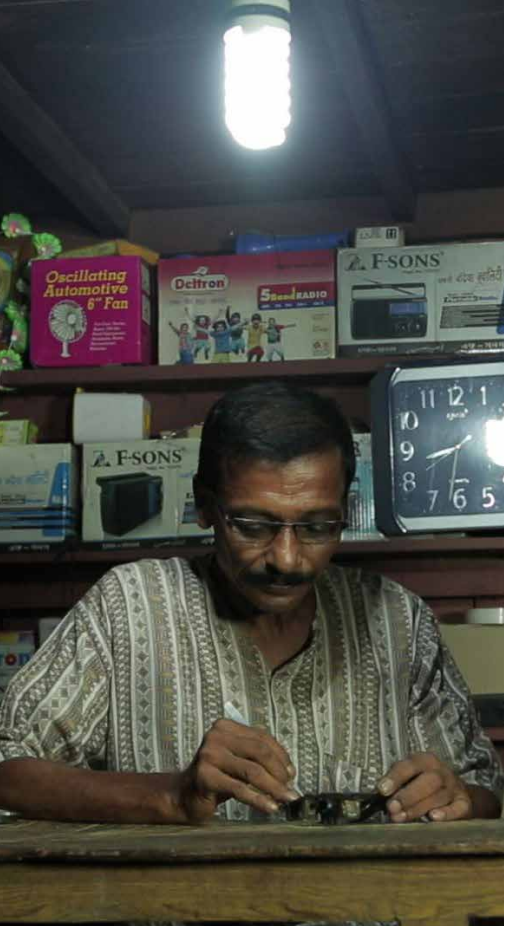
ELECTRIFYING REMOTE AREAS

Innovations by OASYS South Asia Project

The issue of electrifying inaccessible areas is the need of the hour today. To address this problem, various efforts have been made by different authorities. In this article, **Debajit Palit** and **K Rahul Sharma** describe an innovative effort of the OASYS South Asia Project to electrify remotely-located villages in India.

The OASYS Project

Globally, there are more than 1.3 billion people who do not have access to electricity. Although conventional grid connection has been the predominant mode of electrification, it has, however, not been able to successfully reach numerous remotely located regions both in India and in many countries across the globe. In addition, many households in grid-connected areas in India also do not take connections from the grid, the primary reason being unaffordability and unreliability of the central grid. The problem of electricity access requires solutions which are techno-economically viable, institutionally feasible, socio-politically acceptable, and environmentally sound. Such solutions need to be identified and targeted in order to propel a conscientious and collective effort aimed at improving the quality of life for targeted sections on all fronts and tangents. Given that institutional issues and development of viable business models for rural electricity and energy supply have not been receiving the attention they require, it is necessary to carry out a systematic analysis and research.



The 'Off-grid Access Systems for South Asia' (OASYS South Asia) project aims to develop a systematic analysis and research foundation in order to find appropriate local solutions for sustainable rural electricity supply, especially for the off-grid areas. The project was devised to answer two key questions—whether there exist cost-effective, secure, and reliable local off-grid electricity supply solutions which can meet the present and future needs, and if local solutions have the potential for scaling-up and replication potentials which can be brought to the mainstream for wider electricity access in the developing world.

The efforts entailed a thorough review of the prevalent off-grid electrification sector, a detailed investigation of a suite of alternative decentralized business solutions, and corresponding institutional frameworks for rural electricity and energy supply, along with a special focus on South Asia as the targeted region, for the evaluation of case studies, demonstration projects, and applied academic research, respectively. As part of the OASYS project, an important component was to develop an off-grid delivery model framework and implementation of demonstration project(s), covering un-electrified villages, to test the framework. Demonstration projects have thus been implemented in four different locations situated in the states of Odisha, West Bengal, and Uttar Pradesh in India, through three distinct business and institutional models aligning with site-specific conditions.

Demonstration Project(s) under OASYS

The demonstration projects implemented under the OASYS South Asia project employed mini-grids, microgrids, and pico-grids providing either AC or DC power to

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electrify households and shops/micro-enterprises in the project areas. The three models employed are as follows:

- Community-managed model with NGO (AC and DC microgrids of different capacities in five villages) in Dhenkanal district, Odisha. They serve around 150 households.
- Community-managed model with district administration (20 kWp AC mini-grid in one village) in Kandhamal district, Odisha to serve around 250 households.
- Privately-operated (micro-utility) model: Selected through a competitive bidding from eligible project developers. This model implements the following:
  - » Solar DC microgrids in Uttar Pradesh to serve around 4,200 households.
  - » Solar AC pico-grids in West Bengal. They serve around 500 households and shops.

