e-net

energy network

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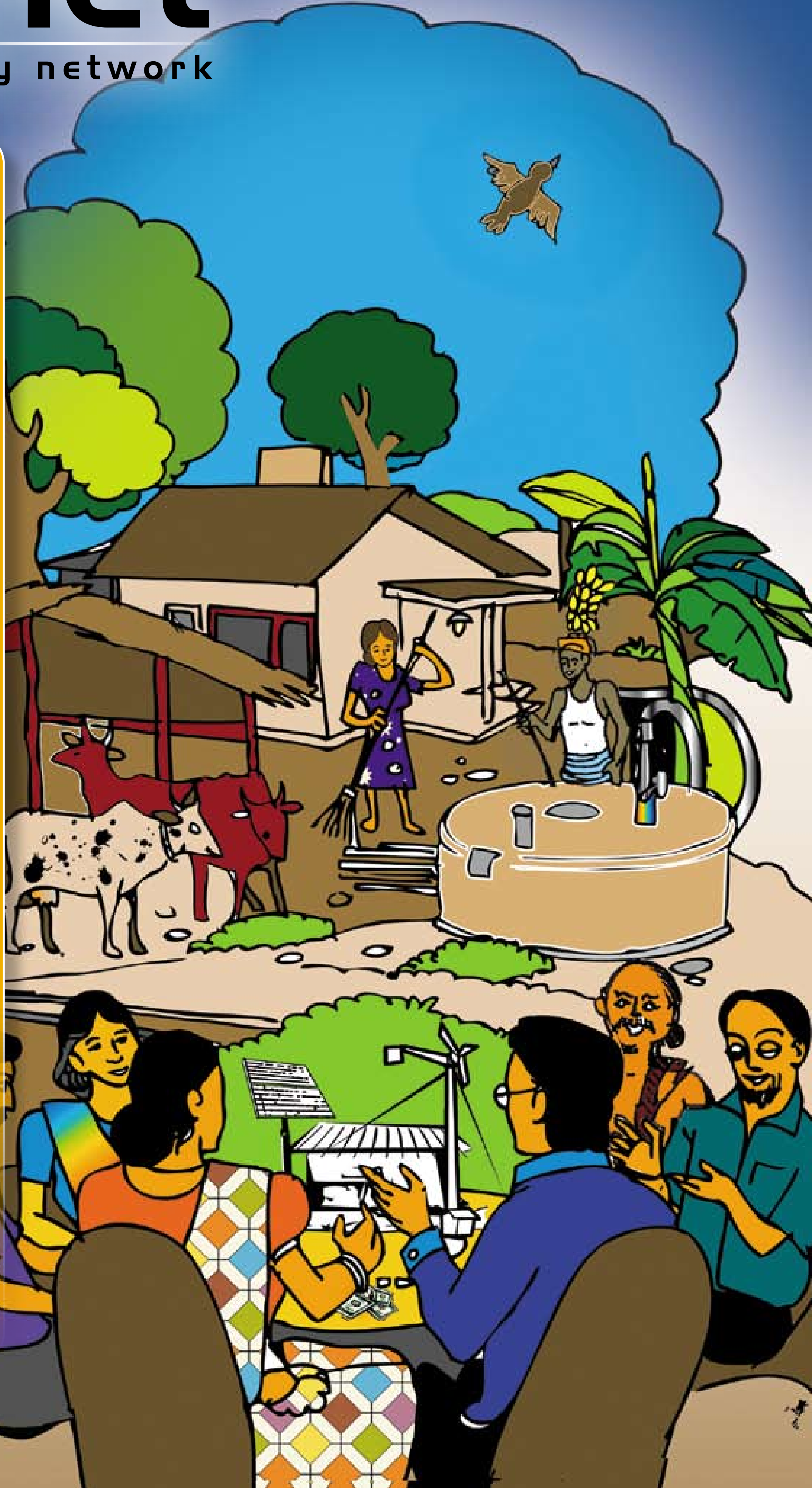

FEATURES

COLUMNS

editorial

The March 2008 issue of the **e**-net magazine focuses on appropriate-financial mechanisms and financing practices for practical implementation. The lack of financing is a major barrier to the adoption of renewable energy technologies, especially by poor communities who need it the most. Once again, the magazine is a culmination of regional efforts, showcasing the experiences, opportunities and challenges of India, Sri Lanka, Nepal, and Bangladesh in the financing of community based renewable energy initiatives.

The articles featured elaborate the processes adopted for overcoming financial barriers and are consistent with **e**-net's objective of information sharing to increase co-operation and collaboration in the South Asian region. Shreekar Pradhan's article "Financing options for decentralized renewable energy technologies" discusses micro finance mechanisms as a means to increase the affordability of renewable energy technologies for rural populations. Citing the case of the Biogas Support Program of Nepal that is generating US$ 0.6 million per year as revenue, he advocates the development of Clean Development Mechanism (CDM) projects as a potential source for additional funding, and sustainable financing.

Anand Rao in his article shares experiences in the creation of a micro enterprise that delivers solar energy based lights to street vendors on a rental basis through a project of Small-Scale Sustainable Infrastructure Development Fund (S^3IDF). Mr Kapila Subasinghe, Project Director of the World Bank funded Renewable Energy for Rural Economic Development (RERED) Project in Sri Lanka describes the World Bank funded line of credit for development of the renewable energy sector in Sri Lanka. With over 100,000 households opting for electricity access through the Energy Service Delivery (ESD) and RERED projects, he suggests that off-grid community based hydro systems are now proven to be sustainable and financially viable. Mr. Ashok Kumar Singha assesses the risks and opportunities in community based financing in India. He goes on to propose a methodology for risk mitigation.

An overriding theme of all articles however is the role of carbon finance for increasing the financial feasibility of renewable energy projects. The issue is complex and the process of converting carbon abatement activities in the field into finances is perhaps beyond the competence of most practitioners. This competency gap needs to be overcome so that the region benefits from additional finance that is required. How it can be done may well be the subject of another article or a special issue.

This issue also carries a special feature by Dr. Md Obaidullah on the renewable energy sector in Bangladesh, providing an overall view of the renewable energy resources and their applications. He also discusses policy developments in the country and its current energy scenario.

We hope that you find the contents of this issue as well as the last one relevant to your information needs. We welcome your suggestions and opinions about **e**-net. Please write to us at e-net@sa-energy.net. This issue, as well as the last one, is available on the **e**-net website www.sa-energy.net.

IMPRINT

e-net is a magazine for the dissemination of information on decentralized and renewable energy technologies, implemented using a community based approach.

This issue of **e**-net is supported by DGIS Netherlands.

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LIGHTING FOR STREET SIDE VENDORS IN URBAN AND RURAL MARKETS, INDIA

By Anand Rao

People running vending carts and petty shops on road sides can be found in almost every city, town, and village in India. In spite of their omnipresence they are not always given the legitimacy to run their businesses, due to which they are denied access to electricity supply and hence lighting. Small-Scale Sustainable Infrastructure Development Fund's (S^3IDF) vendors lighting project, provides lighting access to street vendors through the creation of a micro-enterprise which delivers solar energy based lights to street vendors on a rental basis. The micro-enterprise runs on a financially sustainable basis providing lights to the vendors and also earning a profit.

Street vendors selling their fruits, in stalls using solar charged lights (Photo courtesy of S^3IDF)

To date, developing countries have fared poorly in providing access to clean, reliable and affordable energy to their populations. Looking at access to electricity, according to the International Energy Agency (IEA, 2002) 1.64 billion people (27% of the world's population) did not have access to electricity in 2000. In India, as per the 2001 census figures (Census of India, 2001), only 56% of households had electricity supply. These figures indicate that if access to electricity among the low-income population is to be significantly improved, we need to look for solutions beyond centralized power generation and distribution. Not only has the centralized model failed to reach the poor, its large dependence on fossil fuels and resulting carbon emissions is a huge burden on the environment. Energy delivery models need to be decentralized, based on clean renewable technologies, which can be locally financed, operated and managed.

Recent technical innovation, especially in the renewable energy sector, and changes in regulatory systems provide an opportunity for small scale businesses to supply energy services with a degree of financial sustainability. Small-scale enterprises are well suited to provide utility services at a standard and cost that meets the needs of poor people. In the energy sector poor people represent a significant market for modern services as they spend a high proportion of their cash incomes on the traditional and inefficient energy sources that they use, such as firewood, candles, batteries and kerosene.

S^3IDF is a 'social merchant bank' that helps small enterprises to provide modern energy and other infrastructure services to poor people in ways that are financially sustainable and environmentally responsible. It covers the provision of services necessary for poverty alleviation - electricity, water, sanitation, transport and telecommunications. S^3IDF is registered as a non-profit organization in both the United States and India.

Introduction to Street Vendors

Sarojamma, is a vegetable vendor in Dasarahalli, a suburb in Bangalore and 15 km from the city center. Sarojamma earns around Indian Rs. (INR.)100 a day running her business from morning till night under open skies, braving the hot sun, rains and the municipal authorities who chase her away from time to time. Like Sarojamma, there are around 10 million street vendors in India's cities, towns, and villages (Source: NASVI website) making up a sizeable number, close to 1% of India's population. In spite of the vending profession being a source of livelihood to a large number of poor and the vendors providing goods and services at reasonable prices and at convenient locations, they are often subjected to constant harassment by the local administration. This is due to outdated laws, lack of coherent policies and absence of any concerted efforts to address their issues.

Lighting Problems of Street Vendors

With no clear policy of registering street vendors and the absence of an authorized location from which to carry out their business, most run their businesses without legal approval. Lack of legitimacy to run their businesses denies them the benefits and support they are entitled to, such as business loans, insurance and basic services such as electricity supply. As most street vendors conduct a large part of their business after sunset when people visit the markets, lighting then becomes essential for them. Street vending is an activity that requires mobility and it is important that each vendor has his or her dedicated lighting source which can be easily transported .

