sector consultants can be costly, especially for a rural community with a low level of economic activity. Therefore, in the current context, this cost has to be met through outside means in order for projects to be developed. In Sri Lanka's case, the ESD project has GEF Technical Assistance funds for a consulting company to act as the project facilitator. However, the ESD project ends in July 2002.

Can this process be sustained without this external subsidy and intervention? There are several ideas that are currently being discussed and the most promising one is to establish Off-Grid Energy Development Centers at the Provincial Council level. These centers would be funded by the government and have the capacity to provide the rural communities with the same ability to hire consultants to assist the communities to develop projects. The idea requires the central government to establish a special fund to support all the provincial councils in this program, as a part of a rural electrification fund.

Another idea is to establish an apex organization with all the Electricity Consumer Societies as members. This organization would support the ECS's to be sustainable over a long period of time. For instance, many an ECS face problems at a time when technical breakdowns occur to the system. If the repair is costly, they may not be able to meet it. Also, with so few technical experts available, it gives rise to a monopoly situation and at times, the charges can be unreasonably high for repairs.

The ECS apex body can ensure that all members are provided with proper guidance and advice to keep the project running smoothly at a technical and a management level. An apex body may also operate a revolving fund to provide loans for expansion of projects or even assist with the main grid connection at a later date. Having a Provincial Council body will complement such an organization. There are already micro financing institution models such as the Thrift and Credit Cooperatives Society (SANASA) in Sri Lanka, which operates in this basis.

In the area of utility grid connections, the power sector reforms may enable the ECS to link with a utility grid where it can purchase electricity at bulk rates and distribute within the community. This will move the off-grid-centralized approach to the grid-based approach. With proper planning and foresight, South Asia could witness a future where off-grid projects would be incorporated, possibly along the lines of the Bangladesh REB, thus eventually tying them also onto the main grid system.

7.5 Replication in Other Countries

First of all micro hydro is resource based and can be replicated in countries in the region, which have hilly terrain with water sources. India, Bhutan, Pakistan, Nepal and Sri Lanka have such terrain in rural communities.

As such, this off-grid centralized electrification model can be applied, but requires appropriate intervention from urban centers with capital, technology and capacity building for project facilitation, development and management.

Community participation is paramount in developing successful projects. If projects are demand driven, this will fall into place. If a project is supply driven by the government or another outside entity, this aspect will require much more attention. As it is, even in demand driven projects, there are social issues that have to be addressed in terms of the community participation. Here, leadership and teamwork is key to a project's success. As such, replication of these types of projects will hinge on the nature of the community and how committed they are to being involved in such projects.

Finally, with power sector reforms underway in the region, off-grid projects will need to be considered as a vital element of the national energy mix.

Legislative action is also required to amend Electricity Acts to enable the ECSs to operate legally as micro-utilities. Such a change will help the transformation of the ECSs towards becoming a Rural Electric Cooperative Society (RECS) as described in the previous section. This way the development of such projects will become easier as there will be policy level support and incentives from the government and interest from investors in developing projects.

Section 8 Off-Grid Decentralized Rural Electrification

8.1 Background

There are many possibilities for rural households to obtain electricity at the individual level. Technologically, it could be kerosene or a diesel generator; a battery based 12-Volt DC power system, a small wind generator, a biogas generator system or a micro hydro. However, the first step for a rural household in moving away from kerosene lighting is to invest in a battery based system. The most popular technology used at the moment is a 12-Volt battery based system as it is the cheapest and the easiest to obtain (even though the regular recharging of the battery is an inconvenience). The next most popular and a graduation from a battery system is the solar photovoltaics (PV) system.

Most of the land area in rural South Asia has an abundance of sunlight. As such, if the area is not connected to the grid, is too far to transport fuel to, and has no other energy resources (wind, hydro etc.), a popular alternative is decentralized solar PV systems.

People who use an automotive battery get it re-charged every ten days or so at the nearest charging center. In addition to a few 12 –Volt lamps, this system has the added benefit of powering a small television and a radio. The next step is to add a solar PV module to the system to close the loop, so the battery does not have to be transported, at times, up to 10 kms to the nearest charging center every time it requires recharging. However, a solar PV module cannot be merely hooked up to this system, as the existing components such as the battery and wiring may be of poor quality.

A solar PV system, therefore, is a distinct unit that has to be installed to a technical standard. It is accepted that a typical system should have the following components in order for it to provide an adequate service to the end user;

The Solar PV System

- The Solar PV Module
- Battery
- Electronic Charge Controller and Fuses
- Lamps and Switches
- Appropriately sized Wiring and Connections
- Sockets for a Television/Radio

The most successful method of disseminating solar PV systems in the region has been to sell the systems outright to customers.

