Financing Renewable Energy in Developing Countries: Analysis of Business Models and Best Practices

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INTRODUCTION

The World Bank has reported that an estimated 1.29 billion people in 2008 lived below $1.25 a day, equivalent to 22 percent of the population of the developing world. Almost over three billion people live on less than $2.50 a day and at least 80% of the world population lives on less than $10 a day. The relationship between income poverty and energy poverty is also ubiquitous. Today, there are 1.4 billion people around the world that lack access to electricity, some 85% of them in rural areas. Without change in current policies, by 2030 the number of people without electricity will drop only by 200 million. Sub-Saharan Africa continues to remain one of most the electricity deprived areas of the world. Further, the number of people relying on the traditional use of biomass is projected to stay same by 2030 (Kaygusuz, 2012, p. 1116).

It has been argued that rural electrification results in poverty reduction. Availability of clean, affordable and efficient electricity spurs economic growth and fulfills human needs of health and education (Nouni, 2008, p. 1189). It also provides electricity inputs for basic activities such as pumping water for drinking and irrigation, lighting for increasing working hours in the evening, and increase economic and social productivity of the rural poor (Nouni, 2008, p. 1189). Moreover, clean and affordable energy can also act as a catalytic in achieving Millennium Development Goals (MDGs) (Bast, 2011, p. 4).

However, traditional finance mechanisms are not applicable in rural areas. Rural populations are spread out often in small pockets with dispersed locations and hence conventional grid is difficult to extend to such areas. As a result of low population density, difficult terrain, and low consumption, rural electricity schemes are costly to implement (Tomkins, 2008, p. 48). Project financing is virtually not possible since project cash flows are not adequate. In addition, low rural incomes can lead to problems of grid affordability and maintenance. Also, long distances mean greater electricity losses and more expensive customer support and equipment maintenance. Thus rural electrification projects have often required subsidies to make them financially viable (Tomkins, 2008).

However, success of Grameen Shakti and other successful rural electrification programs have shown that the task of rural electrification can be undertaken with government support and long-term commitment to rural market. This report will therefore highlight some of the common ways of undertaking rural electrification projects including micro finance energy lending programs and commercial finance approach such as fee for service, leasing and consumer credit finance. In doing so, it will highlight some real world examples such as Grameen Shakti and SELCO and will discuss common ways to manage credit and operations risk in rural energy financing.

LIFE IN RURAL AREAS AND BOTTOM OF PYRAMID:

Life in rural areas is starkly painful. Almost a third of the world's population earns $2.50 or less a day. The quality of life gets severely affected since rural poor suffer most from natural calamities, tragedies and catastrophes. Moreover, irregular income streams and lack of access to financial markets deprive them of essential health, insurance and credit products. A common analogy to define this level of poverty is to imagine standing in water up to one’s chin. The only thing one is prepared to focus on is whether water will rise further. If it does, life becomes terribly miserable. The penchant for risk is close to zero.

However, academicians have realized that there is a business case with the poor living in extreme poverty. With $ 2.5 per day income and a population of 2 billion people, it signifies a market of approximately five billion dollars a day. Moreover when the next segment of the poor is added in the group (individuals earning $5 a day), it makes the total market for the poor at an estimate of $ 10 billion a day and a staggering $ 3.6 trillion per year. This market is referred as “bottom of the pyramid” publicized much by C.K. Prahalad and S.L. Hart in their 2002 article, ‘The fortune at the base of the pyramid’ which frames the global economy as a pyramid based on the 4 billion poorest people, with enough demand for private sector to venture into those markets.

SCOPE OF RENEWABLE ENERGY IN RURAL AREAS: KEY CHARACTERISTICS FOR SUCCESS

Rural demand for electricity comes mainly for cooking, lighting and space heating. Cooking accounts for between 90% and 100% of energy consumption (Karekezi, 2002, p. 1073). The rest of the energy consumed is for lighting, provided either by wood fuel or kerosene lamps and candles. Space heating is required in areas with cold climates, and is often catered by energy used for cooking.

From the user centric perspective, rural electrification needs to take into account of 1) affordability, 2) reliability and 3) applicability of renewable energy technology to domestic needs. Low income rural population lacks the means of purchasing high cost RET equipment like solar panel. Since, credit markets are often absent in rural areas, the ability to raise capital and deposit a collateral is beyond the means of the poor. Further, this also explains why down payments and high initial payments for RET does not allow RET dispersion in rural areas (J.D.Schillebeeckx, 2012).

From the perspective of donor or supplier of RET (governments, in most cases), there are other factors that need to be taken into account. Cost recovery is probably the single most important factor for supplier of RET in rural electrification projects, determining the long-term effectiveness of such projects. When electricity utilities rely on subsidies (which are cyclical and regressive), higher sales only result in higher losses, thereby creating a significant disincentive for utility to expand on an unprofitable system (Barnes, 2004, p. 5).