With no electricity supply, a large number of vendors rely on kerosene/LPG lanterns for their lighting needs. As is well known, kerosene/ LPG lanterns have several disadvantages. Firstly, they have high running costs. In spite of both kerosene and LPG being subsidized, the rationed supply of the subsidized fuels is inadequate for the vendors and as a result they have to buy their fuel from the open market, paying high prices. Also running around for kerosene and LPG is time consuming and cuts down their productive business hours. The poor quality of light from these lanterns is another issue, as is the heat generated by the lanterns which reduces the life of the perishable fruits and vegetables placed next to the lanterns. This affects their sales and leads to significant losses for the vendors. Regular maintenance of the lanterns is another problem. The vendors also have no option but to inhale the unhealthy fumes coming from the lanterns. Using subsidized kerosene for commercial lighting in vending does not serve the purpose of the subsidy meant for domestic household consumption, leading to wastage of the subsidy and a loss to the government. From an environmental angle, the burning of kerosene and LPG adds to the release of greenhouse gases and in the process adds to the burden of climate change.

Lighting Solution

A solution which addresses the lighting needs of this large vending community needs to have the following four attributes: it should be affordable, replicable across locations, permanent, and improve over time. S³IDF's study of the vendors' lighting needs indicated that the vendors required a very reliable lighting source. At the same time, vendors were not in a position to invest a large sum of money for the lighting solution. They preferred a solution where the payment matched their daily business cycle. Their daily business cycle involves investing cash in the morning to buy stocks for the day, selling all or most of their stock over the entire day and ending the day with cash from their sales. It is at the end of the day that they can pay for the lighting service. In addition, they do not want to be burdened with the lighting asset as their business has a degree of uncertainty, where they might not do business each and every day of the week.

Based on this analysis and looking at a solution with the desired attributes, S³IDF has developed a business model to provide reliable, clean, high quality solar lighting to street vendors. The model involves fostering a local micro-enterprise which on a daily basis rents batteries for running highly efficient electrical lights. To make the solution affordable, the lights are given on a daily rental basis, with the vendors paying less than what they pay for kerosene or LPG. The batteries are charged during the day by solar photovoltaic (PV) panels or hybrid grid-PV systems at a central charging station (owned by the micro-enterprise). In the evening the batteries are delivered to the vendors. The vendors typically use the solar light for an average of 4 hours every evening, after which the batteries are collected and returned to the charging station. In addition to providing the vendors with good quality light, the business is also environmentally beneficial as the lights run on solar energy.

By ensuring that the vendors pay a daily rental lower than their expense on LPG/kerosene, the lighting service is made affordable. Additionally, the daily rental model solves the problem of high initial investment for the vendors and enables them to pay a daily rental only if they use the lights. Thus, compulsory repayments (like those for a loan) do not burden them. Another very important issue this model solves for the vendors is reliability of lights. A light on rent

"I used to spend INR. 90 for 5 days of kerosene lighting. My business has increased after I switched to solar lights and it costs only INR. 60 for 5 days.";Manju, Panipuri Stall
(Photo courtesy of S³IDF)

offers the vendor a completely reliable lighting solution. On the technical side, with the energy source being solar, the solution is not dependent on the availability of electricity at the location, which is extremely crucial in rural areas where electricity supply is not reliable. It is solar energy that makes it possible for the micro-enterprise to provide reliable lighting service to the street vendors. Solar energy technology and locally available components make the technical solution widely replicable.

To ensure financing for the project is not dependent on external funds, the financing is done on commercial terms through local banks. The non-reliance on external financial support further ensures widespread commercial replicability. The permanency of the solution is ensured by the micro-enterprise running on a profitable basis covering all operating and financing costs. Experience from over 25 projects which S³IDF has fostered, suggests that for a project serving 40 vendors the monthly revenue to the micro-enterprise is around INR.18,000 and the total costs, including financing costs (considering a three year term loan), is INR.14,000. This gives the enterprise a monthly profit of around

INR. 4,000. Since there is a profit, there is an incentive for the micro-enterprise to continuously supply lights to the vendors and address all service issues. With the micro-enterprise being open to competition from other similar enterprises, it is continuously forced to improve the lighting service, both in terms of quality and price.

The Role of S^3IDF

To replicate this lighting solution, S^3IDF identifies appropriate entrepreneurs, non-governmental organizations (NGOs)[2] and self-help groups (SHGs)[1] who want to own and operate a micro-enterprise for a given vendor community. It enables the micro-enterprise to access finance from local financial institutions, through its intermediation services and the provision of partial risk loan guarantees (explained below), and enables access to technology, know-how and service by linking the micro-enterprise with technology partners. It also provides support for examining the feasibility and profit ability of the micro-enterprise: conducting surveys, demonstrations, providing risk management and mitigation suggestions to the technology partner and entrepreneur. S^3IDF fostered projects in South India serve over 1000 street vendors and this number is expected to rise significantly as the business model is widely propagated. For all the projects, local banks have extended loans, for 3 years at 7% to 12% interest rates.

For the first projects, local banks were unwilling to extend loans as they perceived high risks from the project. To overcome this, S^3IDF placed partial risk guarantees in banks in the form of fixed deposits equal to 75% of project costs. As the confidence of the banks in the project has grown, the partial risk guarantee amount has reduced from 75% to 25% and now in many projects, banks are willing to finance the project without any partial risk guarantee from S^3IDF.

Hassan Marketplace Lighting Enterprise

A particularly interesting replication of this business model is a micro-enterprise serving street vendors and small shop owners in the market place of Hassan in Karnataka. The project started in January 2005 with the entrepreneur, Mr. Muniyappa Murugesh, investing in a solar charging station capable of serving 50 customers. Mr. Murugesh runs a tailoring business along with a telephone kiosk in Hassan.

S^3IDF financing in the form of a partial risk loan guarantee and a loan to the entrepreneur facilitated a much larger bank loan. S^3IDF also provided assistance in accessing an interest rate subsidy under the UNEP (United Nations Environment Program) scheme administrated by certain local banks including Syndicate Bank, which financed the project. The bank provided a 3 year loan at an annual interest rate of 7% with equal monthly payments. Concurrently, S^3IDF worked with the technology supplier, SELCO (SELCO Solar Light Pvt. Ltd.) to develop an economical solution for backup power and charging when solar energy is insufficient.

Mr. Murugesh provides lighting services at a daily rental charge of INR.12 per vendor (4 hours of lighting). This is less expensive than the vendors' previous cost for kerosene based lighting. The rental income covers the running costs and loan repayments and also provides a profit to the entrepreneur.

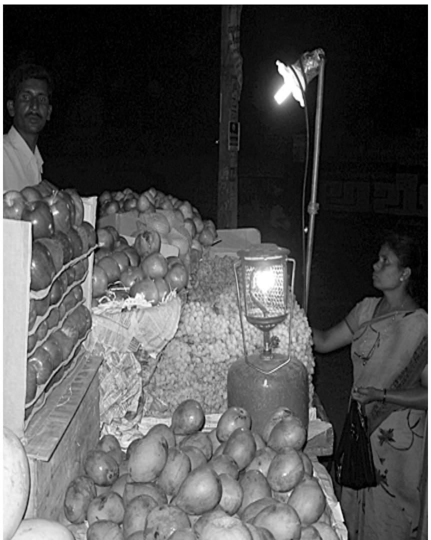
Mr. Murugesh expanded his business as more street vendors and shops started requesting the lighting service (adding another 70 vendors to the initial 50 vendors). The entrepreneur approached Cauvery Grameen Bank, a local bank, on his own and received financing (INR. 500,000) for the expansion with his own collateral.

The enterprise now has the capacity to provide lighting for around 134 customers, of which 120 customers are being serviced and the rest use the service for emergencies. The entrepreneur has 3 employees to cater to the rising demand, thus generating employment through the enterprise. He is making timely repayments against the loan taken by him from the bank. The entrepreneur has also invested in a three-wheeler to transport the batteries. He is planning to expand to another 50 vendors in the same region. Murugesh's monthly collections total approximately INR. 30,000/ month, with total monthly expenses of around INR. 20,000, giving Murugesh a healthy profit.

Mr. Murugesh, the owner of the Hassan Lighting Project, with his solar panels
(Photo courtesy of S^3IDF)

[1]Self-Help Group (SHG) is a small voluntary association of women, preferably from the same socio-economic background. The SHG promotes small savings among its members. The savings are kept with a bank. This common fund is in the name of the SHG. Usually, the number of members in one SHG does not exceed twenty. Source: http://www.indianngos.com/ngosection/newcomers/selfhelpgroups.htm

With the switch to solar energy based lights, the project is saving between 1 to 1.5 liters of kerosene/ LPG per vendor per day (saving at least 120 liters of kerosene/LPG daily). The savings in kerosene is leading to multiple benefits. Firstly, each vendor is saving at least INR. 5 per day on lighting expenses compared to the LPG/kerosene option. According to the vendors, the good quality light has increased their business. Clean quality light is attracting more customers and the vendors are able to sell for longer hours in the night. Earlier, they often had to shut down when they ran out of kerosene/LPG. In addition, the clean light does not damage their perishable goods, further increasing their income. With higher income, the vendors are able to invest more in their businesses and in turn earn more. A preliminary estimate of the carbon savings from the avoidance of kerosene/LPG usage from this project is around 20 tons of CO_2 per annum. Thus the project does not only benefit the vendor community but also brings significant environmental benefits by reducing greenhouse gas emissions.



'Solar lights do not give out heat or fumes, so my fruits do not get spoilt.' Jabir, fruit seller (Photo courtesy of S³IDF)

Although, the lighting project is a financially viable project, it has still not reached a stage of auto replication where no pre-investment support is required (as is now being provided by S³IDF). Looking at the lighting project as a micro/small enterprise, widespread evidence suggests that such appropriate implementation by enterprises is constrained by inadequate access to technology and know-how, as well as access to required long-term financing. To fill this gap, organizations such as S³IDF are required. From the policy angle, there needs to be an acknowledgment that enterprises can provide access to infrastructure services and hence need to be encouraged and supported through technology and know-how access, and provided with appropriate backing from financial institutions, especially for long-term financing. Given this, we could see many more enterprises emerging to provide infrastructure services to the poor and could play an important role in increasing infrastructure access to the poor.