There are “fee for service” models emerging in countries such as the Dominican Republic (developed by a company called Soluz), but the large areas that have to be serviced with a dispersed population, especially in Bangladesh, Nepal and Sri Lanka require a significant investment in infrastructure. Here, the ownership of the system lies in the

hands of the energy service company along with the obligation to ensure efficient operation of it in order to obtain the monthly fee. This operation seems financially unviable and as such is not developed in the region.

There are successful models of solar PV dissemination in Nepal, Bangladesh, Sri Lanka and India. One common feature in all these models is the attention paid to customer service. Customer service is especially important when in-house financing is provided. If the system breaks down during the repayment period, the customer will not pay the installment.

Therefore, this study will examine the approach where solar PV systems are sold to customers as a cash sale or with micro financing.

8.2 The Market

The solar PV market consists of typical village households, which are dispersed in rural areas that have no other energy source such as a waterway available in the area. These homes would have been using kerosene for lighting or a battery based system to operate a few lamps, television and a radio. A typical household would be engaged in agriculture and in rural terms, at the middle to upper income level (between US $ 1,500 and US $ 2,500 per annum income).

The challenge to developing this market comes from the fact that these households are dispersed far and wide in remote areas. As such, institutions promoting solar PV systems have to establish infrastructure close to the market. This requires a decentralized operation, which for a typical business poses many challenges.

8.3 Institutional Arrangements

A typical organization has to have a relatively flat structure with the front line team of technicians and sales people empowered to make crucial decisions in order to make a sale. This requires training as well as a well-defined set of procedures and guidelines in within which to operate.

Sales of a solar PV happen in many different ways:

- At the solar center/shop in the village
- During demonstrations at village markets
- While the technician/sales person travels through the areas visiting existing customers

Satisfied existing customers are an important source of new sales as people in surrounding areas have seen the system in operation.

In many instances, a household may not have sufficient funds in hand to pay for an entire system, if financing is not available. In these cases, the technician/sales person has to

make a judgement on the creditworthiness of the customer and install a system based on this.

The company has to establish infrastructure in potential rural areas in order to market, promote, assess requirements, design, sell, install and maintain systems. This center has to also keep in stock parts and items such as bulbs, fuses, controllers, lamp-circuits, and batteries in order to respond to after-sales requirements as quickly as possible.

Micro financing has now become an integral part of a successful solar business. This happens either in-house like in the case of Grameen Shakti in Bangladesh or in vendor/micro financing institution partnerships such as in Sri Lanka and India.

8.4 Developing a Business

The first step in developing a business is to establish the market potential. Typically, target areas would be where the utility grid does not currently reach nor is expected to reach for the next 5-10 years. As such, information on grid extension plans of the utility is crucial. However, as rural grid extension in South Asia is politically motivated, even the utilities have no control over where the grid will go in the near term. Local politicians have decentralized budgets that may be invested in grid extension for political reasons, even though the area may not bring an adequate return on the investment to the utility.

For instance, in Sri Lanka, the Ceylon Electricity Board extends the grid based on a **12%** return on investment. Therefore, this does pose a challenge to private sector and NGO solar PV business developers. However, the local politician can override this by investing in the grid extension, even if the project is not viable. Micro hydro developers also face this problem. One way to overcome this issue is to develop business in areas in consultation with the local politicians as well as the CEB regional offices.

Once, it is established that an area would not get access to the grid, a market study should be done with household surveys. As there are typically, households using kerosene and a battery- based system in rural areas, there should be two different questionnaires. This survey should assess the electricity requirements, ability to pay for a system and the willingness to pay. It should also assess the increase in market share if micro financing is available. The ability to pay will be directly related to what a household spends on lighting and entertainment currently. Willingness to pay will depend on the need.

If there are children in the household, people put an importance on studying and entertainment with a TV and a radio. This is where the intangible value for electricity comes in that cannot be measured. This also becomes an emotional decision and people seem to move mountains then to obtain a system. It is very difficult to capture the market potential based on a quantitative level, given this situation.

Once the market potential is established, there is sound basis to set up a business. The most important aspect of the business would be to establish the infrastructure to market, promote, design, sell, install and maintain systems close to the market place. As the

market is in remote rural areas, this infrastructure has to be set up as close as possible to these areas. Typically, a village solar center is established to do the above tasks. The center also requires trained personnel. A solar PV system, like any other technology requires high quality components and sound installation practices. Technically qualified people are required to provide this service. However, in order to keep the overheads as low as possible, it is also important for these people to possess marketing and people skills as well. However, this can pose a challenge, as often technically talented people may not be people oriented. Therefore, the selection process is crucial to ensure that these team members have talent in both technical and marketing areas.