Moreover, the price of electricity needs to be adequate to cover the O&M costs. There is a wide invalid belief that electricity tariffs need to be extremely low in order to benefit the rural electrification projects. However, charging the right price allows the electricity company to provide an electricity supply in an effective, reliable, and sustainable manner to an increasing number of satisfied consumers (Barnes, 2004, p. 5).

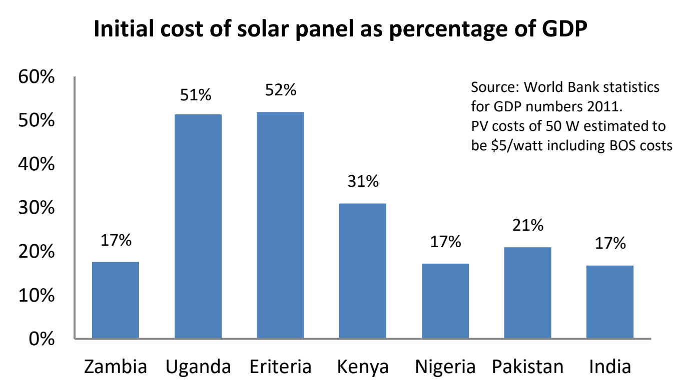
IS SOLAR PV AN ANSWER TO RURAL ELECTRIFICATION?

Often however, RET case is best argued by solar photovoltaic (PV). Solar PV has definite advantages especially when it comes as an energy supplier in rural areas. Rural populations are spread out often in small pockets with dispersed locations. The geography poses another important issue with conventional grid difficult and expensive to extend to low income and dispersed population. As a result of low population density, difficult terrain, and low consumption, rural electricity schemes are costly to implement (Tomkins, 2008, p. 48). Project financing is virtually not possible since project cash flows are not adequate. In addition, low rural incomes can lead to problems of affordability (though where electricity replaces other commercial fuels, such as kerosene, households' energy costs may fall rather than rise). And the long distances mean greater electricity losses and more expensive customer support and equipment maintenance. Thus rural electrification projects have often required subsidies to make them financially viable (Tomkins, 2008).

Solar PV can be a panacea for rural electrification since distributed generation means that it will be close to load, eliminating T&D losses and customized to dispersed villages with low operating and maintenance needs. PV is also showing cost competitiveness in rural areas especially the price collapse of PV module post 2009 with declining LCOE and dollar per watt cost.

Despite LCOE and $/watt with a downward trend, there exist one substantial barrier for the mass implementation of PV as a distributed energy supplier in rural areas: high upfront capital costs. High upfront PV panel and BOS costs implies that significant percentage of rural household investment is devoted to a technology that is yet to be tested in their own circumstances. A simple comparison of initial costs of solar PV as compared to percentage GDP of different countries can capture this reality. A small PV system of 50 KW with a cost of $ 5 per watt (including panel, BOS, marketing and transportation costs) means a cost of $ 250 for the system. The graph below shows the cost of $250 as a percentage of each country's GDP which is a significant portion of a country's GDP per capita. This comparison itself is misleading since the GDP per capita figure also includes urban residents. Rural inhabitants of developing countries are poorer than their urban counterparts with often less regular income flows.

For rural households, the investment needed to purchase a PV system represents a huge capital outflow. For example, in Kenya, the typical cost of a PV system can purchase up to 3 cows, which provides milk besides being a liquid asset in the times of crisis. Alternatively, instead of purchasing PV, households may prefer to purchase 4 to 5 bicycles which can be further leased and provide the family a steady stream of income. Further, in some parts of sub-Saharan Africa, the investment of



a typical PV system could build a new house for the family (Karekezi, 2002, p. 1076).

The investment required in PV system is a tough choice for rural poor. An already cash strapped poor can use the same savings for other important occasions like marriage, death and other times of wealth and crisis. Moreover, PV production is highly mechanized with labor costs contributing to only small part of the total production costs, giving less opportunity to create domestic jobs and services. This also means that developing countries will not be able to capitalize on increased penetration of PV technology and have to depend on increased imports, resulting in additional burden on foreign exchange reserves that are already constrained on accounts of high imports. With exports relying largely on commodities production, a downward cyclical trend in commodity markets often result in severe economic depression among rural communities forcing them into further poverty. For instance, recent commodities price shocks in cotton and coffee have hit mostly rural population in Sub-Saharan Africa and Asia that rely on raw exports of such commodities as their income. In essence, it would not be a good macro-economic practice to encourage RETS (with high upfront capital costs) unless national governments and donor agencies are committed of providing subsidies for long term.

The next few sections will cover financing methods of rural electrification projects:

MARGINAL COST FINANCING

Public sector projects especially rural electrification projects need to be implemented keeping in mind the marginal benefit and costs approach. Capital is only scarce and limited and therefore if it is being used for rural electrification projects, it is not used for some other projects such as a school or a hospital. A functioning school or a hospital offers far better productivity improvements than rural electricity especially when it is connected to the grid, resulting in generally high costs and poor quality of supply and disappointing low load growths and low productivity gains if not targeted adequately. In most cases, national governments need to allocate scarce resources to different sectors of the economy as well as individual projects within a given sector such as health, education, energy and environment (Munasinghe, 1988, p. 4).