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Census of India (2001) , Census of India 2001, Tables on houses, household amenities and assets, available at: http://www.censusindia.gov.in/Tables_Published/H-Series/H-Series_link/S00-019.pdf (visited on 18 February 2008)

National Association of Street Vendors in India (NASVI) , available on the Nasvi website, www.nasvinet.org/about.htm (visited on 18 February 2008)

Anand Rao heads the projects team at S³IDF in Bangalore, India. At S³IDF, he has successfully developed over 40 infrastructure related small-scale projects in the lighting, livelihoods, transportation, biomass and information technology sectors.

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e PAPERS

e-net welcomes articles for the next issue which will focus on:

'Emerging technologies in the community based renewable energy sector'

Articles should ideally be based on actual case studies and look at the implementation/ potential implementation of a specific technology using community participation. .

The length of the article can range from 1500 -2500 words (inclusive of footnotes and references). Illustration, graphs, tables, and photographs are welcome (with sources acknowledged). Please include a brief description of the author and the organization s/he represents.

Articles chosen for publication in the **e**-net magazine will be subject to editing. Contributors should make themselves available for any clarifications that may be necessary up to the point of publication.

Please e-mail all articles to e-net@sa-energy.net by 15th May 2008.

IMPLEMENTATION OF OFF-GRID COMMUNITY BASED HYDRO PROJECTS; RERED PROJECT, SRI LANKA

By Kapila Subasinghe

Renewable Energy for Rural Economic Development (RERED) Project is a World Bank funded line of credit for development of the renewable energy sector in Sri Lanka. Electricity from the national grid is enjoyed only by about 75% of the Sri Lankan households and the others depend mainly on kerosene. However, with the Energy Service Delivery (ESD) and RERED Projects, over 100,000 such off-grid households have opted to access electricity through off-grid community based hydro schemes and the installation of household based solar systems.

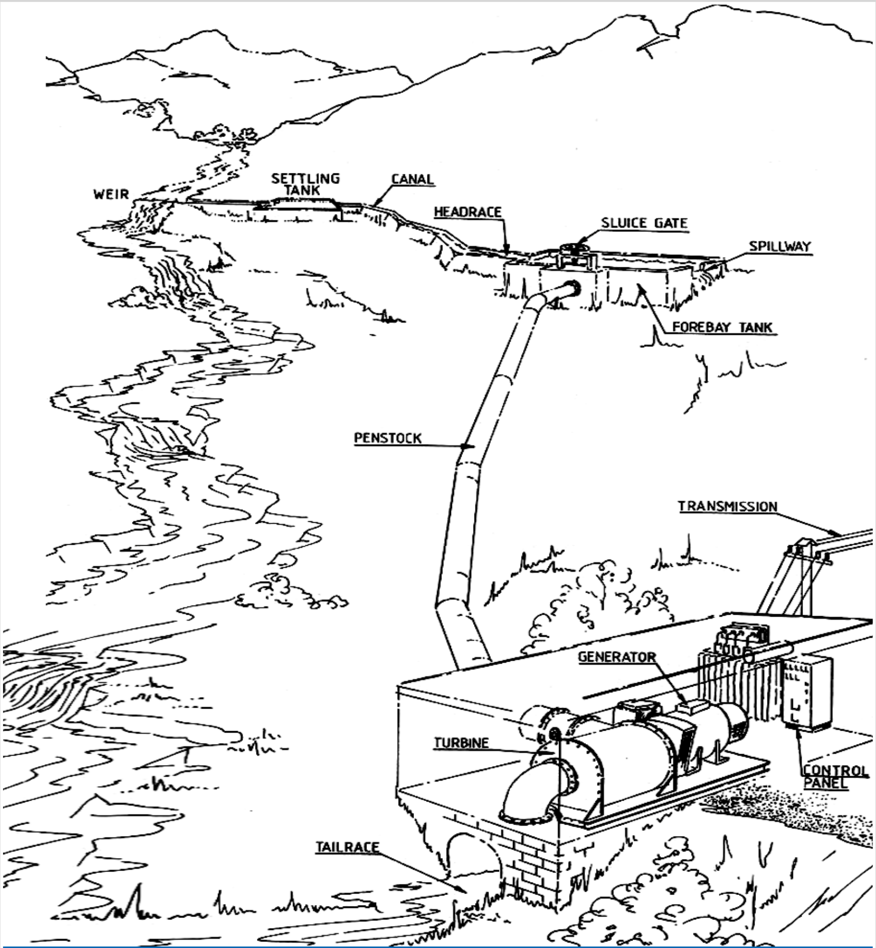

Diagram of Village Hydro System
(Source: Case Study 2 - Upgrading Micro Hydro in Sri Lanka, Drummond Hislop, IT Publications Ltd.)

Background

RERED is a follow-on project, made effective in 2002, after the successful completion of the first renewable energy line of credit, the ESD Project (implemented from 1997 to 2002). The RERED Project's credit line of approximately US$ 75 million is complemented by a grant of US$ 8 million from the Global Environment Facility. A primary objective of the RERED Project is to improve the quality of life in rural areas by providing access to electricity through the introduction of renewable energy technologies.

Implementing Off-grid Community Based Projects

Off-grid hydro projects have been implemented in Sri Lanka even prior to the ESD Project, with the technology being introduced to the rural communities mainly by ITDG (now Practical Action) and in most cases fully funded by grants from various donors. The introduction of the ESD Project facilitated two important features in the village hydro concept - financial feasibility and community accountability. Projects were assessed based on their financial viability with bank loans becoming an integral part of the financing mechanism and were implemented with greater contribution, commitment, participation, ownership and accountability from the village community.

Several stakeholders, namely, the village Electricity Consumer Society (ECS[1]), project developer, equipment suppliers, verification consultants, participating credit institution (PCI) / regional financial institution and the Provincial Councils play a key role in the successful implementation of a village hydro scheme. The Administrative Unit (AU) of the RERED Project coordinates with all these stakeholders and provides necessary guidance and support to ensure smooth implementation, whilst administering the credit and grant components of the Project.

The role of the project developer in implementing a village hydro is manifold. The developer should be technically competent and also possess good social skills. The developer is responsible for all project activities from identification of a potential site to commissioning, as well as for training ESC members on operation and maintenance. The developer, upon preliminary investigations will assess the site potential and thereafter, mobilize villagers and educate them on the advantages and limitations of a community based hydro project. If the village community is willing to proceed, the developer will assist them to establish an ECS.

1 An ECS consists of community members who are in charge of operating, maintaining and managing the village hydro scheme.

Thereafter, the developer in consultation with the ECS, will prepare a detailed project report addressing technical and financial issues. The critical factor at this stage is community participation to ensure long-term sustainability.

Technical Assessment

The developer together with the village community carry out a detailed hydrology study, assess the site potential and decide on the location of project structures. Depending on the site potential the developer will advice the ECS in selecting the number of households that can participate in the scheme. On average each household is provided with approximately 250W. Thereafter, the developer will introduce the ESC to equipment suppliers and assist them in evaluating alternate quotations and selection of suppliers. Simultaneously the developer will also assist the ECS to obtain the necessary statutory approvals.

Financing Structure

The initial village hydros were financed by a bank loan, the co-financing grant from the ESD/ RERED Project, and equity contribution. However, with benefits to the rural communities becoming quite evident with the successful implementation of initial projects, the Provincial Councils now also provide grant assistance, making even certain marginal projects commercially feasible. The co-financing grant is linked to the power output and beneficiaries, and the developer will estimate the co-financing grant based on the technical assessment.

Equity by the community is mostly in the form of labour. However, the beneficiaries make a monthly contribution to the ECS as a membership fee. This membership fee is utilized to meet operation and maintenance expenses, service the bank loan and to create a buffer in the event of any breakdown. Accordingly, the ECS's borrowing capacity depends on beneficiaries' monthly contribution, which in turn is somewhat directly proportional to their monthly saving on kerosene. Once the ECS's borrowing capacity, co-financing grant entitlement and equity contribution are assessed, the ECS will seek grant assistance from the Provincial Council to bridge the gap. The cost of engaging the developer and verification consultants will not be a part of the project cost as these expenses are borne by the RERED Project.

Ethgala Ella Village Hydro Project
(Photo courtesy of Lanka Praja Isuru Sanwardhana Padanama)

Role of PCIs

Once the technical and financial assessment is complete, the developer will introduce the ECS to a PCI and assist in negotiating a loan. The PCI will do its independent technical and financial assessment and decide on providing a loan. With commercial viability of village hydro schemes proven beyond a doubt, even regional financial institutions, which are not registered as PCIs (non-PCIs) are now actively involved in financing village hydro projects.

Role of AU

The AU ensures that the all village hydro schemes conform to the RERED village hydro Technical Specification. Prior to granting a loan the PCI or AU (if financed by a non-PCI) will engage a verification consultant, who is a qualified chartered engineer, for a design verification. The developer and the ESC will be allowed to proceed only upon successful verification. Upon commissioning of the power plant, a consultant is engaged again for an installation verification to ensure that operational aspects conform to the Technical Specification. Independent confirmation is obtained from the ECS subsequent to both verifications to ensure that the developer has attended to rectification work if any, as recommended by the verification engineer.

The AU also administers the credit line and reviews PCI documents to verify eligibility for refinance. The AU, among other things, ensures that the necessary statutory approvals have been obtained by the ECS, loans are approved by PCIs for eligible projects, suppliers and contractors have been engaged at prevailing market rates upon evaluation of competitive quotations, and funds are disbursed for intended purposes. On administration of the grant, the AU reviews and recommends the release of grant funds to the developer and the ECS. The developer's preparation grant[2] is released in stages with the final tranche (portion) being released after a minimum of six months from successful installation verification. This is upon confirmation by the ECS that they are satisfied with the training provided and are capable of operating and maintaining the plant independently.