Once a solar center is established, promotions and marketing is the key to developing the business. The systems maybe sold under a brand name and like any commercial business, the brand building process is crucial as the rural markets are now getting sophisticated.

A new technology like solar PV requires people to see a system operating. As such, demonstrations are crucial. An effective form of demonstration is to invest in a system installation at a village community center or a religious center (a temple, kovil, church or a mosque).

For instance, Power & Sun (Pvt.) Ltd. (later Solar Power & Light Company Ltd.) in Sri Lanka first installed systems at Buddhist temples, as this was a traditional village community center. Often the community also contributed to the purchase of the system, which gave them some form of ownership. The television became the drawing point for the community in the evenings. As the system operated over a period of time, people gained confidence in the technology and began purchasing their own systems. Other promotional means are through demonstrations at village markets. Once a few systems are sold in an area, the best form of marketing would be through the existing customers. Therefore, it is crucial to ensure that the system is installed well and backed up with after-sales service to ensure customer satisfaction.

All the current successful promoters in the region such as Grameen Shakti in Bangladesh, Selco India or the member companies of the Sri Lankan Solar Industries Association[9], have developed sound after-sales service practices as one bad customer will spread the news in the area, thereby severely affecting potential future sales.

Typically, a system is checked once a month at least for six months and bi-monthly afterwards as a part of the one-year free service program. Warranties are provided for the components. Solar PV modules have warranty periods between 10 and 20 years (depending on manufacturer) and all other components have a 1-2 year warranty. User training is a very important component, as the customer has to learn the capabilities and the limitations of the system.

[9] The Solar Industries Association (SIA) of Sri Lanka was formed with GEF Technical Assistance Funds as a part of the ESD project to assist the industry to work together to grow the market. So, far members include, Shell Renewables, Selco Sri Lanka, Alpha Thermal Systems, SEEDS (MFI) and Access Solar. SIA is doing technical training, a market study to assess future potential and lobbying for more policy level support as well as general public relations activities for the industry through its secretariat.

This is no different to ownership of other products such as tractors or motorcycles. The system also requires some basic maintenance such as periodic checking of battery electrolyte as well to ensure that the connectors are kept clean from salt deposits. Depending on the size of the system, the power availability will vary, so the customer has to manage the system to ensure that they get electricity when most required. The skill of managing the system improves with time, so support from the business during the first six months of ownership is important. Also, this support provides the customers with a safety net and builds confidence in the technology.

Grameen Shakti has formal user training programs on a regular basis. This not only helps customers to learn about the system, but also creates a lasting relationship between them. They use these programs also as a means of marketing in the areas. Current customers are also given gifts such as umbrellas using special raffle draws. This way, Grameen Shakti creates goodwill with existing customers as well as others in the area.

Other vendors in the region provide customer training in varying degrees of formality, but it is accepted that it is also an important marketing tool to develop the business in the area. On the other hand if a system fails and there is no proper back-up service, it will set back the process of market development.

Grameen Shakti and the Vision for a Connected World

Grameen Shakti is a part of the Grameen Bank, which was established in 1976 to extend banking facilities to the poor in both urban and rural areas of Bangladesh. The bank is established in 40,000 of the 68,000 villages. The Grameen organization believes that the rural areas in Bangladesh will come out of their poverty by leap-frogging into the world of information technology. Grameen Shakti has already established six computer-training centers and has plans to open 14 more in the next two years. This is creating a rural base of experts in the area. It also has the vision of opening up solar PV based communication centers with internet, email, fax and telephone services in every village. Part of this dream has already been met with the telephone services fast becoming commonplace with Grameen Mobile Phones. Grameen Bank has established an associate non-profit company called Grameen Telecom in 1997 to develop the mobile phone market in rural Bangladesh. There are about 7,000 Grameen Phones in the market already.

The objective of the program is;

- To provide easy access to a telephone in rural Bangladesh
- To introduce a new income generating source for Grameen Bank borrowers
- To bring the potential of the information revolution to the rural Bangladesh
- To introduce telecommunications as a tool to eradicate poverty

Grameen Shakti has got a strategic alliance with Grameen Telecom to sell solar powered telephones with financing in rural areas. This vision is not only creating opportunities in rural areas for people, but also expanding the solar PV market as these also act as effective demonstrations of solar PV technology. There is an added poverty alleviation benefit where Grameen Shakti links solar PV to income generation as well as improving the quality of life.

