SMART VILLAGES
New thinking for off-grid communities worldwide

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Findings from the Bangalore Forward Look Workshop on mini-grid technologies for India

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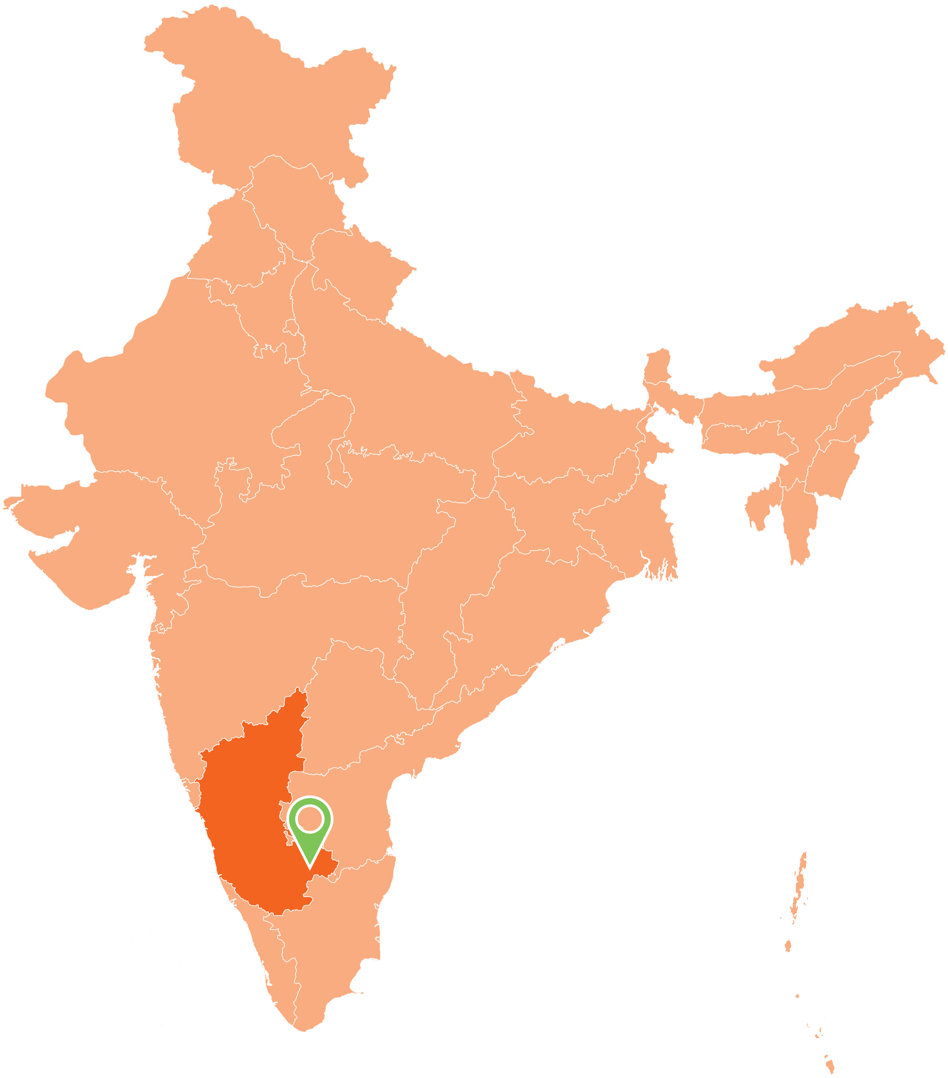
The Indian Institute of Sciences (IISc) together with the Smart Villages Initiative held a workshop in July 2016 focused on mini-grid energy generation, storage, and transmission technologies in India and how they will be implemented. The workshop was held at the IISc campus in Bangalore and brought together academics, students, policymakers, business people, and NGO practitioners interested in sustainable energy and rural electrification.



It aimed to address key questions on the future of mini-grids in an Indian context, such as:

- What are the advances in "smart" electrical control technologies, new types of storage, and new means of integrating photovoltaics with diesel/batteries/other technologies that might have a real impact on Indian rural electrification in the coming 5-10 years?
- What are some on-the-ground characteristics of remote rural life that technology researchers need to be made more aware of to have impact?
- What would it take (reduction in cost, charging regimes, end to central grid electricity subsidies, etc.) to make mini-grids commercially viable in India?

- What are the key issues to do with grid integration? Many villages have a grid connection, but it is poor. What is needed to ensure mini-grids can be integrated with the grid? What are the pros and cons of doing so?

With these points in mind, the international workshop hosted a diverse and wide-ranging discussion from key experts over two days with over 140 people in attendance.

Key points and recommendations are summarised below:

Solar power will play an increasingly important role in the next 5-10 years.