A common approach to use marginal costs analysis is to use cost benefit ratio. Cost benefit analysis is a way to quantify all the benefits and costs and evaluate the alternatives on the basis of minimum attractive rate of return (MARR). The approach allows a more general way to allocate scarce resources to renewable energy projects rather than somewhere else in the economy. A project is accepted if:

PW (benefits) – PW (costs) > 0 or;

$$\frac{B}{C} = \frac{PW\ benefits}{PW\ costs} = \frac{EUAB}{EUAC} > 1$$

In government sponsored rural electrification projects, where costs and benefits are hard to calculate, the equation can be molded as follows:

$$\frac{B}{C} = \frac{All\ quantifiable\ consequnces\ to\ the\ users\ or\ the\ public}{All\ quantifiable\ consequnces\ to\ the\ sponsor\ or\ government}$$

In a typical rural electrification projects, the following quantifiable benefits may accrue to public (broken down in three segments):

Industrial and Commercial use of electricity

- Motive power – replacing liquid fuels
- Lighting – replacing liquid fuels or gas
- Space heating - replacing liquid fuels, biomass, coal, animal waste or gas
- Processing food - replacing liquid fuels, biomass, coal, animal waste or gas

- Transport – replacing liquid fuel

Household uses of electricity

- Lighting – replacing liquid fuels, biomass, coal, animal waste or gas
- Preparing meals - replacing liquid fuels, biomass, coal, animal waste or gas
- Space heating - replacing liquid fuels, biomass, coal, animal waste or gas
- Home appliances – replacing batteries, biomass or coal
- Drinking water – replacing liquid fuels (for pumping)

Agricultural uses of electricity

- Water pumping - replacing liquid fuel or manual labor
- Heating and drying – replacing biomass, coal or liquid fuel
- Milling, chaff cutting, threshing - replacing biomass, coal or liquid fuel

Source: (Munasinghe, 1988)

The following quantifiable costs will be accrued to the sponsor (mainly government):

- Initial investment
- Opportunity cost of capital
- Operation and maintenance

Starting with the household customers, the benefit estimation of incremental revenues is relatively simple with an estimate of potential revenues that would be realized with selling of electricity to rural population. A further benefit is accrued by calculating the foregone expenditures on alternative fuels like lighting for kerosene (Munasinghe, 1988, p. 16). Other benefits such as increased productivity and convenience are difficult to quantify and should only be accounted with prudent estimates. A similar analysis can be undertaken for commercial and industrial customers by estimating increased benefits accrued to the business or replacement of existing, less efficient energy generation means (such as isolated diesel generators or fuel savings etc.).

An alternative can also be used by estimating total net benefits (which equals benefits less costs) and then calculating net present value (NPV) of such projects. In its most primary sense, a project is accepted if the NPV of a project is positive using a discount rate:

$$\text{NPV} \sum_{t=0}^{T} \frac{B-C}{(1+r)^\wedge t}$$

Where B and C are benefits and costs in year t; r is the discount rate and T is the time horizon.

Similarly, project IRR of rural electrification project can be calculated and compared with IRR of different public-sector projects such as health, education and infrastructure to reach a conclusion. In order to accurately judge the project IRR, sensitivity analysis can also be performed (such as raising all costs by 20% and reducing all benefits by 20%) and comparing the resulting IRR to competing projects IRR.

The drawback of benefit cost approach is the difficulty in understanding benefits and costs. The approach does not take into account "welfare" which is central to rural electrification projects rather it only takes into consideration incremental/marginal benefits and costs. The approach might tell us how to maximize income but does not provide us a clear idea if the underlying goal is to maximize welfare (with higher subsidies or lower incremental revenues). The choice, in the end, resides with the government and their overall aim whether they want to maximize income or optimize welfare.

ENERGY MICROFINANCE

Microfinance is usually referred as an extension of the provision of financial services to micro-entrepreneurs and small businesses, which lack access to banking and related services primarily because mainstream banking and finance ask for high transaction costs. Access to clean and efficient energy services can be improved if people will have access to small loans with low transaction costs to pay for them.

Below are some of the most practiced microfinance energy lending models:

Energy finance lending with technical assistance. In this model, Micro Finance Institution (MFI) enters into contract with an energy service company with MFI giving out the loan and service company extending technical and after sales services. The financing is therefore backed by service and maintenance of the energy products which increases customer confidence on the technology and encourages positive reviews (Morris, 2007, p. 21). The model can be further worked around with variations. For instance, governments and donor agencies can offer grants and partial price subsidies (25–45 percent of the upfront cost) to the client, dispersed by energy service companies and monitored by independent government or third party audits.