8.5 Micro Financing

The up front cost of the solar PV system is relatively high for a typical rural household. As such, financing becomes an integral component of marketing solar PV systems. However, financing is a specialist business and outside the core area of a typical company marketing solar PV systems. There are entities such as Grameen Shakti in Bangladesh where there is in-house financing. But, this is more of an exception than the rule.

Therefore, vendors have to create partnerships with specialist micro financing institutions or banks that operate at a rural level. Mainstream financing institutions that are urban based are not yet venturing into rural areas. As such, the choice is somewhat limited. Even, if rural lending institutions exist, most shy away from lending for individual solar PV systems, as there is an issue of security. This is compounded by the fact that systems are installed in a dispersed manner. Therefore, the risk of financing a solar PV system seems too much for these institutions.

However, there are successful models that have emerged in India and Sri Lanka with sound vendor/financing partnerships. In Sri Lanka, a pioneering rural micro financing institution (MFI) called Sarvodaya Economic Enterprises Development Society (SEEDS) has now evolved into a development bank and provides financing for solar PV systems in partnership with the vendors. SEEDS has a vast network of rural MFIs operating as village level cooperatives.

The Sri Lanka Vendor/Financing Partnerships

Vendor/Financing partnership has evolved in Sri Lanka where a leading micro financing institution (MFI) called SEEDS is providing rural level credit for solar PV household systems. SEEDS is in partnerships with vendors, Shell Solar, Selco Solar Sri Lanka and Alpha Thermal Systems. SEEDS has an agreement with each of the vendors whereby when a system is sold, if the customer is deemed credit worthy, they will be provided a loan for a period of 3 to 5 years. One special feature of the agreement is that the vendor guarantees to cover any customer who defaults on the payment. This way the vendor also has a commitment to keep the system operating efficiently and minimizes the risk to SEEDS. If a customer defaults on a regular payment because of operational problems with the system, the vendor will repair the system if it has a fault. But, if it's a willful default by the customer, the vendor will repay the entire loan amount to SEEDS and then remove the system from the customer.

The process works as follows:

- the vendor gets a sale
- vendor informally assesses the credit worthiness
- obtains **25%** down payment
- vendor gets the SEEDS loan application filled
- installs system
- trains customer on the system operation and maintenance
- hands over the loan application to the area SEEDS office
- SEEDS loan officer visits customer
- SEEDS loan officer approves customer
- SEEDS office approves loan
- SEEDS makes payment of balance **75%** of system cost to vendor
- SEEDS loan officer collects monthly repayment

It takes about 60-100 days for the vendor to get the payment. However, the customer gets the use of the system from the day of the installation and the SEEDS office begins payment collection from 1st month by the local office.

A typical system costs between Rs. 27,000 and Rs 35,000 (US $ 290 and 375) (30 Wp to 40 Wp system installed with up to 6 lamps, controller, wires, switches and battery). The vendor pays **25%** down payment and SEEDS finances **75%** of the cost. The loan period is between 3 – 5 years and the interest rate is about **24%** per annum.

Up to December 2001, a total of 9,500 systems have been installed with vendor/SEEDS financing and there have been no reported loan defaults.

8.6 Human Resources

This approach calls to the test the most modern methods of human resources development and management. The decentralized nature of the business requires the organization to empower the frontline team members who interact with the customers. In fact, this business has to be managed by remote control. Marketing solar PV is a difficult business. The frontline team has to endure much physical hardship to reach customers. Then there is the challenge of selling a relatively new technology, which costs much higher than what people have been paying for energy. On the other hand, one cannot get away from the fact that, the organization has to be profitable to be sustainable. The direction to achieve this success has to come from the top of the organization, often based in an urban center of a country.

Any team will consist of a diverse set of people who will have their own needs, style and motivations. Therefore, if each member has to be managed differently based on some basic guidelines and principals to keep some uniformity. Uniformity is important in creating a brand image down to reporting procedures. Situational leadership is most important in the process of establishing best practices in marketing, selling and after sales service. In effect dealing with people in different styles based on the team member talents. There has to be consistency also in the fact that purpose of the organization is "performance". This performance has to be deemed valuable by both the internal customers (team members) and the external customers.

Therefore, the challenge is for the top management to define performance in terms of the right outcomes (i.e. sales targets, customer satisfaction levels) and let each team member find their own route to achieve these outcomes.

Feedback is an essential part of this process. Grameen Shakti does an annual customer service survey to get feedback from customers. There are also random checks on customer satisfaction levels. This is an excellent way to keep track of the performance of the team on achieving the outcomes.