Community-managed Model with NGO

This demonstration project is located in the Dhenkanal district of Odisha, where a community-managed and NGO-supported business model has been developed to set up five solar mini and pico-grids. The village cluster, namely Rajanga village (and its Hamlet), Kanaka village, Baguli village and Chadoi hamlet, with a total population of 555 inhabitants, are completely un-electrified and are located within the Kandhara Reserve Forest, thereby making electricity access relatively difficult. Furthermore, the targeted areas have not been considered under the national rural electrification scheme, namely the 'Rajiv Gandhi Grameen Vidyutikaran Yojana' (RGGVY), steered by the Ministry of Power, Government of India, due to their location within a forest area. Owing to this remoteness and the fact that private developers

> "We were living on the roots and fruits from the forest and didn't know what light was. Now my children are able to study at school during the daytime and at home during the evening. They even take tuitions in the evening. I am really grateful for the light."
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> **Lalita Pradhan**
> Member
> Village Energy Committee,
> Dhenkanal project

were unwilling to invest in such a high business risk area (due to low population and paying capacities), a subsidy-based community-managed model was developed.

The Energy and Resources Institute (TERI), along with its grassroots partner, the Institute for Research and Action on Development Alternatives (IRADA), identified different household electricity needs and new livelihood activities which could be initiated post stable electricity intervention. Through this assessment process, active participation of the village community was ensured by the formation of a Village Energy Committee (VEC), which is responsible for the management of the electricity project. Three of the villages have an AC microgrid while the hamlets (with 12–15 households) have a low voltage DC microgrids, respectively, based on the population of the villages and the potential for livelihood-generating activities. However, considering that this is a community based project and it is therefore important to maintain homogeneity, regardless of whether the village has an AC or DC system, the quality and quantity of services provided to each household has been kept exactly the same. This project has enabled numerous livelihood opportunities, which include activities that use applications, such as grinders for spices, packaging, 'Saal leaf' plate-making, better irrigation facilities, functioning water purifiers, and installation of fans and street lamps in community areas/institutions like clinics and schools, etc. Moreover, smart grid interactive inverters and battery management system, with auto load cut-offs or timer-based operation, enable users to efficiently manage the limited energy produced by the AC and DC microgrids. The project was commissioned in March 2014 and is supposed to be completely independent by early 2015 by which time TERI will exit the project and the management will be completely handed over to the VEC and IRADA.

Community-managed Model with District Administration

While the community-managed models can ensure local decision-making and contribute to sustainable long-term operation of the power plant, this model extends the concept to include the district administration as a key stakeholder. The district administration of the Kandhamal district of Odisha is supporting this project through the contribution of land, a room for housing the battery and inverters, and the power distribution network and the OASYS project is supporting the installation of the solar power plant, training and capacity-building of stakeholders, and other soft support to make the project sustainable. The district administration is also a member of the management committee and on TERI's exit from the project, the project then will be handed over to the district administration. The involvement of the local administration is essential for the scaling-up of such initiatives, in order to ensure smoother revenue transactions, maintenance, and repair, and funds allocation in case of a need to enhance the system capacity. This project will support over 250 households from a 18 kWp capacity solar power plant. Further, once the mini-grid concept is tested and its efficacy in providing clean electricity is demonstrated, the district administration is also expected to cover other un-electrified villages and hamlets in the district using fund available under the District Innovation Fund and/or other developmental programmes to scale-up the initiative in the district.

Privately-operated micro-utility model

In this model, a cluster approach for implementing solar DC microgrids

> "People of these islands are unable to come up with collateral, and hence the banks are reluctant to give them loan. So NABARD came up with this instrument called the joint liability group. This belongs to agriculture sector basically, but now they have extended it to the energy sector. With these groups they were able to give loans without any collateral. So we did some 45 loans initially and it worked out well. We have been getting hundred percent repayments on that. Seeing this, other banks like United Bank also came forward to give loans.."
>
> **Col. Vijay Bhaskar**
> Country Director
> Mlinda Foundation

and solar AC pico-grids is used. Mera Gao Power and the Mlinda Foundation has been supported as parts of this initiative in Uttar Pradesh and West Bengal, respectively, with the objective to enhance participation of private sectors in rural electrification. A formal bidding process was invited from around 25 private players in the off-grid electrification space who were asked to submit a proposal requesting for Viability Gap Funding (VGF) from the OASYS project. After an intensive process of evaluation, Mera Gaon Power and Mlinda Foundation were selected and were recipients of the VGF for ensuring sustainable supply of electricity for basic lighting and mobile phone charging facility.