Capacity building

This is an integral part of the project and is provided as an ongoing activity. The developers are registered as eligible to participate in

[2]preparation grant - Developer's fee for consultancy input directly attributable to implementing a village hydro scheme

the Project only after careful review, and their performance is closely monitored during project implementation. In addition programmes are also conducted for developers to discuss issues, share their experence and enhance knowledge. Village hydro equipment suppliers are also registered and monitored by the AU. ECSs are provided with training on management, finance and maintenance aspects. A list of approved verification engineers is also maintained and updated by the AU.

With increasing demand for new off-grid projects and developers and equipment suppliers focusing more on new projects, concerns have arisen about the ability of developers / suppliers to attend to repairs of the commissioned projects in a timely manner. Having understood the problem in advance, the AU is in the process of identifying and providing adequate training to competent technicians in the rural areas capable of attending to such repairs. The trained technicians will be registered as eligible to undertake repairs of village hydro schemes.

Accomplishments

By end 2007, 134 village hydro schemes had been implemented under the ESD and RERED Projects. They have a cumulative capacity of 1,377 kW and provide electricity to 5,651 households. A further 37 schemes with an estimated cumulative capacity of 302 kW are under construction to provide electricity to 1,629 households. Several consumers have also ventured into commercial enterprises utilising the daytime excess energy in the hydro schemes, which is encouraged under the Project by making available grant incentives.

The ESD and RERED Projects have proven the financial viability and sustainability of community hydro initiatives. Today, financial institutions confidently appraise village hydros as commercially viable business enterprises and are keen to finance such projects. In addition they also view these projects as a window to cater to potential business opportunities at household level.

Conclusion

Accomplishments of ESD and RERED Projects have resulted in the creation and growth of a vibrant off-grid community based renewable energy sector in Sri Lanka comprising of developers, technical consultants, equipment suppliers and electricity consumer societies. These stakeholders have also formed their respective industry associations to voice their opinion collectively and serve the industry better.

With the resounding success of the ESD and RERED Projects, the International Development Association (IDA) of the World Bank has decided to provide further assistance to the renewable energy sector in Sri Lanka with "RERED Additional Financing" line of credit amounting to approximately US$ 40 million. This Project is to be implemented within a span of three years and is scheduled to be completed by June 2011.

Mr Kapila Subasinghe is the Vice President (Project Management), DFCC Bank and Project Director of the World Bank funded RERED Project. He has extensive experience in financing hydro projects and managing lines of credit. Mr Subasinghe holds a degree in Civil Engineering from the University of Moratuwa, Sri Lanka and is an Associate Member of the Chartered Institute of Management Accountants, UK.

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e VENTS

National Exhibition and Seminar on Renewable Energy

Date: 24 -26 March 2008
Venue for exhibition: Energy Park (Doyel Chattar) Dhaka University
Venue for seminar: Renewable Energy Research Center, Dhaka

The National Exhibition and Seminar on Renewable Energy will focus on renewable energy and climate change. The seminar is titled 'Climate Change Mitigation: Role of Renewables' and will include presentations of research papers on topics such as solar, wind, biogas and hydro energy, as well as rural energy applications, and renewable energy policy.

Jointly organized by Bangladesh Solar Energy Society, Dhaka, and Renewable Energy Research Centre, University of Dhaka.

Further details on the event are available on www.lged-rein.org, or contact rercdu@yahoo.com .

Workshop on Grid Connected Renewable Energy and Distribution Generation

Date: 9 – 10 April 2008
Venue: Kolkata, India
The purpose of the workshop is to promote policy and regulatory changes and encourage incentives to accelerate the development and interconnection of renewable energy and distributed generation projects into the Indian power system. This event is aimed at an audience in distribution utilities, project developers, regulators, investors, and government policy makers in both West Bengal and the Central government. Participants from other states are also welcome. Special opportunities include one-on-one side meetings with Indian and U.S. project developers, policy makers, utilities, and regulators, as well as a site visit.

For further details please contact John Hammond (e-mail: JHammond@usea.org) or Tricia Williams (e-mail: TWilliams@usea.org), of the U. S. Energy Association (USEA). - Tel: +1-202-312-1230

BANGLADESH: RENEWABLE ENERGY RESOURCES AND APPLICATIONS

By Md. Obaidullah

The Bangladesh Government has recently prepared an energy policy which emphasizes coal extraction (mainly for use in electricity generation), more efficient use of gas, and the promotion of renewable energy. These policy developments and others, as well as the country's current energy scenario are presented in this article, as are the available renewable energy resources and their applications.

Education provided to the students on photovoltaic boats
(Source: Ashden Awards website)

1. Introduction

Energy is one of the basic elements that is considered essential for growth and development. Energy demand in Bangladesh is increasing by an estimated 10% per year. The current energy-mix in Bangladesh is 65.5% renewable (biomass and hydro-power), and 34.5% non-renewable including coal, natural gas, petroleum products and crude oil (Akbar, 2004). Different studies show that natural gas accounts for 70% of the country's commercial energy consumption (S. Akbar 2004, University of Dhaka 2007). The country needs to supply adequate and affordable energy, especially electricity for producing high quality products, for its survival. In recognition of the importance of energy for socio-economic development, the Government of Bangladesh (GOB) has given continued attention to the overall development of the energy sector and the revised National Energy Policy (NEP) is awaiting approval. The Government of Bangladesh has a noble vision to provide electricity for all by the year 2020.

Energy is a vital input for the development of a country. The problems of poverty in rural areas of Bangladesh and other developing countries have been aggravated by the scarcity of energy resources, dwindling forest reserves and diminishing water sources. Escalating oil prices and a growing shortage of traditional fuels like fuel-wood, dried leaves, cow dung, etc. have made life more miserable in rural areas. Special attention is needed for the development of the hilly and rural isolated areas.

Bangladesh has good potential for harnessing renewable energy sources (e.g. solar, wind, biogas, biomass). Bangladesh enjoys sunshine most of the time, so has enough solar power to implement sustainable solar energy projects. Its long coastal areas have potential for wind power harvesting to produce electricity. Most rural people use cow dung or other animal and plant wastes for energy. All these wastes can be used to generate non-polluting energy and high quality manure, with the help of biogas technology. Transformation of biomass into clean energy not only meets the energy demands of the rural people, but also ensures a cleaner environment. These renewable energy sources need no major maintenance, have no pollution hazard and can be used in isolated areas. Thus, sources of renewable energy like solar energy, wind energy, biogas, biomass and the like, can solve the rural energy problems of Bangladesh and assist in reducing poverty.

2. National policy

The NEP of 1996 is still valid because the revised versions are awaiting approval. NEP 1996 was divided into the following five components (GOB, 1996): Non-renewable energy policy, Petroleum policy, Renewable and rural energy policy, Power policy and Rural electrification policy.

The draft NEP (2004) and draft NEP (October 2006) also have components of Renewable Energy Policy (Islam, 2006). A number of draft policy documents related to NEP and Renewable Energy Policy have created confusion among the stakeholders. There is a need to undertake sincere efforts to resolve the confusion and approve a unified policy for the planned development of both non-renewable and renewable energy sources. In order to ensure optimum use of available resources, Renewable Energy Policy should be made an integral part of National Energy Policy. Drafts of the NEP have recommended establishing a Renewable Energy Development Agency (REDA) to undertake the development of different renewable energy technologies.

3. Current energy situation

Bangladesh is a developing country with a population of 140 million in an area of only 147,570 sq. km. About 85% of the population lives in rural areas. Its per capita energy consumption in 2000 and per capita GNP in 2004 were 200 kgOE (kilogram oil equivalent) and US$ 440 respectively (Akbar, 2004).

3.1 Non-Renewable Energy

a. Natural Gas

Amongst the available conventional energy, only natural gas is being extracted commercially. The share of natural gas in the commercial energy mix of Bangladesh is presently very significant. The contribution of natural gas to the total commercial energy consumed in the country is about 70% (USAID website). The key statistics of natural gas are as follow (BUET website):

Total number of gas fields discovered as of June 2006: 22
Total recoverable reserves (proven + probable) of natural gas in 22 gas fields: 20.51 Tcf[1]
Total gas consumed up to February 2006: 6.38 Tcf
Gas consumption in 1 year (2003-2004): 0.453 Tcf
Gas consumption in 1 year (2004-2005): 0.487 Tcf
Annual average growth rate in demand for gas during the last five years: 8%

Table 1 shows category wise consumption of natural gas in different sectors from July 2004 to June 2005.

b. Coal

The contribution of coal to the total commercial energy consumed in the country is only about 3% (Imam, 2003). Coal resource deposits of about 1,782 million tons have been discovered in three locations. Total coal reserve at Jamalgonj is about 1,054 million tons whose extraction has not yet been found to be economically viable. About 285 million tons and 400 million tons of coal deposits have been discovered in Barapukuria, Dinajpur and Khalaspir, Rangpur (Imam, 2003) respectively. Total peat reserves of Bangladesh have been estimated as 600 million tons. In some rural areas, locally extracted peat is used for domestic cooking and in small industries.

c. Electricity

Bangladesh Power Development Board (BPDB) is fully responsible for the electricity generation and distribution network in Bangladesh, except Dhaka city area and some rural areas, which are managed by Dhaka Electricity Supply Authority (DESA), Dhaka Electricity Supply Company (DESCO) and Rural Electrification Board (REB).