This process is based on individual talents of people[10]. This takes it back to the hiring process. In hiring the front line team for the solar PV business, people have to be multi talented [11].

[10] Talents are recurring forms of behavior in people or what people are naturally good at. Latest management theories suggest skills, knowledge and talent are distinct elements of performance. Skills and knowledge can be taught whereas talents cannot.

[11] There are three basic categories of talents people possess. They are "Striving" or "why" of a person (competitiveness, altruism etc.), "Thinking" or "how" of a person (decision making process, practical, linear or a strategic thinker etc.), "Relating" or "who" of a person (relationships, confrontational or friendly etc.) according to "First Break the Rules – What World's Greatest Managers do Differently" by Marcus Buckingham and Curt Coffman of the Gallup Organization.

Solar PV business requires a multi talented frontline team. This team has to possess all three talents. Altruism is an important talent as the inherent difficulties of doing this business is rewarded by grateful customers who often become their friends. Electricity changes people's lives and this alone is a motivator for many of the talented front line team members. The team also has to possess both technical and relationship talents. As the companies have to keep the overheads as low as possible, it is not feasible to have specialist marketing and technical staff.

Therefore, in addition to technical talent and the related acquired skills, the team has to have a talent for thinking on their feet and be a "people" person. This business is about relationships. This is a further challenge in the hiring of the team.

The success of the Sri Lankan solar ventures has been as a result of this emphasis on human resources.

The Case of Power & Sun (Pvt.) Ltd. (later Solar Power & Light Company Ltd.)

Power & Sun (Pvt.) Ltd. (later Solar Power & Light Company) developed a frontline team of ten youths to become micro entrepreneurs. They were encouraged to earn an independent income by selling accessories, bulbs, and batteries in addition to supporting the local dealer to sell solar PV systems and installing them. Each team member was provided a motorcycle and a tool kit, which they owned and paid for on a monthly basis. One of the key learning points was that some of the talented technicians refused to market and sell systems. As a result, they got marginalized, as the company could not afford to support them without their marketing and selling of the systems. The remaining team was nurtured over the years with training, motivation and financial rewards for developing their areas. There was very close contact between the management and the team. The management encouraged the team to take risks to develop the market. Much of the risk came in the form of giving customers short- term credit, since at the time there was no micro financing available. They became known as "Mr. SUNTEC" (brand name) in their areas. This was the model that Shell Renewables International inherited when it purchased Solar Power & Light Company in 1999.

8.7 Customer Service

Customer service is the key success factor in developing this market. This is a challenge in the solar PV business given the fact that the customer base is spread out over distances. The nature of this market may mean walking for hours to reach customers, especially in the hilly terrain of Nepal, for instance. Grameen Shakti takes customer service so seriously that they do an annual independent customer service survey to ensure that accepted standards have been met. There is always room for improvement, so these surveys are used as important feedback towards improving service.

Customer service is even more important with micro financing. If there is no in-house financing like Grameen Shakti, it is often a vendor/MFI partnership. Here the MFI takes a risk in financing a system that could potentially breakdown (if the system or the installation is of poor quality). In this event, the customer would not repay the loan.

Therefore, there has to be a commitment to service from the vendor to ensure that the system operates well. Often, the vendor has an agreement with recourse to minimize the risk to MFIs as described earlier.

Therefore, the entire organization has to be geared to satisfying the customer. This means recruiting talented people, training and empowering them at the front lines to ensure that high standards are adhered to in serving the customer.

In the successful companies, customer service is not only an onus on the front line people, but the entire organization. The head office must support the front line team with quality products delivered on time. Cross-functional relationships within the organization are crucial to offer a smooth delivery of service to the customer. For instance, when there is a system failure (i.e. controller, lamps, battery), head office must support the team with spare components on time in order to rectify the problem.

This becomes a challenge when the vendor has a MFI partnership. In Sri Lanka's case the MFI is a socially oriented organization. There can be a clash of cultures between business that is bottom line oriented and the relaxed and more people oriented attitude of the MFI. This may mean delayed loan approvals or system payments, which will affect cash flow of the vendors. All this will ultimately affect customer service, as the companies have to finance the infrastructure to provide it.

Overall, rural populations are becoming more and more sophisticated. As such, the companies have to also offer new products to enhance and improve the system on an ongoing basis. Typically, for the first purchase the customer may not have cared about the design of the lamps fixtures, but after a year, they like an upgrade to more aesthetically pleasing fixtures, at least in the living room areas. Customers also like to move on from a black and white TV to a color TV or to get a fan, which then requires an upgrade in power. These create more opportunities for business.

