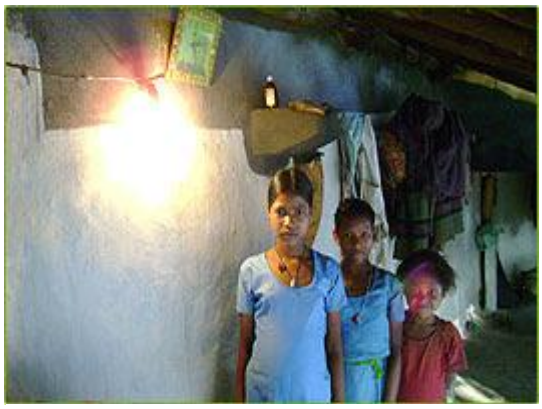
Off-grid power solutions



Household with electricity connection from a biomass gasifier system in Kumhedin village, Madhya Pradesh

Despite widespread privatization and liberalization of the electricity sector in the 1980s and 1990s, rural electrification has been largely neglected. This is attributed to the fact that rural electrification provides little by way of market incentives for profit-seeking private companies. Besides, it is also characterized by geographical remoteness, dispersed consumers, higher costs of supply and maintenance, low consumption and limited ability to pay. However, studies have repeatedly underlined both human and economic benefits of rural electrification. An Energy Sector Management Assistance Program (ESMAP) study on rural electrification in the Philippines revealed that households lacking electricity were much poorer and less educated than their electrified counterparts. Another impact study on the rural electrification programme in Sri Lanka also corroborated the direct linkage between electrification and poverty eradication. The study also noted localized benefits of electricity to households that lead to enhancement in quality of life, better health and improved air quality and also illustrated long-term benefits for the community in terms of sustainable economic growth.

According to 2010 estimates, 1.4 billion people (i.e. 22% of the total global population) do not have access to electricity. Of these, approximately 612 million (i.e. 42% of the population) live in South Asia. The current total penetration of grid electricity in the rural areas is about 50%, leaving one out of every two people without access to electricity. However, there is also wide disparity in rural electrification in South Asia. While the Sri Lankan rural electrification rate of 75% is higher than the global average, only 12% of the rural population in Afghanistan is connected to the grid. India, Pakistan and Bangladesh constitute more than 90% of those lacking access to electricity. Hence, appropriate local solutions need to be found.

Off-grid distribution line in Mahishakada village, Orissa

In this context, the Off-grid Access Systems for South Asia (OASYS) project seeks to provide a review of the status of rural electrification in South Asia, and identify best practises in off-grid supply that can be replicated in developing countries. Based on an analysis of the findings, a framework will be designed and implemented to test the model(s) that are techno-economically viable, institutionally feasible, socio-politically acceptable and environmentally sound. Then, based on results, the project will recommend scaling up of a particular model or different models depending on local situations. The key questions for which answers are being sought as part of this project are:

- Are there cost-effective, secure and reliable local off-grid electricity supply solutions that can meet the present and future needs?
- Are these solutions socially acceptable, institutionally viable and environmentally desirable?
- Do these local solutions have the scaling-up and replication potentials?
- Can these solutions be brought to the mainstream for wider electricity access in the developing world?

As part of this joint consortium study, TERI has been assigned the task of reviewing the South Asian and other developing countries' experience with respect to off-grid solutions. It is also studying various service delivery models and financing options for rural electrification. Additionally, it is working with TERI University to develop a framework and accordingly set up a demonstration project in India. TERI will also work with other partners to frame policy guidelines on off-grid power solutions.

As part of this project, a workshop was held in 2010 to discuss the findings. These included the following:

- Technology, demand estimation, financing, tariff, and operation and management issues play an important role in producing viable and successful business for off-grid electrification.
- State or donor support has been the form of sustenance for off-grid projects, but some attempts towards commercialisation are evident. Linking these projects to Clean Development Mechanism (CDM) and the carbon market can prove to be beneficial.
- Most rural electrification projects have a subsidy component. Capital subsidy has enabled the implementation of the project in many cases but is insufficient for its sustainability.
- Rural and small enterprises can sustain off-grid electrification. However, innovative financing mechanisms need to be explored.
- Thus far, many of the benefits from rural electrification have gone to the non-poor (both in terms of access and subsidies). Rural electrification schemes have failed to provide universal access and have been unaffordable for the poor.
- Rural electrification systems relying on just one source of energy may not always be the ideal solution. DG hybrid systems can provide solutions in speeding up electrification, reducing long-term cost, and protecting the environment.
- Grid-based electrification remains the most common form of electrification in the world. The off-grid experience, a recent phenomenon, is gaining momentum, but in many cases, this is being used either in the pre-electrification phase or as a temporary solution until grid extension can take place. In this regard, the success of China in providing power to its population needs detailed analysis.