Given the uncertainties around the future of carbon capture and storage and nuclear power on a large scale, solar power is anticipated to play a crucial role in the next ten years, especially in India. 100 km^2 of solar PV could supply India's current electricity demand. Currently, the dominant technology is crystalline silicon. Thin-film technologies are becoming commercially available, and organic printable PV is a promising emergent technology. A systematic approach is needed to evaluate options, including a life-cycle analysis of new technologies that identifies the process and materials factors that limit cost and carbon intensity.

Energy storage is a key technology constraint for renewable mini-grids.

Lithium ion batteries are improving in affordability and performance, and flow batteries are becoming more feasible. There is more development needed for lead-acid batteries—cycle life is improving but needs to be further increased. Supercapacitors are emerging as part of an increased focus on battery control systems and lead acid battery lifetime enhancements. Developers need cost-effective integrated systems.

More demonstration projects involving solar PV and technologies other than solar PV are needed.

Complementing solar energy, more success stories are needed that also include wind, hydro, and biomass. Successful implementation of mini-grids in a variety of contexts across the diverse regions of India will stimulate more investment in rural development and should provide much-needed case studies to research further key questions related to mini-grid deployment. More primary data on issues to do with people's ability to pay, the types of productive enterprises that are best-suited to various contexts, and how to better involve local community government would be very helpful for governments and businesses in this sector.

Typically, mini-grids need various forms of support to achieve financial viability.

At present in India, government interventions are needed to support the spread of mini-grids. Off-grid energy should be treated as infrastructure and funds prioritised for off-grid installations: the ballpark cost for 10kW solar installations in 50,000 villages is INR 150 billion (US$ 2.24 billion).
For mini-grid financial sustainability without subsidy, reducing capital cost is a key challenge. A key objective is to reduce the cost of mini-grids by 30–50% over the next few years. Optimisation of the design and operation of inverters and batteries can make an important contribution to this cost reduction. In designing mini-grids, the focus should be on minimising life cycle cost rather than just the initial capital cost. But there can be problems in the way tenders are set up. Key challenges are: designing the system with plenty of room for growth to meet future aspirations, devising a sustainable tariff based on actual usage that will cover battery replacement in four to five years, and lastly, the provision of ongoing technical support.

More management and communication is required to integrate mini-grid and grid developments.
There is a need to think carefully about how power generated from a mini-grid can be put back into the grid in a reliable manner. It would be beneficial to have more transparency around which areas will be connected to the grid and how reliable that grid will be in the future. Good communication and collaboration between governments and mini-grid businesses can build consumer and investor confidence. Policy regimes should be simplified to encourage mini-grid uptake in grid connected villages as well. Where there is a grid connection, transparent arrangements need to be in place for feed-in tariffs, capacity charges, etc.

Capacity building needs to be emphasised across all aspects of rural development.

Better links should be fostered between developers and the Ministries of Agriculture and Education to develop villagers' skills that will be necessary to support new opportunities for livelihood generation.

The aim should be to increase the GDP of each village by at least a factor of three. Energy, education, and employment (E^3) leads to empowerment. To empower farmers and villagers, moving them up the agricultural value chain requires the creation of micro-enterprise zones in villages to groom micro-entrepreneurs and increase incomes. A massive capacity building programme should be launched to train rural youth and inform villagers about potential livelihood options.

Practitioners must focus on the social aspects of mini-grid deployment.

Apart from the technical challenges, there are also social challenges. To give an example: if someone defaults on their payment, by what means should they be pursued? Technology can help with problems like this as well. Many problems can be solved by making certain that there is an initial buy-in by the local community. This must be an integral part of any mini-grid developer's business plan.

There must be a balance between government intervention and entrepreneurial developments.

Government subsidies of 90% of the capital cost of a mini-grid are too high to be scaled up without huge government investment. The government needs to rethink requirements for parity in tariff charging between mini-grids and (subsidised) grid-connected electricity, but this must be done with careful management of expectations and through consultation with rural communities. Also, in India, there are uniquely large amounts of funding available through corporate social responsibility donations, but this funding can be difficult to access in large amounts and in a coherent way. With government encouragement, there is a need to have hundreds of entrepreneurs to accelerate system change for rural environments.

Notes

We aim to provide policymakers, donors, and development agencies concerned with rural energy access with new insights on the real barriers to energy access in villages in developing countries—technological, financial and political—and how they can be overcome. We have chosen to focus on remote off-grid villages, where local solutions (home- or institution-based systems and mini-grids) are both more realistic and cheaper than national grid extension. Our concern is to ensure that energy access results in development and the creation of 'smart villages' in which many of the benefits of life in modern societies are available to rural communities.

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