Companies are beginning to also get closer to the customer, such as Grameen Shakti's customer seminars. They offer gifts to customers in order to develop an ongoing relationship. There has also been an attempt to develop a Customer Newsletter, as this is another way getting closer to them as well as keeping customers informed about new products.

Section 9 Electricity Supply Regulations in Relation to Rural Energy Supply

The following activities are considered to be the primary activities that constitute electricity supply regulation in the ***Rural Energy Services – Legal and Regulatory Review***.

These are correlated to the approaches in this study to assess specific regulations that are required for the particular approaches.

Table 9-1:Electricity Supply Regulations in Relation to Rural Energy Supply

Activities	Relevant Approaches	Comments
Tariffs setting and enforcement	▪ Micro Hydro and Biomass Mini Grids	This is relevant in the process of protecting customers from private sector developers of these projects.
Electricity supply regulations making, revision, and enforcement	▪ Rural Electric Cooperatives ▪ Micro Hydro and Biomass Mini Grids	The Electricity Act Sri Lanka for instance does not allow any organization other than the utility, Ceylon Electricity Board to generate and sell electricity.
Licenses issue, enforcement, and revocation for electric power generation, transmission, and distribution	▪ Rural Electric Cooperatives ▪ Micro Hydro and Biomass Mini Grids	Revising of Electricity Acts.
Electricity supply service quality, reliability, and safety standards setting and enforcement	▪ Rural Electric Cooperatives ▪ Micro Hydro and Biomass Mini Grids ▪ Solar PV Systems	To protect customers - especially important in rural mini grids as keeping costs down may compromise on safety standards, for instance. The ESD project in Sri Lanka has established standards for micro hydro and solar PV and tied to the GEF grant.

Consumer protection	▪ Rural Electric Cooperatives ▪ Micro Hydro and Biomass Mini Grids ▪ Solar PV systems	Minimize the risk to consumers. This is most important in the area of selling individual solar PV systems, where the consumer takes a risk, especially if no financing is available.
Licensees uniform systems of accounts establishment and enforcement	▪ Rural Electric Cooperatives	Relevant especially with decentralization of energy services to regional bodies such as provincial councils in the case of Sri Lanka.
Control of rural electricity supply entities management structures Control of rural electricity supply entities operational and financial performance	▪ Rural Electric Cooperatives ▪ Micro Hydro and Biomass Mini Grids	An Apex body could be effective here for both approaches.
Arbitration, adjudication, and settlement disputes among licensees	▪ Rural Electric Cooperatives	
Ability to use legal means, including use of subpoena powers, to obtain information for tariff and regulations setting and enforcement actions	▪ Rural Electric Cooperatives	
Land use rights authority, such as the establishment of rights-of-way for electricity distribution systems	▪ Rural Electric Cooperatives ▪ Micro Hydro and Biomass Mini Grids	Clear guidelines will help in micro hydro and biomass mini grid project development.
Environmental regulation and permitting	▪ Micro Hydro and Biomass Mini Grids	Streamlining approvals will fast track and keep costs down in micro hydro and biomass mini gird projects.
Electricity demand forecast preparation, including power to collect information from licensees	▪ Rural Electric Cooperatives	Leads to transparency and will enable replication
Promotion of efficient, economic, safe supplies and use of electricity.	▪ Rural Electric Cooperatives ▪ Micro Hydro and Biomass Mini Grids ▪ Solar PV systems	Protecting customers as well as investors.

In this study a number of approaches have been discussed that lend themselves to replication. However, in order for replication of the approaches to occur in South Asia, most of the issues identified above under 'Comments' need to be properly addressed as the current Electricity Acts do not recognize their significance.

In Sri Lanka, for instance, the Electricity Act does not allow any party other than the Ceylon Electricity Board (CEB) to generate and sell electricity to consumers, without its permission.

As such, all the village hydro developments are operating outside the Electricity Act. They are able to skirt the legalities because they are community based. As the ECS operates as a cooperative, instead of the ECS selling electricity to consumers, they give memberships to consumers who pay a fee. So there is no tariff in these schemes. However, this is an anomaly that has to be addressed in the Electricity Act of Sri Lanka.

Section 10 Conclusion

Three approaches have been studied in this paper. All have a role to play in the electricity sector of South Asia. In fact, they complement each other in the process of rural electrification. The rural electricity market is complex by the nature of the region's demographics, socio-economic situation and politics. Electrification has become a key political issue in the region and as such has been subjected to ad-hoc short-term policies and developments, which has left most utilities in the region bankrupt. Also, over **50%** of the population yet use kerosene for lighting.