In the case of Mera Gaon Power, the VGF supports the installation of microgrids for connecting 2,900 household initially, with the condition that an additional 1,500 households are to be given service connections over the next two years, by re-investing part of the revenue generated from the first 2,900 connections, thus reducing the overall subsidy from OASYS project to around 30 per cent. MGP is responsible for all operations, maintenance and management on its own using its human resource. Sandeep Pandey, Director at the Mera Gao Power states, 'The fund that was allocated to us under the OASYS project in 2013 was utilized to open a new branch in Laharpur block. At that time, we were in need of funds, and the aid was very helpful. We are still using the leftover fund to install new microgrids. Although Laharpur block has 1,000 villages and hamlets, our base is in 500–600 villages and we are looking at a potential of around 7,000–8,000 customers. With the help of the fund, we not only bought new systems, but also trained our staff.' This is, by far, the biggest of the OASYS projects in place, planned to serve over 4,200 households by using low-cost modular solar microgrids. Under this model, an auto switch (on/off) for basic lighting (2–4 light points) and mobile phone charging is provided for community members. MGPs key focus is on strengthening operations and ensuring timely collection and thus they have formed Joint Liability Groups (JLG) with all the users of a single microgrid acting as one JLG. The JLG assures payment based on weekly tariff and a collection efficiency of around 90 per cent has been observed. The connection charge is ₹ 50 and collections of ₹ 25 per week are made by users to MGP on a prepaid basis. Users may also choose to pay in advance for more than one week as well.

In the case of Mlinda Foundation, the users themselves have availed small loans from a local bank (with Mlinda Foundation providing the risk guarantee) for establishing the solar AC pico-grids in their homes and repayment period for the loan is around 3 years. The OASYS project has supported Mlinda Foundation for about 30 per cent of the total project cost to make the repayment amount affordable to the users. Each pico grids consists of adequate capacity of solar modules, which are mounted on one of the houses in which the inverter and battery bank is also installed,

> When we first started it was very hard sell particularly with the investors and with many of the other players in this space. So, there was a feeling that what we offered was too little; it wasn't enough for what people wanted. They think everybody wants fans, TVs, coolers, grinders ... but actually the fact is that we focused what are these priority basic needs ... and that is light. So as long as kerosene is being used in households then MGP provide better solution, but once kerosene is eliminated then we can look at offering more.
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> **Brian Shaad**
> Director
> Mera Gao Power

and shared by 6–10 households. Each system provides a household with three light points of 2W LED bulbs and a point for mobile charging. Here also, a JLG model is used for revenue collection. The JLG is responsible for receipt of payments and operation of the systems. Secondly, a 'Market Segment' is also in place, where JLG is formed consisting of the shop owners and members of market committee, who will be responsible for operations and collection of the payment. The

installations have recently been completed in all the beneficiary households as well as in the market.

The Way Forward

All the projects implemented focus not only on technology, but also on other critical aspects that enhance ownership and therefore revenue generation, such as training and capacity-building on skills relevant to the target group, sustained monitoring and evaluation of project performance, inflows and outflows of revenue, and lastly, enhancing energy development income-generating linkages to foster consistent project sustainably. The three examples showcased in this article also demonstrate innovative ideas that can create enabling environments for different stakeholders working within the rural energy access space. Based on the specific characteristics of the socio-economic development of the user community, maturity of the business model and the strengths and weaknesses of local institutions, the article aims to substantiate the point that a 'one size fits all' approach is either not applicable or not required in every situation. Government subsidies should be continued in scenarios where the viability of business models is low, and restructured to enable scaling up of interventions in other scenarios. The roles of different actors will vary, depending on the socio-economic characteristics and geographies. Where in some cases local governance is important, in others it may be more suitable to promote a micro utility-like model. The OASYS project team is also carrying out intensive monitoring of the different technical and institutional models to draw lessons based on the operational experiences and document such lessons for future reference. EF

This article is based on experiences from implementation of off-grid electrification projects in India by The Energy and Resources Institute, as part of a multi-consortium research project titled 'Decentralized off-grid electricity generation in developing countries: business models for off-grid electricity supply' (Alternatively called Off-grid Access System in South Asia), led by the De Montfort University and lasting from October 2009 to April 2015. The research project is funded by the Engineering and Physical Sciences Research Council (EPSRC) / Department for International Development (DFID) research grant (EP/G063826/1) from the Research Council United Kingdom (RCUK) Energy Programme. The Consortium Partners are: De Montfort University, the UK; The Energy and Resources Institute, India; TERI University, India; University of Manchester, the UK; and Edinburgh Napier University, the UK.

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