1 Tcf – trillion cubic feet

State-run BPDB owned generation capacity:	3985 MW
IPPs generation capacity:	1290 MW
Total installed generation capacity:	5275 MW
Power generation capacity:	4590 MW
Peak demand:	3700 ~ 4500 MW
Per capita generation:	160 kWh
Access to electricity:	32% of the population
Annual growth in demand:	8 ~ 10%

Table 1: Category wise natural gas consumption

Sectors	Consumption
Power	43%
Captive power	7.5%
Fertilizer	20%
Industry	10.5%
Residential	11.5%
Others (commercial, domestic, tea estate, brick field, CNG and losses)	7.5%

(Source: BUET website)

There are a number of Independent Power Producers (IPP) who generate and sell power to BPDB. The key statistics of the electricity sector of June 2006 are given above (BPDB website).

d. Petroleum Products and Crude Oil

Bangladesh Petroleum Corporation is responsible for the import and overall management of petroleum products and crude oil. A small petroleum oil deposit has been discovered in Haripur (Sylhet) with an estimated recoverable reserve of 1.6 million tons of crude oil (University of Dhaka, 2007). At present imported oils contribute about 30% of total commercial energy consumed in the country. Table 2 shows the statistics of imported petroleum products and crude oil in recent years.

Table 2: Import of petroleum products and crude oil

Year	Crude oil		Petroleum products	
	Quantity (thousands tons)	Value (Million US$)	Quantity (thousands tons)	Value (Million US$)
2001-2002	1225	220	2072	2536
2002-2003	1331	289	2214	3319
2003-2004	1252	314	2262	4015
2004-2005	1063	364	2692	7214

(Source: University of Dhaka, 2007)

3.2 Renewable Energy

Various alternative and renewable energy sources have been explored and many of them have been put to use, some commercially. The known renewable energy sources are solar, wind, biomass, biogas, and hydropower energy.

a. *Solar Energy*

Solar energy utilization is being accepted gradually, but its slow progress is due to high initial cost, low daily operation time, and lower output level. Solar energy has been used in Bangladesh for drying crops and fishes since the early days. The government has waived duty and taxes on solar and other renewable energy applications to encourage both public and private sectors. Different Educational Institutions, government organizations, NGOs and private organizations are now engaged in promoting diversified application of solar energy. Among them, the role of LGED, REB, BPDB, Grameen Shakti, Rahimafrooz, BRAC, RERC, IDCOL, BUET[2] is significant for improving solar utilities in Bangladesh.

Bangladesh is situated between 20.34° and 26.38° latitude north and has a good solar energy potential. The availability of solar energy is technically termed as 'insolation'. The average annual solar radiation on a 240 inclined surface is estimated as 4.2 kWh/m^{-2}/day^{-1} (Khan, 2003). Table 3 (on page 12) presents monthly insolation data for different locations in Bangladesh.

b. *Wind Energy*

Bangladesh, like many other developing countries, has a long-standing tradition of using wind energy, especially in sailboats. Considering the large proportion of river transportation, the contribution of wind energy to the energy balance as a replacement of fossil fuel should be quite significant. However, technological interventions in using wind energy for mechanical and electrical energy have not yet been introduced commercially in the country.

[2]LGED – Local Government Engineering Department, RERC – Renewable Energy Research Centre, IDCOL – Infrastructure Development Company Limited, BUET – Bangladesh University of Engineering and Technology.

It is generally believed that the coastal areas of Bangladesh (a 724 kilometer long coastal belt along the Bay of Bengal) are suitable for installing wind turbines. There are many islands in the Bay, which belong to this country. The strong south/south-western monsoon wind coming from the Indian Ocean, after traveling a long distance over the water surfaces, enters into Asia over the coastal areas of Bangladesh. The wind is enhanced when it enters the V-shaped coastal regions of Bangladesh, and after traveling a long distance over oceanic water surfaces, it becomes energetic and it is suitable for electricity generation. This trade-wind blows over our country from March to October.

The potential sites for harnessing wind energy in Bangladesh are given below (Hasanuzzaman ,2003)-(i) Patenga; (ii) Cox's Bazar; (iii) Teknaf; (iv) St. Martins' Island; (v) Maheskhali; (vi) Kutubdia: (vii) Sandwip; (viii) Anwara; (ix) Hatia; (x) Sonagazi; (xi) Companigonj; (xii) Ramgati; (xiii) Bhola; (xiv) Char Fession; (xv) Kuakata; and many other coastal and off-shore islands in the Bay.

Accurate data of wind velocity and direction is needed for applications of mechanical and electrical power generation. A project has been undertaken with the funding of UNDP to build a wind speed database across the county. Twenty wind monitoring stations were installed at different sites. Table 4 on page 12 shows wind speed data from the measurement station at Kuakata, where sensor height is 25 m.

c. *Biomass*

Among all the energy sources in Bangladesh, biomass plays the most vital role. It is inefficiently absorbed as various forms from rural households to factories. The utility gas service is available for cooking purposes in about 30% of total urban areas of Bangladesh. The rest of the urban areas depend on electricity, LPG (cylinder), kerosene and fuel wood. Each year, huge amounts of fuel wood are consumed in Bangladesh for cooking purposes only and the consumption is increasing daily due to Bangladesh having one of the fastest growing populations. This consumption has resulted in the forest reserve of the country decreasing significantly. Due to acute deforestation, the ecological balance is also threatened.

Utilization of biomass fuel resources is largely inefficient and wasteful. Introduction of biomass briquetting and improved cook stoves in Bangladesh has attempted to address this problem in the recent past. Biomass briquetting is a relatively new technology in Bangladesh. Mostly, machines of heated-die-screw-press type are used to produce briquettes from rice husk, which is the main raw material.

Different forms of biomass use include rice husk (26%), cow dung (19%), rice straw (16%), twigs and leaves (14%), badges (7%), fuel wood (5%), and jute sticks (4%) (Ahamed, Nargis and Sarkar, 2003). Due to the present high rate of biomass use, there is serious concern about preservation of limited forests in the country and striking a balance between ecological, social and environmental needs (Ahamed, Nargis, and Sarkar, 2003).

d. Biogas

Biogas can be produced from animal, human and plant (crop) wastes, weeds, grasses, vines, leaves, aquatic plants and crop residues, etc. An agriculture based country like Bangladesh has huge potential for utilizing biogas technology. According to the Bangladesh Council of Scientific and Industrial Research (BCSIR), there are about 22 million cattle which excrete about 0.22 million tons of dung per day. Theoretically, this can produce on an average 2.72 x 109 cubic meter gas/year (Haque, 2006). If each family of Bangladesh can be associated with a Biogas Plant, then human excreta alone would generate approximately 10 billion cubic meter gas.

Table 3: Average monthly insolation at different cities in Bangladesh (kWhr/m2/day)

Month	Dhaka	Rajshahi	Sylhet	Bogra	Barisal	Jessore
January	4.03	3.96	4.00	4.01	4.17	4.25
February	4.78	4.47	4.63	4.69	4.81	4.85
March	5.33	5.88	5.20	5.68	5.30	4.50
April	5.71	6.24	5.24	5.87	5.94	6.23
May	5.71	6.17	5.37	6.02	5.75	6.09
June	4.80	5.25	4.53	5.26	4.39	5.12
July	4.41	4.79	4.14	4.34	4.20	4.81
August	4.82	5.16	4.56	4.84	4.42	4.93
September	4.41	4.96	4.07	4.67	4.48	4.57
October	4.61	4.88	4.61	4.65	4.71	4.68
November	4.27	4.42	4.32	4.35	4.35	4.24
December	3.92	3.82	3.85	3.87	3.95	3.97
Average	4.73	5.00	4.54	4.85	4.71	4.85

(Source: Khan, 2003)

e. Hydropower

Hydropower potential is still quite low in Bangladesh, because rivers are mostly on flat surfaces with low gradients. Presently, the only hydroelectric plant in the country (Karnafuli) has a capacity to produce 230 MW of electricity. There is a potential to produce 250 MW of power at Sangu and Matamuhuri river, though the cost of new storage is very high. Such projects are not encouraged by the government considering their adverse environmental and social impacts (Islam, 2003).

4. Renewable energy applications

Application of renewable energy resources has been mostly confined to research, development and demonstration projects. They are still something of a novelty in Bangladesh and their share is as yet insignificant in the country's total energy supply.

4.1 Solar Energy

Solar energy is harnessed in two ways:
i) Solar photovoltaic (PV) for PV electricity generation and
ii) Solar thermal

i) Photovoltaic

Rural electrification using PV systems is gaining importance daily in Bangladesh. Solar Home Systems are highly decentralized and particularly suitable for remote inaccessible areas. The solar PV program mainly targets those areas, which have no access to conventional electricity or low coverage by the Rural Electrification Board or little chance of getting connected to the grid within 5 to 10 years. Solar home systems are 12-volt DC stand-alone systems. Each solar home system includes a PV module, battery, charge controller, fluorescent lights, wiring and outlets fixtures for installation. Table 5 presents the progress with solar home system installation in Bangladesh. As of July 2007, 128,813 solar home systems (SHS) have successfully been installed in Bangladesh.

A case study: PV boats bring education to wetland communities (Source: Ashden Awards website)

The remote Chalanbeel situated in the central western region of Bangladesh is home to some of the poorest and most marginalized communities in the country. Road access is extremely limited with boats being the only dependable means of transport, especially in the rainy season where much of the area becomes flooded due to monsoon rains. Many people have no land with which to support themselves and no access to education, training or modern energy supplies. There is no grid electricity and very basic sanitation. Although all children are meant to get free education, it is difficult to find teachers who will stay in the region as transport is limited, and schools get flooded in the monsoon. Shidhulai Swanirvar Sangstha, a local NGO initiated an innovative approach to address this issue. They installed PV modules on the roof of the boat (Fig. 1), to provide between 500 Wp and 2 kWp of power, depending on the demand. The PV modules charge an array of lead-acid batteries through a charge controller, and power the electrical equipment on the boat. All 88 boats have PV-powered lighting, using 10 W compact fluorescent bulbs, and mobile phones. The specially designed boats have PV-powered computers, with internet access. Battery charging stations have also been installed on the boats. This has encouraged the dissemination of more PVs for lighting, electric appliances, and navigation in the night.