The workshop also discussed the conventional grid system, renewable-based mini-grids, and stand-alone systems in Nepal, Bangladesh, Sri Lanka, and India. The findings showed:

- The success in the dissemination of solar home systems (SHS) in Bangladesh and Sri Lanka demonstrate that it is possible to implement off-grid programmes in association with the private sector and microfinance institutions that operate in rural areas. While these experiences may be true for only SHS delivery, the design principles key to their success can be extended to cover other off-grid technology.

- The rate of success also depends on the extent of the government's commitment in creating an enabling environment for the promotion of rural electrification. The case of Bangladesh and India are two examples where we can see that the creation of the Rural Electrification Board (REB) and launch of Rural Electricity Supply Technology (REST) Mission and later the Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) has assisted in increasing the electrification rate substantially.
- Whereas community centric off-grid projects have succeeded in some cases, there are also negative fallouts. One of the key reasons may be that almost all off-grid projects are located at remote areas, thereby making it more challenging from the point of view of sustainability.

The key challenges for off-grid power in Nepal, Bangladesh, Sri Lanka and India were identified as:

- Less concentrated demand for electricity;
- Low economic activity implying lower demand;
- Lower ability to pay;
- Difficulties in operation and maintenance;
- Non-availability of skilled human resource for operation and maintenance of power plant; and
- Weak fuel supply chain linkages and absence of biomass markets (in case of biomass based projects).

The issue of grid electrification vis-a-vis the user's preference for a particular mode is complex and needs to be studied. However, it is clear that an effective service delivery model along with innovative financing mechanisms, customised to a given situation, can lead to a success story. What is needed now is development of business models, considering their scaling up potential, and implementing such models covering different socio-cultural-economic-enviro set up to test their viability and replicability potential.

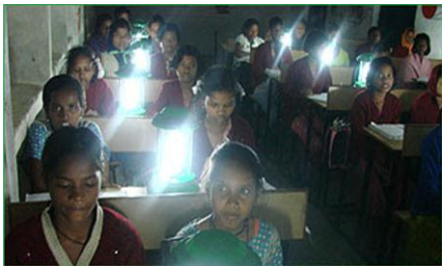
Objectives

- to investigate and suggest cost-effective, secure and sustainable local solutions to electricity access problems taking into account resource, skill and other constraints, and to recommend the appropriate institutional arrangements;
- to demonstrate the functionality of the identified solutions through appropriate pilot projects in selected areas of South Asia;
- to recommend and support up-scaling of identified and demonstrated energy solutions to other rural areas;
- to facilitate, build, and develop interdisciplinary research skills in UK universities and in partner institutions in South Asia, and a real collaboration between academia and other stakeholders;
- to disseminate the lessons and experiences gained through the investigation and demonstration works to a wider academic and non-academic audience; and
- to develop collaboration between academia and other stakeholders and ensure two-way capacity building and knowledge transfer.

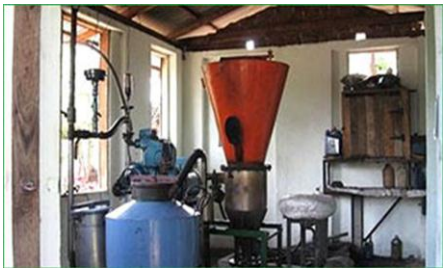
Activities

- In-depth analysis of off-grid delivery options and framework development;
- Assessment and selection of appropriate business models;
- Demonstration project;
- Study of scaling-up, replication and mainstreaming of selected models;
- Recommendations for wider delivery of off-grid solutions.

A solar power plant in Sagar Island, West Bengal



Solar lantern facilitating education at Kasturba Gandhi Balika Vidyalaya, Korba, Chhattisgarh



A biomass gasifier in Galoruwa-Kolonna village; Sri Lanka
Source: Asoka Abeygunawardana, Energy Forum, Sri Lanka

Note: This webpage was published at the TERI website on 25 May, 2011.