One company end to end model: An alternative model is when modern energy services offer financing itself (not using third-party MFI) or a MFI offering technical and after sales energy services after providing initial capital. Energy companies generally establish their own credit programs since it is difficult for MFIs to operate in rural populations despite agriculturally affluent rural areas with stable energy demand. Similarly, MFIs venture into energy services since it brings better efficiencies in their business operations to operate alone rather than relying on a third party to affect their business performance. For instance, in the Dominican Republic and Honduras, subsidiaries of the energy company Soluz offer micro-rental financing options to rural clients (Morris, 2007, p. 22). On the other hand, Grameen Shakti (MFI) offers after sales services and technical support to its customers once providing them with initial financing.

Microfinance based on subsidies: In this model, subsidies are offered as either funds or grants to MFIs for further lending to rural poor for energy services (Morris, 2007, p. 22). In many community electrification projects, capital costs can also be funded by a mix of contributions from the community, grants from MFIs, and loans from multilateral/donor agencies.

COMMERCIAL FINANCE

Fee for service: As discussed above, in developing countries, photovoltaic systems remain unaffordable for inhabitants of rural areas due to high upfront costs which therefore warrant innovative and affordable financing mechanism for these countries and citizens. Fee for service schemes is one of those. This method enables users to spread the up-front costs of photovoltaic systems over a long period, and charge a minimum fee per month that usually provide solution to the problem of operation and maintenance of their equipment. However, the ultimate ownership of the equipment resides with the supplier of the equipment, usually an Energy Service Company (ESCO).

There are several advantages of using fee for service models in energy lending. Often times, fee for service schemes have been handled by ESCOs which are then responsible to obtain monthly payments from customers rather than handing out energy systems directly to customers. This enables to link financial and commercial interests within one organization (Lemaire, 2009, p. 22). ESCOs can obtain and use centralize subsidies from public authorities given individually to each customer would probably be monitored more loosely by a public administration or a bank. Moreover, when ESCOs manage the systems, local authorities can trust them to recover the cost of the systems, unlike if the systems were given directly to individuals (Lemaire, 2009, p. 22).

However, even well subsidized fee for service programs (where ESCOs get upfront subsidies from donor agencies or governments) there are possibilities of such models not working out. First, these approaches are targeted to rural areas where income stream is unpredictable and fickle. There is high possibility that rural poor can default even on the most affordable of installment plans. Second, these models are implemented in areas which suffer from high inflation rates which can make lending expensive, if the initial borrowing by ESCO has taken place in foreign currency relative to local currency. A study from Zambia on fee for service model concluded that even with an initial subsidy, only the wealthiest customers of the area, with regular incomes, can be targeted (Lemaire, 2009, p. 18). It also suggested that like all rural electrification programs, a long-term involvement of the state is still needed to cover part of the capital costs and expand the scheme to new customers.

With basic economics, it can be seen that high capital outlays of solar PV cannot be disseminated to rural areas without the help of donor agencies and long term government commitment. It is clear that majority of citizens of Africa and Asia will never be able to pay for the full cost of off grid solar, in the same way as they are not able to pay for the full cost of grid connection. The question then becomes: should people of rural areas be entitled to subsidies similar to those who are already recipient of on-grid energy services, mostly residing in urban areas? If the answer is yes, then fee-for service energy companies provide an appropriate model of delivering reliable energy services to these areas and should be considered seriously in rural electrification planning.

LEASING

Whereas fee for service does not allow ownership to be transferred and thus reduces the incentive for rural poor to produce energy of their own, leasing models allow rural poor to take ownership of the system. Under a leasing arrangement, ESCO typically retains ownership of the energy system until the cost is recovered (also known as financial lease). The system itself is taken as security for the lease arrangement. In this model the owner of the property - ESCO - allows the client – rural poor– to use the property for a specified time in return for payment. The ownership is usually transferred to the user after the leasing period ends.

Leasing arrangements generally comprise of the following components (The U.S. Agency for International Development, 2003, p. 118):

- Lessee cannot terminate the agreement or if he does, he will be charged a penalty
- Arrangement on purchase option of the system after the basic leasing period
- Level of leasing installments, interest rate and monthly payments
- Technology operation and maintenance of the equipment (ESCO can provide O&M cost for a price)

Most leasing programs for RETs have been set up with donor agency grants or low- or zero-interest loans provided to ESCOs and further channeled down to rural poor. One can always come up with different variations such as establishment of a revolving fund to buy PV systems that will be rejuvenated by payments made by the customers. ESCO will serve as the manager of the funds, will decide the credit requirements of participants, registers qualified customers, carries out bulk system purchases, provides installation and maintenance services, collects fees, and performs other administrative tasks. Once, however, a loan is paid off, ownership is transferred to the customer.