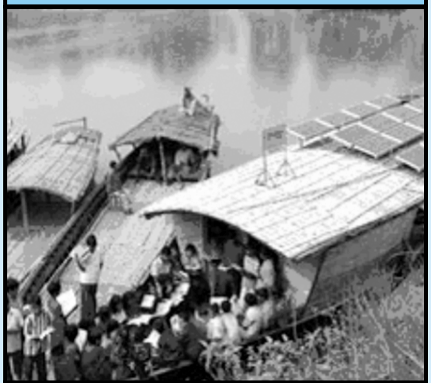

Fig. 1 Electricity generated on boats using solar PV

Table 4 : Wind speed data from the measurement station, Kuakata (sensor height 25 m)

Month	Monthly Mean wind Speed (m/s)	Standard deviation of wind speed (m/s)	Peak wind speed (m/s) (date/time)	Lull period (hours)	Coefficient of variation	Prevailing wind direction
August 1996	5.88	0.65	19.83 (21/0840	9.47	0.13	SW
September	3.77	0.57	21.92 (28/0700)	140.50	0.20	SW
October	2.18	0.46	23.17 (29/2050)	425.33	0.23	N/NE
November	1.98	0.48	13.17 (5/0640)	236.33	0.29	N/NE
December	3.35	0.48	9.42 (7/0910)	12.33	0.16	N
January	3.18	0.44	10.25 (22/1300)	36.50	0.15	W/SW
February	3.37	0.42	14.42 (1/0950)	19.33	0.14	SW
March	4.84	0.52	35.25 (23/0430)	6.67	0.12	W/SW
April	4.93	0.87	35.67 (7/0640)	7.67	0.13	W/SW
May	6.28	0.63	21.50 (19/1540)	6.83	0.10	W/SW
June	7.31	0.68	24.00 (27/0730)	20.67	0.10	W/SW
July 1997	7.34	0.65	20.67 (10/0540)	3.09	0.10	w

(Source: Ahamed, Nargis and Sarkar 2003)

Table 5: Progress with Solar home system installation till July 2007

Participating Organization	Number of SHSs Installed
Grameen Shakti	79,564
BRAC Foundation	27,691
Srizony Bangladesh	4,111
COAST Trust	1,549
TMSS	1,109
Centre for Mass Education and Science	1,496
Integrated Development Foundation	1,507
Shubashati	1,385
UBOMUS	2,667
BRIDGE	1,349
RSF	4,601
PDBF	582
PMUK	142
HF	771
Mukti Cox's Bazar	212
Other	77
Total	**128,813**

(Source: IDCOL website)

ii) Thermal
Using sunshine for the drying of crops and clothes is common throughout Bangladesh. Popularizing the solar thermal appliances can increase the actual use of solar energy quite significantly. Despite the uncertainty of sunshine during the monsoon months, well-designed solar thermal appliances can be attractive to the users in the rural areas as well as in the urban areas. The solar thermal appliances that can be made popular quite easily are solar dryers, solar cookers and solar water heaters. A variety of solar thermal systems have been developed and fabricated in Bangladesh but mostly for research and demonstration purposes. They have not been commercialized, nor put to wider real-life use.

Solar Dryer: Bangladesh University of Engineering and Technology (BUET), and the Bangladesh Council of Scientific and Industrial Research (BCSIR) have developed a cabinet dryer for drying fruits and vegetables, using bamboo and polythene sheets. It has been producing dried coconut powder in Noakhali. The project offers an income generation activity for poor women, as the product has a constant market with the biscuit factories.

Solar Water Heater: Various types of solar water heaters have been fabricated and experimented at BUET and RERC of Dhaka University. Although the country has a wealth of experience in laboratory scale work on solar heaters, none of these have been put to use in real-life situations.

Solar Cooker: Two types of solar cookers may be used in Bangladesh - focusing type and box type. Different experiments found that solar cooking is possible on sunny days as well as on semi-cloudy days of the year using a box type solar cooker (Chowdhury, Motaleb, and Sarkar, 2003).

4.2 Wind Energy
The potential of wind energy has not been fully explored in Bangladesh, mainly due to the lack of reliable wind speed data. It appears that the potential wind speed will not be high, however wind energy can be put to a variety of uses, especially for wind pumps, hybrid electricity generating systems with wind as one of the energy sources, small battery chargers at isolated places and electricity inputs to local grids in some coastal areas or the bay islands. Examples of practical applications of wind energy in Bangladesh could be shrimp production, fish/poultry farming, salt/ice production, fish-mill industries, hatcheries, domestic applications and vegetable irrigation - all using decentralized electricity (hybrid or mechanical energy from wind).

4.3 Biogas
Dissemination of biogas technology is gaining momentum. A good number of institutions are already involved in planning, research, development and dissemination of this technology. The Institute of Fuel Research and Development (IFRD) of BCSIR has been the main actor in the dissemination of domestic biogas plants in Bangladesh to date. Under the pilot biogas plant project implemented by IFRD a total of 21,858 biogas plants were installed throughout the country. It is reported that more than 80% of the plants are currently in operation (Haque, 2006). IDCOL, a company owned by the Government is currently implementing an ambitious programme for the delivery of 60,000 biogas plants by 2010 (IDCOL website).

5. Donor agency roles in the promotion of renewable energy
Various donor agencies like UNDP, UNESCAP, UNESCO, GTZ, ADB, and SIDA[3] have been involved in the promotion of various renewable energy technology programs by providing financial support in the form of grant aid. The donor agencies should strengthen their roles to work in the renewable energy sector in Bangladesh with various government organizations, NGOs, academic institutions and the private sector. This will help to disseminate renewable energy technology projects such as solar, wind, biogas, biomass, and sustainable hydropower. Donor agencies should pay attention to finance in setting up laboratories in the public technical universities for practical lessons in renewable energy technologies.

6. Barriers to commercializing renewable energy
The major barriers to commercializing renewable energy in Bangladesh are discussed below:

Policy: There is no well-defined government policy regarding renewable energy in Bangladesh. However, the revised policy has recommended establishing a REDA for the development of different renewable energy technologies.

Institutional: This barrier is the real constraint, not only to the development of renewable energy sources but also to their wider dissemination. An appropriate institutional infrastructure is required to coordinate at all levels in planning and implementing of renewable energy activities.

Financial: The financial barrier is the crucial barrier to commercialize the renewable energy projects. Lack of adequate financing schemes has been a major problem for setting up renewable energy projects.

Technical: Renewable energy resources are unlimited but the technology to harness it is in the development stage. Non-availability of cost-effective, commercially viable technology for utilization of renewable energy constitutes one of the barriers. Local manufacturing and assembly of renewable energy technology components and equipment are currently limited.

Skills: Development and successful implementation of renewable energy

[3] UNDP (United Nations Development Programme), UNESCAP (United National Economic and Social Commission for Asia and the Pacific), UNESCO (United Nations Educational, Scientific and Cultural Organisation), GTZ (Deutsche Gesellschaft für Technische Zusammenarbeit), ADB (Asian Development Bank) , SIDA (Swedish International Development Agency)

technology requires sufficient information and inputs of manpower. It is imperative that education on renewable energy be included at various levels in schools, colleges, universities and other academic institutions. This will be useful in the design, development and evaluation of this emerging technology.

Knowledge management: There is also a knowledge gap in renewable energy technology among policy makers, energy managers, engineers, and scientists of the South Asian countries. Organizing international / regional seminars, and workshops on renewable energy technology (where renown energy experts in the region can share their experience and present papers) can help overcome this barrier.

8. Conclusion

The following conclusions can be drawn from this article.

- A proper government policy guideline is essential for the development of renewable energy technology in South Asian countries like Bangladesh. The revised national energy policy has recommended establishing a Renewable Energy Development Agency (REDA) to undertake the development of different renewable energy technologies. The Bangladesh Government should consider this issue and approve the revised policies.

- There is great potential for renewable energy resources and they can contribute significantly towards poverty alleviation and rural development in the country. Thus, research in this sector should be encouraged and the necessary funds must be provided.

- Using solar PV on boats is a valuable experience that may lead a new effort in providing education and electricity services to many waterside communities.

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e UPDATE

REGIONAL COOPERATION IN BIOGAS TECHNOLOGY

An introductory public seminar was held in January 2008 on plug flow type biomass based biogas systems in Sri Lanka.The key players, mainly practitioners and decision makers in the biogas sector in Sri Lanka attended this programme. The continuous (Chinese) and batch (Sri Lankan) type biogas systems are the biogas systems popular in Sri Lanka. Animal dung and paddy straw respectively are the main sources used to charge the above biogas systems. The plug flow type biomass based biogas systems have the main advantage of using the solid state organic matter to charge the biogas systems on a daily basis to generate a continuous and steady supply of biogas.

Professor H N Chanakya and Professor B V V Reddy both from the Centre for Sustainable Technologies (formerly Centre for Application of Science & Technology to Rural Areas, ASTRA) of the Indian Institute of Science, Bangalore shared their knowledge and experiences with the audience. They have had decades of experience in design, development, testing and use of many types of biogas systems in India. Prof. Reddy and Prof. Chanakya visited the Sri Lankan biogas units in order to gain an exposure on the technologies being used and their applications and identify the resources to generate biogas and the materials available to construct them prior to the seminar.

The seminar was inaugurated by the Chairman of the Technical Advisory Committee for Biogas in Sri Lanka, Mr. G K Upawanse and over 40 participants from different parts of Sri Lanka attended. It dealt with various aspects of the conversion of agro-residues and weeds in plug flow biomass based biogas technology, its merits & demerits, global experiences with special reference to India, skill requirements, suitability and availability of alternative materials, avenues for income/livelihood generation, etc.

Practical Action is negotiating with the Centre for Sustainable Technologies of the Indian Institute of Science to arrange a capacity building programme for the constructors & practitioners (as trainers of trainees) from other countries in the South Asian Region in late March 2008 on this technology. The trainees would be able to get back to their respective countries and adapt the technology and approaches to help face the challenge of managing organic waste and energy crises.