In the meantime, the demand for electricity has created market-based activities led by NGOs and the private sector. Decentralized technologies such as solar PV and micro hydro are utilized to bridge this void. Yet, only the more affluent in rural areas have been able to afford a solar PV system as well the fortunate communities with a water resource and outside facilitation, have been able to benefit from a micro hydro mini grid. Therefore, the actual number of households that benefit from these initiatives has been low compared to the potential market.

In Sri Lanka, for instance, it is recognized that 200,000 of the 2 million unelectrified households could afford a solar PV system at current prices. Yet only, 20,000 systems have been sold in the last 10 years. There are similar statistics in the other South Asian countries. Yet, most of these 20,000 householders are happy with the service they get from this system. Therefore, why this is not moving faster is because, governments in the region have not considered and supported alternatives such as solar PV and micro hydro as viable options. As such, governments seem to be working at cross-purposes to alternative energy promoters when they should be working together. Therefore, governments continue to look at rural electrification through grid extension. Given the current economics of grid extension, the governments will have bring in alternative approaches to the energy mix to meet the goals set for electrification. There has to be public/private/NGO/CBO partnership in the process, in order to attract outside investment for development.

There has to be the political will also to change the regulatory structure of the energy sector. ***Rural Energy Services – Legal and Regulatory Review*** addresses many of these issues. This will require the current utility model to be restructured. This system is entrenched in South Asia, so change is not going to come easily. The change also has to happen in a transparent manner and in consultation with all the stakeholders. The number of stakeholders has increased as it begins now with the end-users or customers from rural to urban areas who want to be a part of the process. The Energy Forum of Sri Lanka has reached the most remote rural stakeholder groups and has created a network to include them in the dialogue on energy. There has to be a participatory process, as people cannot be left out of the loop in developing the new paradigm of electrification.

All this requires creative thinking. Governments have to take the cue from the rural population who desperately want electricity and have taken the risk to invest in new technologies like solar PV. They also have to support the promoters of these businesses and NGOs, who have taken the risk to explore new market opportunities. They have all, in the process, created a paradigm shift in electrification. Government has to support this process now as the shift has commenced. This way it will become a part of a rational new energy mix in South Asia.

Therefore, this study's aim was to illustrate that alternative approaches are already successful, be it the Rural Electric Cooperative model, the Off-Grid Centralized or the Decentralized models. They just have to be incorporated to so it al becomes an integral part of the national energy policies and delivery systems.

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Appendix A The Rural Electrification Board of Bangladesh

Statistics as of June 2000

Total Number of PBS - 66
Number of Thanas (sub-districts) - 424
Number of Villages - 29,684
Total Distribution Lines - 116,496 kms
Total 33/11 kV sub-stations - 195 (constructed by REB)
- 50 (taken over from PDB-DESA)
Total Number of Consumers - 2,891,647

Customer Categories

1. Domestic - 2,355, 091
2. Small Commercial - 340,954
3. Irrigation - 82,253
4. Industries - 58,219
5. Street Lights/others - 55,130

Average Bill Collection Rate - 96.93% (55 PBSs)
Average System Loss - 16.24%
Average system loss except 6 - 13.85%
PBSs recently taken over which has large losses (on average 22.82%)

Source: Annual Report 1999-2000, Rural Electrification Board, Bangladesh – June 2000

The Management Team of REB

Position	Main Responsibilities
Chairman	Chief Executive Officer of the Board and responsible for overall development, management and administration of REB and affiliate organizations like PBS.
Member – Engineering	▪ Engineering systems design for REB/PBS ▪ Standards and specifications for equipment and materials for electrical and civil projects ▪ Tendering for services and processing of contracts for REB/PBS engineering projects as directed by the board ▪ PBS feasibility, planning, engineering studies, power supply, electrical operations, electrical maintenance and repairs of major equipment

Member – PBS & Training	▪ Development, organization and establishment of boundaries of the PBSs in the several districts of the country as approved by the board ▪ Establishment and enforcement of PBS electric service regulation and lay down terms and conditions under which PBS members will get electricity services ▪ Business operation of PBSs, assisting in personnel recruitment, management, billing, collecting, power use and other member services ▪ Development and administration of the REB Training Institute for orientation and training of all level of leaders and employees of REB and PBSs.
Member – Finance	▪ Assist Chairman in financial planning and obtaining sufficient capital, including foreign financing for various phases of the rural electrification program. ▪ Internal accounting and financial control of REB funds according to a uniform system of accounting as adopted by the board ▪ Consolidation and preparation of annual REB budget for submission to board ▪ Preparation of various financial reports as required ▪ International and local procurement of equipment and material and supplies as approved by the board ▪ PBS loans accounting systems, financial planning, periodic audits of PBSs
Part-Time Member	Four part-time members shall serve as liaison for their respective organizations in an advisory capacity to the board.