HOW TO MANAGE CREDIT RISK – INSIGHTS FOR RURAL MARKETS

Credit risk is an important consideration in any lending activity. Normally, credit risk is defined as the risk of default or of reductions in market value caused by changes in the credit quality of issuer or counter parties (Duffie, 2003, p. 4). The credit risks are usually borne by the lender that include lost principal and interest, disruption to cash flows, and increased collection costs. Credit risk is the most important risk, even more important than technological, political and liquidity risks.

Credit risk is difficult to manage in rural areas since default rates are high for poor segment that lack collateral for loan securitization. Grameen Bank model has shown that careful lending to the poor, possibly in community groups can significantly improve re-payments and that poor can be credit worthy, a belief which has never been accepted by the mainstream financial community. Here we will highlight basic principles of credit risk that need to be taken into account when lending to the poor.

Capital is a scarce resource which serves variety of purposes, one of which is to provide a buffer in times of financial crisis, illiquid and uncertain markets. In rural markets where individual income stream is often fickle, managing credit risk can be challenging and need to be supported by either government or donor agencies loan program. Credit risk management becomes problematic in rural areas where work is predominantly agricultural based since it is inherently more risky than other sectors due to its vulnerability to climatic shocks, commodity price volatility, and trade restrictions (Wenner, 2007, p. i).

There are two broad means of evaluating credit worthiness 1) appraisal of repayment capacity and 2) asset backed lending. The first method requires officers and staff involved in credit related activities such as credit approval, administration, and monitoring and recovery facilities on the grounds to evaluate customer credit. For this to work, an effective assessment needs to be done to ascertain borrower’s financial condition (income stream) and historical performance etc. As a Grameen Bank best practice, the credit process starts at the branch manager, who knows customer and income profile and then approved by a supervisory authority. A stringent credit approval requires greater personnel to constantly review credit profiling of customers and will result in greater human resource activity. However, this activity is warranted as rural electrification is not a profit driven exercise, rather an activity to support rural development. The only disadvantage, however, is high administration costs due to high requirement of personnel on the ground.

Asset-backed lending values and secures a loan based on the collateral, usually the asset itself. The asset backed loan has to be understood in terms of valuing and understanding assets and after resale markets. Normally, asset backed financing have three important risks: asset illiquidity, unanticipated asset depreciation due to changes in technology or market, and legal risks. The longer it takes to liquidate securitized assets; the worse off the lender will be (Wenner, 2007, p. 12). Similarly, the lender loses if collateral inventory loses market value, deteriorates in storage, or is damaged (Wenner, 2007, p. 12). Lastly, because asset-based financing results in complex documentation and strict compliance with commercial codes, legal errors can prove costly to the business. More importantly, asset-backed lending tends to work where there are well-defined property rights, uniform commercial codes for all jurisdictions and functioning property registries and court systems, much of which is unfortunately not well defined in developing countries.

IS $/KWH MODEL VIABLE IN CREDIT RISK EVALUATION IN RURAL AREAS?

The financial viability of any energy system is evaluated by using metrics such as LCOE and $/KWh costs of energy. However, as discussed, high upfront costs of RET such as PV system creates a barrier to rural communities to use such systems. As K.N Reddy elaborates, even the cheapest of PV systems (two and four light) can only be afforded by the richest rural sections constituting only 17 and 7 percent of entire rural population. Even the cheapest light system is beyond the means of the poorest 25% of the rural population (Reddy, 1999, p. 3440). Moreover, installing a RET equipment in rural areas will always be prohibitively expensive, resulting in high $/KWh costs. A high $/KWh costs can only be repaid with either high monthly installments (shorter tenor of the loan) or longer loan period (with small monthly installments), both of which are not good credit risk mitigating strategies. High monthly installments will put additional burden on borrower's already meager disposable income whereas longer loan period will increase operational costs of collecting loan and raising chances of default.

The question then is: Since RET is cost heavy, are they mass deployable? The answer to this can be best understood by the fact that if the purpose of RET technology is to augment income capacity, then $/KWh and LCOE metrics do not apply. For instance, suppose that a one light PV system let a tribal household to weave two extra baskets per day or allow a vegetable vendor to extend the working hours in night, resulting in incremental income not possible previously can result in substantial savings to pay for the PV systems.

Thus, it is important for RET planners to incorporate income generating programs/ideas that can best supplement PV system deployment. Without supplementing income generating opportunities, RET projects will continue to sustain on subsidies, fail to alleviate poverty and will only be limited to rural rich.

REGIONAL RURAL BANKS

Regional Rural Banks (RRB) offer several advantages as a vehicle for energy microfinance lending. First, The RRBs mobilize financial resources from rural areas and grant loans and advances mostly to agricultural laborers and rural peasants and farmers. Second, pricing is transparent and market based which increases competition and promotes fairness. RRBs can also get price and interest rate subsidies from governments which can result in low prices for consumers. Moreover, with enough human resource on the ground and credit and adequate and recovery staff recovery staff, rural lending can become an attractive proposition for banks since repayment records are generally good. RRBs can be given a front end subsidy (to cover high upfront costs of RET) or a back end technology (subsidies given to customers if they meet monthly repayment requirements) to facilitate rural energy financing.