RISKS AND OPPORTUNITIES IN COMMUNITY BASED ENERGY FINANCING IN INDIA

By Ashok Kumar Singha

Dependence on depleting fossil fuel energy sources for energy has resulted in uneven economic growth, spiraling energy costs and environmental concerns across the globe. India is no exception, but has the renewable energy sources which, with community participation, can help address these problems. The following article describes the challenges and opportunities available in the country's renewable energy sector and provides possible solutions for financially viable community based renewable energy options.

The power sector in India is dependent mainly on fossil fuels. A little less than 2/3rds of the country's total power capacity is from thermal sources (coal, gas, and oil). Fossil fuel based systems require higher capital outlays and are complex. Out of India's total energy sources, renewable energy contributes to only 8% of the total power (140,301.8 MW) produced. There is scope for community participation in the renewable energy sector, including : (a) Small Hydro Projects (b) Biomass Gasifiers (c) Biomass Power and (d) Wind and Solar photovoltaics. Out of the aforementioned sectors, the biomass based systems hold the most promise for community participation.

It is important to note that 50% of the households in India do not have access to electricity (Planning Commission, 2006). Energy access is a key requirement to attain the dual agenda of high and inclusive growth. In any road map for energy systems of the future, decentralized and distributed renewable energy systems are bound to figure prominently to meet the energy service requirements of millions of people living in rural areas in a sustainable manner. With depleting energy reserves, environmental concerns, and rising cost of energy generation, the country can no longer hope to continue

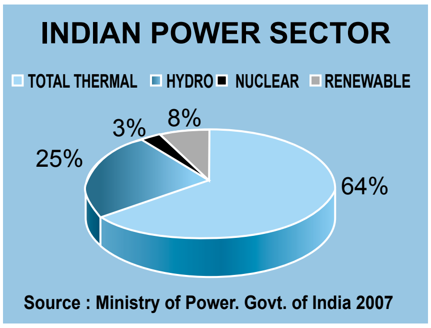

Figure 1 Energy Sources in India

to depend on conventional fossil fuel-based energy sources to meet its ever growing demand for energy. According to one estimate (Planning Commission, 2006), about 18,000 MW of installed capacity based on biomass residues and an additional capacity of 60,000 MW from dedicated plantations can be sustained at a plant load[1] factor of 68.5%. However, this will require increased investment in deploying decentralized energy systems using renewable energy sources, promoting local energy entrepreneurs and empowering local communities to participate in the local energy value chain. In our study, we have examined about 4 - 5 cogeneration projects[2] operating in rural areas[3] using combustion route to fire biomass like rice husk and prosophis juliflora and coal as a supplementary fuel. The optimal point at which the technology can be viable requires a larger plant (5 MW). This in turn requires biomass collection and transportation over a large area. A 5 MW power plant opeating for 6,000 hrs a year requires a plantation catchment of 7500 hectares (with an average yield of 5 Ton/ha). Investment in such a plantation is approximately INR. 5,000 – 7,000/ha/year. The actual cost of generation (excluding capital cost) in this system would be approximately INR. 3.80/kWh. Thus, it is important to evolve a financing mechanism as well as an institutional mechanism to achieve this required scale of production. The modularity and decentralized nature of renewable energy technologies make them well-suited to sustainable energy development in rural areas. The typical risks associated with the renewable projects have been summarized below.

[1]Plant load - The ratio, in a given time interval, of the energy actually supplied by a plant to the product of the maximum power and the time interval (Source: http://www.energy.eu/dictionary/data/1334.html)

[2]Cogeneration projects - Projects which produce electrical energy and another form of useful energy (such as heat or steam) through the sequential use of energy.

(a) Low Plant Load factor

(see table below)

Type of Renewable	Risks
Solar	Considering the availability of solar radiation of 1000 to 1600 Hrs it translates to a plant load factor of 25%
Wind	It can vary from 13-20% considering the array and park efficiency, availability of the machine and evacuation to grid.
Bio-mass	If linked to an industrial production system (like sugar cogeneration) can achieve up to 55% PLF
Small Hydro	By and large dependant on the water release from the dams and fluctuating rainfall PLF is not more than 30-40%

Source: Compilation from the Ministry of New and Renewable Energy (MNRE) data

(b)Uncertainty in the Grid availability

In most cases the unavailability of the grid effects the power evacuation. Thus investors do not come in even though biomass is available in plenty.

(c) Remote location

The constraints in transportation and communication links affect the installation and servicing of equipment, and there is also a lack of trained manpower.

(d) Financial Constraints

The banks in the rural areas

[3]Based on the monitoring reports from the UNFCC (United Nations Framework Convention on Climate Change)

consider such projects as unviable or risky and insist on collateral security and guarantees. In general the renewable project financing is difficult. Factors that contribute to risk and return, financing sources, options and duration, availability of subsidies, grants and supports in the financial viability and expected revenue flow of the project need to be analysed in great detail. One part of this barrier in finance can be offset by exploring revenue inflow through carbon credit since the renewable projects come under Clean Development Mechanism (CDM). Several potential small projects will be identified which can be financed in this manner or in a bundled form to reduce the transaction cost.

There are several ways these risks can be mitigated to a large extent. A pilot model should involve the following :

• careful planning of the **project location**: where there is a mix of renewable sources available which can work in combination to improve the location level plant load factor for the selected area.

• Assessing the **economic opportunity** in the area, where the energy generated can be linked to a production system like cold storage, rice/flour mill, etc.

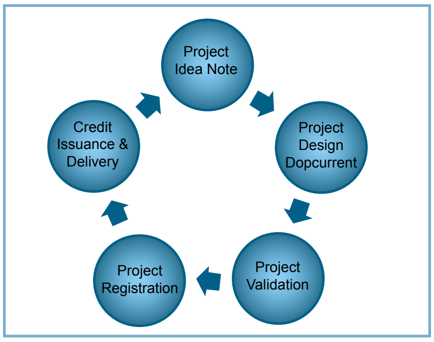

Figure 2 CDM Project Cycle (Source : UNFCC)

• The biomass based system should have a **captive plantation**[4] preferably in the degraded wastelands where it does not compete with food crops. Field bund based plantation is also possible for certain species.

• Project Planning should take in to account the **carbon financing**. Certified Emission Reduction (CER) credits generated from these projects are sold to buyers in the developed countries (termed as Annex I countries) at a rate varying from US$6 – 10 / CER. To avail this it is important to have a project entity in place. This can be a cooperative society, a *panchayat*, a producer group or any private entrepreneur. This entity, with the advice of competent climate change advisors, should develop a project idea note, a project design document that will be carefully developed using the bundling[5] principles. This should be presented to the Designated National Authority for approval. A validator will also be engaged to validate the project and develop a monitoring plan. Once the project is validated, it goes for registration. The typical cost for such an initiative should be in the range of INR. 1.5 to 2 million. This amount is usually reimbursed by the buyers of the carbon credits. Therefore, a project generating about 30 - 40,000 CER per annum has a viable means of getting upfront finance from CER buyers. Normally the projects are for a 10 year fixed term. So a project, as stated above, can earn up to INR. 20 million from carbon credits alone. In general, the carbon credit revenue can improve the Internal Rate of Return on this kind of a project by 12 – 15%.

• **Skill development:** It is important to build the local skill base for the installation, maintenance, and management of the project. Therefore, capacity building and training of the local people could be packaged in to the project planning, as could contracting the suppliers who should provide training on the handling and maintenance.

[4]Captive plantation is a plantation which is meant for the own use of the project entity (i.e. a paper industry going for a plantation activity).

[5]Bundle is defined as: "Bringing together of several small-scale CDM project activities, to form a single CDM project activity or portfolio without the loss of distinctive characteristics of each project activity. ….Such characteristics include its: technology/measure; location; application of simplified baseline methodology. Project activities within a sub-bundle belong to the same type. The sum of the output capacity of project activities within a sub-bundle shall not exceed the maximum output capacity limit for its type." (UNFCCC)

The past few years, have seen the price of centralized sources of energy rising in India and it is hitting the poor hard, especially in rural areas. Hence there is a need for decentralized and renewable energy sources which would minimize distribution losses and utilize locally available biomass and other resources. These resources are green and clean, and can be tapped by the local community. While formulating policy it is important to note that, demand for energy (in relation to supply) is a key determinant of price and not the cost of production alone. To the consumer, what is important is the price of the commodity and how important the commodity is in his / her basket of goods and services. S/he does not compute the profit margin that the producer is likely to make at a given price.

If energy supply is made more profitable, more suppliers will enter the market, thereby meeting the growing demand. This trend is likely to bring down the price. Therefore, the aggregation of producers is key and can be encouraged by micro-finance institutions, large NGOs and through effective public-private partnerships. The aforementioned policy focus, project planning and implementation procedures as well as sector support in terms of technical knowledge and financial mechanisms need to be fine-tuned in order to develop community based renewable energy projects further.

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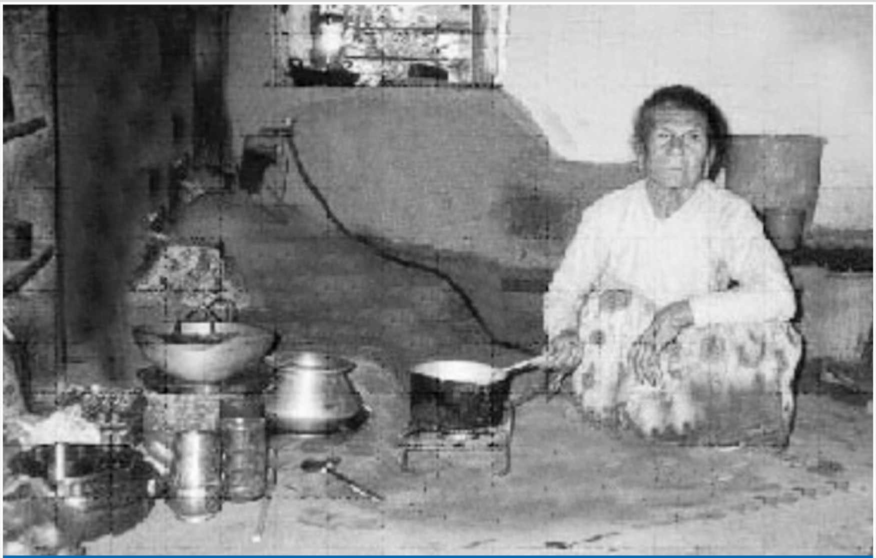
FINANCING OPTIONS FOR DECENTRALIZED RENEWABLE ENERGY TECHNOLOGIES

By Shreekar Pradhan

Renewable energy sources are a viable environmentally friendly energy alternative for rural communities. However, financing such systems remains a challenge, especially in developing countries. This article looks at the access to finance for such systems through micro credit and carbon financing. Examples of renewable energy household level projects which have successfully tapped into these financing sources are also provided.