PERFORMANCE TARGETS AGREEMENT
Criteria

1. System Loss:
2. Accounts receivable:
3. Accounts payable:
4. Debt Service Coverage:
5. Plant revenue ratio:
6. Equity status as percent of total capitalization:
7. Recovery of Amounts Written-off:
8. Payment of Debt Service Liability (TK '000)
9. Annual Load Factor:
10. Revenue per KM of Line (TK '000)
    The revenue per KM of line must be maintained at a minimum of Taka 5000 per KM of line above the total expense of providing electric service per KM of line.
11. Total cost of providing Electric Service/KM of Line. (Excluding Power depreciation & Amortization expense, Interest expense & Provision for uncollectable amount, i.e. 0.5% of sale of electricity.) (TK '000)
12. Percentage of total connected consumers Billed:
13. Annual Growth in consumers (service in place):
14. Re-connection of disconnected consumers:
15. Liquidity Status
16. Inspection of distribution line (KM):
17. Maintenance of distribution line (KM):
18. Preventive Maintenance of Transformer & OCR (No):
19. Repair of damaged transformer & OCR (No):
20. Consumers Hours Outage:

Appendix B Grameen Shakti, Bangladesh

The Vision of Grameen Shakti based on the interview with – Mr. Dipal Barua, Managing Director (19th November 2001)

- GS projects to have installed 7,000 by end of 2001
- The GS business is centered on customer service excellence. There is a strong focus on training and the GS teams are disciplined in this area. GS also does an annual "Customer Service Survey" independently to assess the level of customer satisfaction and how to improve. They also have special training programs for customers and provide gifts and certificates of ownership to create a "pride of ownership of a GS system". GS is building brand loyalty in this manner and creating goodwill. Customers are looked upon as their best form of promotion to increase business.
- GS has an important role in Bangladesh as **75%** of the country does not have access to the grid. The aim to work up to 100,000 systems in 5 years.
- The GS vision is to create income generation activities with solar PV in combination telecommunications. Here he is developing a strategic partnership with Grameen Phones (already has about 7,000 connections), which is creating a network of women entrepreneurs who provide telecommunication services in the village.
- This vision extends to the Information Technology area where GS has established 6-computer training centers in villages (with a target of 20 in 2 years) with a view of establishing Internet Centers in villages, which can be utilized in adding value in commercializing the rural agricultural sector. GS targets to establish 20 Multi Communications Centers (computer training, internet, fax, telephone services) also in 2 years.
- In addition GS plans to establish 20 battery- charging centers in a very low income remote areas.

Appendix C The First Grid Connected Solar PV System in Sri Lanka

The first ever grid connected solar PV system was inaugurated in Sri Lanka in January 2002. The Honorable Minister of Energy, Karu Jayasuriya, opened the project. This 25 kW system supplies the Ceylon Electricity Board (CEB) Grid during the day. The system is owned by Worldview Global Media based in the suburbs of Colombo and was funded through NORAD. The linking up of the system to the CEB grid is a significant achievement as it has resisted linking small suppliers even though there is a private power purchase process in place. So, far 20 MW of privately developed mini hydro projects have been linked to the CEB through this process. The smallest system installed is a 750 kW unit.

This particular system has 185 Eurosolare solar PV modules (120 Wp) arranged in 9 arrays and feeding 9 Sunny Boy (Ecotec) 2.5 kW inverters. The grid connection system has protection from islanding in the event of grid failure. There is also a set of digital meters that reads the kwh (units of electricity) produced and delivered to the CEB at a given moment, the power produced (kW) and the tons of carbon emissions mitigated from the energy produced from the Sun.

As there is no provision in the CEB's power purchase agreement to purchase solar electricity, the project was passed by deeming it a mini hydro project. Therefore, in the power purchase agreement, it is referred to as a mini hydro project. This is an anomaly that has to be rectified in the power purchase agreement if more of such projects are to come in stream.

Worldview has plans to expand the system to 100 kW. At the total system cost of US $ 125,000 (which included design, hardware, installation, grid interconnection and commissioning), this project is not commercially viable at the moment, given that the CEB pays only Rs. 4.10 (US $ 0.04) per kWh produced.

However, the project has received publicity in the media and this will certainly help in the marketing of rural solar PV systems, as people get more of an assurance that the technology works. It has also set a precedent for the CEB to purchase power from very small producers.