Below is a list of policies/practices that RRBs can undertake to mitigate credit risk in rural setting:

- Geographic and sectoral diversification: External shocks can be mitigated (climate, price, natural disasters, etc.) by practicing geographic diversification ranging broad industries and sectors
- Crop diversification: RRBs provide loans to wide variety of agricultural commodities

- Loan size: RRBs provide small loans to many families rather than large loans to few
- Savings based lending: Classical rural financing approach where credit lending limit is only a multiple of savings. Rural communities are encouraged to save and based on their savings (daily, weekly, monthly), their future credit limit is approved. The savings can, in turn, also act as collateral of their loan. (Wenner, 2007, p. 7). The disadvantage is that if deposit rate is low and inflation is high, then savings will not be substantial.
- Guarantee funds: Default risk can be mitigated by government/donor agencies backed guarantees. Similarly, credit insurance can be purchased wherein bank will collect repayment from insurer in case of loan default (Wenner, 2007, p. 7).
- Provisioning: RRB's can estimate potential losses that it might experience due to credit risk which can be treated as an expense on the company's financial statements. By allowing earlier detection and coverage of credit losses in loan portfolios, it enables banks to build up a buffer in good times that can be used in bad times. Generally, provisioning for bad microfinance loans is done on a "basket" basis, which involves making a blanket provision for the aggregate outstanding balances of loans without looking at individual loan profiles. An example of a basket provisioning is as below:

PARTICIPATING CREDIT INSTITUTIONS:

Whereas regional rural banks and village credit institutions can offer funds for capital expenditures and upfront costs of RET, participating credit institutions (PCI) can offer funds for liquidity management of such a technology. Liquidity management is the way by which farmers cope with fickle cash flow stream that arise from uncertain commodity prices, yields, weather and production costs (Barry, 1981, p. 216). Most farmers are cash affluent in the post-harvest season but require cash in the pre-harvest season to manage their production.

PCIs are owned and controlled by community members and function according to rules established by the community. Loans are given out for working capital purposes to smooth out any variations in the income stream of farmers and can be used for operation and maintenance of RET equipment. Profits are reinvested, shared among members or allocated to reserve for future purposes. Moreover, the unions can form regional and national networks that enable them to transfer excess liquidity.

Credit unions are a suitable institutional type for rural microfinance: They comprise of rural community members and serve excellent function of credit risk management. Moreover, they have the ability to service large numbers of depositors, and use these savings to provide a diversified range of loans to individual members (Zeller, 2009, p. 20). Other key strengths are their ability to sustainably achieve a large breadth of outreach (Zeller, 2009, p. 20) and also act as social guarantor to most of the loans. They are also adaptable and can quickly adapt new technology according to needs of rural communities.

BUSINESS MODELS IN PRACTICE

GRAMEEN SHAKTI:

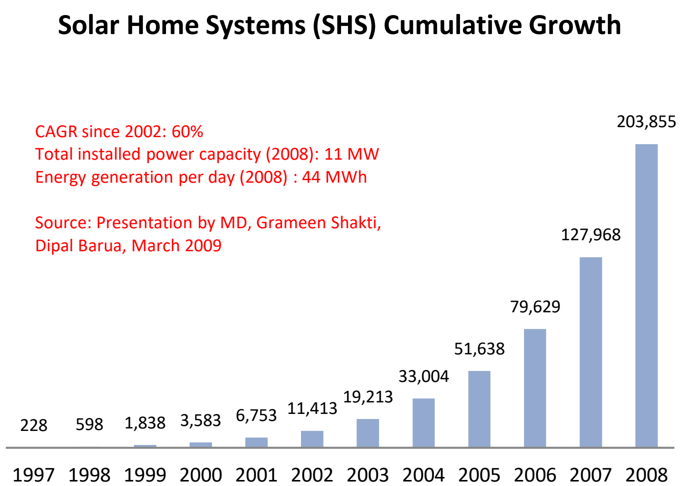
Grameen Shakti (GS) has been successful in encouraging RET in Bangladesh using a business model which is self - sustaining. GS has been successful because it allows customers to choose from wide range of soft credit, in house maintenance at low cost, income generation opportunities, and effective after sales service including consumer friendly options such as a buy back system. Established in 1996 as a not for profit company, GS aim to empower rural people with access to clean, affordable and reliable energy.

The success factor of GS model lies in its competitive pricing model, reputation of Grameen Bank, reliable after sales service and capacity building of rural communities before and after introducing the PV technology.

GS always tried to keep the product within the limit of affordable price for its clients by locally developing accessories of SHS of standard quality such as charge controllers, inverters and ballast for fluorescent lamps etc. It also provides free support for three years from the date of installation. GS engineer visits rural sites once a month during collection of monthly installment to check the system and record its performance. If required, a corrective action is taken on the spot. Moreover, GS arranges training programs for both technicians and the consumers to disseminate the technology and build capacity of local entrepreneurs by providing them business ideas to use RET (Barua, 2004, p. 4).