A 70 year old beneficiary of the BSP programme who cooks for her family members while they are engaged in cultivation work
(Source: BSP website, www.bspnepal.org.np)

Introduction

Approximately one fourth of the world's population lack access to electricity, this includes 1.5 billion population of the developing countries who do not have access to electricity (UNDP, 2007). Grid extension to scarcely populated rural communities is not only costly but takes a long time. Even if the grid is extended to the rural population, most of the end users would not be able to afford it. 2.5 billion of the world's population relies on biomass to meet their cooking energy needs (IEA, 2007). As per World Energy Outlook (IEA, 2006), one third of the population will still be relying on biomass by 2030, if the present trend continues without alternative polices in place.

Decentralized renewable energy sources (RES) are clean, environment friendly alternative sources of energy, suitable for rural communities. These energy sources have provided light to the rural communities who, otherwise, would have to depend either on traditional sources of biomass or kerosene. However, reaching out to the larger rural mass with affordable RES remains a difficult task. Mainstreaming renewable energy for sustainable development and developing a strategy of providing renewable energy technologies (RET) with a level playing field so that they can compete with other commercially available technologies, have been widely discussed for several years (IISD-CCKN, 2004, Farinelli, U., 1999, Eric Martinot et al., 1999). In this context, commercialization of RETs so as to make them accessible, affordable and sustainable in the long term is crucial. However, there are several barriers for the utilization of decentralized RES. In a broader aspect, the major barrier can be seen in technology, policy and finance. However, financial barriers are the strongest hindrance to the promotion of RETs in developing countries. Subsidies have often been used by the governments in many countries to promote RETs. No doubt, a subsidy helps in making a system affordable by reducing cost barrier. However, lessons learnt show that a subsidy alone is not enough for the sustainability of such systems in the long run. The rural population might end up with the system and the continuity of such systems might be questionable in the long run. Further, the lack of availability of sufficient funds, difficulty of accessing governmental programmes and financing agencies, and price distortions between conventional and renewable energy are some of the other financial barriers. In particular, overcoming the cost barrier of RETs in a sustainable manner has been an obstacle. In order to overcome such barriers two prominent financing options, micro credit and carbon financing, are discussed in the following sections.

Micro credit finance

Micro credit financing mechanisms increase the affordability of RETs for the rural population. Flexible repayment schemes, fee repayment schedules which match the customer's income stream and longer loan repayment terms are some of the characteristics of micro credits which are successful in making RETs affordable for the rural people.

In Nepal, the installation of biogas plants is supported by a partial subsidy for the upfront cost. However, the subsidies are enjoyed by persons who are relatively better- off in the society. In order to tackle this gap, capacity building of micro-finance institutions in financing RETs is being carried out. These institutions are now providing micro loans to the low earning population to access such systems. There are more than 200 micro finance institutions trained for financing RETs.

An innovative mechanism in micro credit is used by Himalayan Light Foundation (HLF) which has been providing solar lights to the rural communities (HLF website).

The rural community is required to weave a hand knitted bag every month for 2 years in order to enjoy solar light. HLF purchases these bags from the community as a repayment of the credit provided against the solar light system and it sells the handicraft in international markets. This concept is called as the Home Employment and Lighting Package (HELP) (UNDP/SGP, 2001). In another case, a revolving fund mechanism is developed in order to micro finance biogas plants in WWF projects in Nepal (WI, 2006). At nominal interest rate, loans are provided from the fund to install such plants through micro finance institutions.

Lessons could be learnt from the efforts from Sarvodaya in Sri Lanka and Grameen Shakti in Bangladesh. These NGOs (non-governmental organisations), with the assistance of foreign donors, have been successfully providing micro-credit schemes for RETs. No direct subsidies are provided. Rather, micro credits with flexible small loans are provided. An innovative mechanism called 'Micro utility' services the poor customers, who cannot afford the repayment. They are allowed to rent the load to neighbours and this has made it possible for them to recover the payment. About 4000 Solar home systems are being installed in a month in Bangladesh following these policies (Grameen Shakti Website).

Transaction costs are lower in micro credit than banks. However, the increase in such cost of transaction increases the price of the RET systems at all the stages from manufacturing to the service delivery. Introducing simplified transactions and achieving economies of scale are key to lowering such transaction cost. Thus financing mechanisms should also be extended to the service chain, to organizations that manufacture, install and maintain RETs, in addition to the end users. This would expand the market along with the service chain and while also helping to lay a path for commercialization of the RETs in the long run.

Carbon Finance

The Kyoto Protocol (KP) was adopted during the Third Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) in December 1997. It has developed three flexible mechanisms so that countries can achieve their emission reduction targets with the low cost of abatement. These are the Emissions Trading, Joint Implementation and Clean Development Mechanism (CDM).

CDM is the flexible mechanism through which developed countries (Annex-I) sponsor renewable energy projects in developing countries (Annex-II). The credits go towards fulfilling the emission reduction obligation of these industrialized countries. This is the only mechanism in which developing countries can benefit theemission reduction credit even though they are not obliged to reduce the emission by KP.

CDM has two major advantages for developing countries. Firstly, it increases the financial feasibility of clean energy projects and secondly, it contributes towards the sustainable development of the country. Therefore CDM, through the certified emission credits (CERs) generated from projects, is a potential source of additional funding for the realization of cleaner technologies. A good example is the case of two biogas projects of Nepal (with a total of 19,396 biogas plants) developed under the Biogas Support Programme (BSP) which are the two first CDM projects developed in Nepal (WI, 2006). Together, the two CDM projects in Nepal are already generating US$ 0.6 million per year as revenue. The Voluntary Carbon Market is another emerging carbon financing market in the world. It is different from the compliance market as in the case of CDM. In the Voluntary Carbon Market, the GHG emission reduction produces Verified Emission Reductions (VERs) which can be sold to environment conscious individuals and companies who wish to voluntarily reduce their carbon footprints. Individuals or organizations can purchase CO_2 emission against the amount of emission during its activities (e.g. emission by traveling in a flight, vehicle transportation etc.). Also events, conferences can be presented as a carbon neutral event by purchasing VERs against the emission during such events. WWF Nepal is implementing a Gold Standard Biogas VERs project in Nepal for emission trading in voluntary carbon market (WWF Nepal, 2007). Also the emission reduction from 7,500 number of plants is expected to supplement the fund requirement for the project.

Development of CDM projects could involve several households in small scale cleaner energy production (such as household biogas plants) or small scale efficient energy utilization (for example, using improved cook stoves, solar stoves etc.). This would however, require local capacity, project investors (local and/or foreign), and establishing linkage with the international carbon traders and institutions with capacity to install/distribute the devices at the household levels in rural areas. Thus, individual small scale projects may have difficulties in developing as CDM project despite their eligibility for CDM criteria. Lessons could be learnt from Nepal's Biogas

A woman from bongadovan village, with a hand woven bag, part of the HLF initiative
(Source: HLF website, www.hlf.org.np)

projects on overcoming these difficulties. 19,396 individual household scale biogas plants were bundled together and they were developed as two CDM projects. Bundling together these projects helped in managing the projects and also helped to lower the prohibitive CDM transaction cost. Subsidies were provided to the individual households as per the government's subsidy policies while the CDM revenue was utilized to overcome the financial gap in the whole project.

A recently concluded 13th Conference of Parties (COP) meeting in Bali, showed promising outcomes in RETs especially in biomass projects. The issue of the replacement of non-renewable biomass with renewable biomass was posing a difficulty in CDM project development in the past. However, the Bali meeting included a request to the CDM Executive Board (EB) to approve the simplified small-scale methodologies[1] for replacing non-renewable biomass with renewable energy and improving efficiency in non-renewable biomass end-use (Philip Mann, 2007). This would especially benefit projects involving biogas plants, clean cooking fuel and energy efficient cooking devices.

Concluding Remarks

Financing through micro credit would help deliver cleaner energy services to the rural population by increasing their affordability while simultaneously increasing their capacity in adapting to new emerging technologies. Carbon finance would fulfill the financial gap in overall project development by ensuring an additional flow of funds to cleaner environment friendly projects. These two financing options provide immense potential for RET expansion amongst the rural population.

[1]Simplified small scale methodologies are approved by CDM Executive Board, which are used to demonstrate additionality and baseline determination and monitoring approaches in small scale CDM projects.

There are other measures at national level that would remove financial barriers for the promotion of RETs. Removing subsidies on fossil fuels would give RES a "level playing field". Internalizing of negative externalities of fossil fuels by introducing carbon taxes in their prices would provide a competitive advantage for the RES. These taxes should be deposited into a revolving fund and should be utilized for targeted RET projects as in the case of the Dominican Republic[2]. Similarly, removal of import taxes in RET equipments and accessories, tax relief like "accelerated depreciation" as in the case of India for wind turbines would promote the RETs. Some of the widely accepted policies that enhance the RETs are feed-in tariffs ("adder" as in the case of Thailand (Amornkosit N., 2007)) and green electricity pricing which would give the end user a comparative advantage in the price.

Thus, there are several national level measures as well as financial mechanisms operating at both national and international levels which can help promote RES and make them financially viable. Cooperation between households, provision of access to financing services for the poor, as well as awareness of such financing mechanisms are important, if RETs are to expand and be replicated successfully.

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