GS comes on the back of a reliable name of Grameen Bank which is already proven as a sustainable business model to donor agencies and countries willing to lend support. GS therefore, generates much of its capital through donor agencies and countries willing to support Grameen ventures. The initial capital generated is then re-distributed to customers via different modes as below:

- Model 1: Customer has to pay 15% of the total price as down payment during installation and remaining 85% of the cost is to be paid by monthly installment within 36 months including 12% service charge (Barua, 2004, p. 6).
- Mode 2: Customer has to pay 25% of the total price as down payment and remaining 75% of the cost is to be paid by monthly installment within 24 months with 8% service charge (Barua, 2004, p. 6).
- Mode 3: Customer is given a 4% discount for cash purchase (Barua, 2004, p. 6).



GS business model is different from other energy lending institutions model as it provides all services under **one umbrella** which include soft loans, vast network of trained social engineers, in-house R&D specialists and capacity building initiatives to augment income generating activities via the use of RET.

Such a business model, however, is not easily replicable as it requires huge initial capitalization, deep commitment to rural lending and ability to undertake losses. As mentioned above, GS comes under the banner of Grameen Bank which is already popular among lenders and donor agencies and can undertake such an exercise at a grand level.

SELCO India

The Solar Electric Light Company, India or SELCO India is a for-profit social enterprise based in Bangalore, India. The SELCO India is known to have improved living standards of rural Karnataka by providing solar energy based interventions and low smoke cook stoves. SELCO India is the recipient of Ashden Awards (also known as the Green Oscars) twice, in years 2005 and 2007 (Wikipedia, 2011). SELCO was founded by Dr. Harish Hande in 1995 with initial funding of INR 15,000 and later supported by IFC.

SELCO is distinct from its counterparts in energy lending model because their services and products are not standardized. They believe in distinct and viable solutions for rural communities based on their specific needs and then providing them with doorstep financing to ensure they are able to pay for the product. For instance, lighting needs are carefully designed keeping in mind the needs of the customers and their capacity to pay the monthly, weekly or even daily loan installments.

With SELCO, sales cycle starts with an understanding of how much money a customer can pay as loan installments every month. A SELCO technician discuss with the customer the various costs of providing light, both the real monetary expenses as well as various non-monetary benefits. For example, the household might incur expenditures of Rupees 50 worth of kerosene every month plus the labor time to acquire the fuel. With solar lights, the family might be able to earn an additional income of Rupees 50 per month with added advantages of better health, increased hours of study for the children as well as time saved in procuring kerosene or forest-wood. Adding all of these, the customer might probably be in a position to pay Rupees 150 per month as loan installment which could allow him to procure a two-light system (Mukherji, 2008, p. 6).

As mentioned, SELCO is loosely knit organization and what makes them different is customization of services and products. In such business model, the role of technician becomes even more important. So for instance, if a household requires a minimum of four lights, one each for the kitchen, bedroom, living room and cowshed but can only afford the two then the technician will sit with the family and make some engineering alteration or suggest some lifestyle changes to make the two light system feasible for the household. For instance, a family might need four rooms to be lighted but the rooms need not be lighted simultaneously. It is also unlikely that the family would need lights in the bedroom and in the living room at the same time. Therefore, SELCO technician will complete the wiring in all the rooms, provide four points where the lights can be fitted, but supply only a two light system that would meet both the budget and the needs of the customer (Mukherji, 2008, p. 6). They would ensure that the lights can be easily fixed and removed from each of the four points so that the family can carry the two lights with them from one room to the other depending on where they need them most. Sometimes, the internal structure of the house would allow fixing a light at the intersection of two rooms, ensuring that two rooms get illuminated with one light (Mukherji, 2008, p. 6).

In words of Dr. Harish himself, SELCO's success factor is not in its standardization model (as practiced by Grameen Bank) but rather a flexible financing and energy delivery system.

"We could have gone in for some one-size-fits all system, but we didn't," says Harish. "When it comes to the poor, everyone wants to standardize solutions to save cost, but not us. Thus, we have a significant amount of pre-sales activity, all of which is done by the technicians because they are in the best position to understand the context as well as the solution that can meet the requirement."

Another difference between SELCO and Grameen model is the mode of financing. Whereas Grameen bank is one umbrella model, where customers can get the financing from Grameen Bank, SELCO stays away from financing its customers and focus completely on providing customized services. SELCO works with rural banks, credit cooperatives and microfinance agencies to make necessary arrangement of credit for their customers but very rarely finance the product themselves.

With regards to operation and maintenance, SELCO charges INR 250 as annual maintenance contract for a four light system, which provides customer two maintenance services and one emergency service on call. SELCO technicians check every solar installation twice a year to ensure they are in proper working condition (Mukherji, 2008, p. 7).

To date, SELCO has sold solar lighting to more than 110,000 rural homes and to 4,000 institutions such as orphanages, clinics, seminaries and schools in Karnataka (Mukherji, 2008, p. 13). An impact assessment study by World Resources Institute in 2007 reported that 86% of SELCO's poor customers cited significant savings in energy costs as their primary benefit of using SELCO products, while others thought that solar lighting has aided to their child's study needs (Mukherji, 2008, p. 14).

SOLAR SISTERS

Among the 1.6 billion people on the planet that don't have access to electricity, 70% of these are women and girls. A billion Africans use just four percent of the world's electricity and energy scarcity is hampering both social and economic development of African continent. Solar Sisters, in order to fight energy poverty has created a distribution model to spread energy access to rural Africa by incorporating seed-financing and right technology.

Solar Sister uses the micro-consignment model (MCM) to provide women with a 'business in a bag' which includes a start-up kit of inventory of portable solar lamps and mobile phone chargers, initial business training and marketing support like branded flyers, t-shirts, business and ledgers for accounting along with support for community launch events to showcase the products at high visibility locations (Misra, 2011). These workers then go out in the rural market to solicit new renewable energy customers.

The strong point of this model is the ownership and distribution model run by rural entrepreneurs themselves. In this way, the organization (Solar Sisters) does not have to spend additional money to reach out to customers, lowering down their operations and maintenance costs. In its most basic instance, a woman rural entrepreneur uses the money to purchase a consignment of lamps or lanterns, which she then sells to her close neighbors, colleagues and relatives, encouraging people to replace kerosene lamps with solar lamps by highlighting their benefits (healthier, safer and better for the environment).

The Solar Sister, once selling the first inventory of lamps is further eligible to receive training in marketing, inventory and business skills. She can also become a team leader and recruit other Solar Sisters. Her business incentive includes a commission which she earns from her lamp sales, which help to improve her ability to pay for healthcare, education and food for her family (SouthernInnovator, 2012). Once selling the consignment, she repays the money and is then eligible for her next borrowing.

The benefits are obvious. Solar Sisters, knowing the ordeal of dirty and hazardous energy will be willing to pay for a clean substitute and will encourage others to adapt the technology. Moreover, the distribution model is worth noticing since it pays for commission as incentive, encouraging women to reach out to potential customers without incurring any of its own investment on distribution network which is much cheaper and allows the company to focus more on technology development, arrangement of seed capital from donor agencies and training and development.

Solar Sister began operations with a successful pilot project in Uganda in 2010. As of June 2011, there are 107 Solar Sister Entrepreneurs working in 10 teams reaching 34 communities in 3 countries - Uganda, Rwanda and Sudan bringing the benefit of solar power to over 4360 African people (Misra, 2011).

BAREFOOT COMPANY

Barefoot Power Ltd was established in 2005 that with an aim to reduce energy poverty. The company designs, manufactures, and distributes solar lighting and charging solutions by providing pro poor financial solutions. The Barefoot Power head office is in Australia with manufacturing outsourced in China. Barefoot Power also employs business in a bag solution to the poor by providing initial training and an incentive to earn above average returns based on the level of sales.

Barefoot Power spread 'micro-franchise' by developing entrepreneurs to learn solar business and spread solar products such as LED and solar kits to rural poor. The initial 'business in a bag' program includes a three to four day training, initial supplier credit, sample products, marketing materials and an individual business plan with after-training business support (DeMucci, 2012, p. 3).

The organization markets two basic products, Firefly and PowaPack. The Firefly bag contains 20 lamps, including initial marketing and promotion material. The Firefly Solar LED lamp has a wholesale price to an entrepreneur of $14 and a retail price to end customers of $17.50. Barefoot Power provides a 12 month loan of $250 at a 30% flat interest rate year to the entrepreneur that can supplement $20 to their monthly income by selling only 5 lamps per week. An entrepreneur will generally spend 8 hours per day to achieve this target level of sales (Andrews, 2009, p. 21).

'PowaPack' kits are larger than Firefly packs and include a PV module with 2.5 and 15W power output, a single battery and between two and seven bright LED lights. The pack also comprise of balance of system components such as connectors, wires and a fixed lighting system to suit a home, school or small clinic (Andrews, 2009, p. 24).

The Barefoot power organization manages its credit risk by providing shorter tenor loans. The pros of such a strategy are lower default risk and lower operations and maintenance requirements. Moreover, the business model assumes that borrower has the repayment capacity to pay off the loan as the borrower does not need to generate additional income but it can instead make the repayment with the money spent on kerosene.

In 2009, BFP has sold over 50,000 lamps and plans to supply an additional 4 million lamps till 2013 with an expected cost savings of over $8.8 million dollars on traditional Kerosene savings (GBFund, 2012). The households and businesses benefit from cost savings by switching from kerosene to LED lamps with businesses able to generate incremental income by providing low cost loans.

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