Empowering Kudagaon with a Mini-Grid

This is the second article in our three-article 'Powering Ahead' series on what mini-grids are and why they can be key for achieving remote energy access in India.

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In 2016, we at the Center for Study of Science, Technology and Policy (CSTEP) were studying the electrification status of various villages in Karnataka. The exercise gave us interesting insights into the scope of employing technologies like solar photovoltaic (PV) mini-grids to electrify such areas, where grid extension is not feasible. This motivated us to further investigate the last-mile electricity solutions. For getting deeper into the energy access issue, we decided to implement a mini-grid pilot project and better understand the ground realities.

We looked at several working models (such as biogas plants, solar plants, and solar pumps harvesting river water) and potential sites in Maharashtra, Jharkhand,

Manipur, Bihar, and Odisha. Finally, we chose Kudagaon, an un-electrified remote island on the Mahanadi River, in the Angul district of Odisha. With a population of 300 (according to Census 2011), the island was home to three generations of indigenous people. Due to its geographical features, the possibility of getting connected to the city power grid was slim for Kudagaon. This factor played a decisive role in choosing it as the pilot site — the main grid was unlikely to come into the picture in the future, allowing us to conduct our pilot experiment and also gauge its impact clearly. As the island received good solar irradiance throughout the year, a solar-PV mini-grid made practical sense.

From kerosene lamps to solar-powered LEDs

A promising start

The two most important agents of change in this project were agricultural opportunities and electricity access.

Most of the problems at Kudagaon revolved around agriculture. Discussions with the community revealed that despite good soil and multi-cropping potential, the community grew a single crop in a year, due to the lack of a reliable water source. Their tools were traditional and their crops were rainfall dependent. In the non-farming season, the residents either moved out for work or shifted to nearby towns. Over a period of time, the lack of opportunities caused an exodus, gradually reducing

the active population set. Much to our surprise, the ground survey revealed a cultivable land area of 640 acres with a potential for diverse plantations (varieties of pulses and rice), and fruit-bearing trees, such as mango. The findings meant that commercial agriculture could be developed here. The blueprint of transformation thus found a starting point. After several discussions, the villagers agreed to the pilot and a common vision was set.

We mapped 5–7 key locations for setting up irrigation pumps that would cater to cultivable land, leading to more reliable agricultural practices and production. They would also add to clean drinking water, by supplementing the supply from the dying '*chapakals*' or hand-pumps. The mini-grid, thus, promised clean water and a sufficient supply of food grains, besides electricity.

Construction work took off with the support of villagers

As the discussions on agricultural growth (on topics like types of irrigation pumps, crops to harvest, commercial benefits, food storage, and processing of raw harvest for better selling price, etc.) deepened, more villagers became involved. While hope sprouted with the now-visible opportunities, self-belief bloomed with work involvement.

Simultaneously, as work on the solar plant started, villagers gained a better understanding of solar energy and its utility. Soon, discussions on improving the

quality of indoor living, and especially life after dark, also began, in line with the project vision. We identified an immediate need to light up 85 homes with LEDs. Four commercial spaces — a *panchayat* hall, a community center, and two prospective *kirana* shops — were also included on request. Further, we identified around ten points for installing street lights to light up the roads, for enabling safe movement and prevention of snake-related mishaps.

On-the-ground challenges

While the technical work had its challenges, it was the non-technical aspect that required a multifarious approach, with a prominent improvisation element. A mini-grid can be built and installed with good planning and technical execution, but its sustainability lies in building community ownership for it. This was not easy. It included an array of trust-building discussions, tri-partite agreements to lease land for the proverbial 'Sun energy', and establishing decision-making mechanisms with the villagers. In a way, we had to create an organisational structure to take care of the mini-grid, through finance management, setting up a village energy committee, and organising periodic community meetings to keep the villagers informed on energy usage and complaints.

Challenges: Natural hurdles (makeshift roads washed away by floods); and Trials in building trust (solar energy committee meeting)

Then there were other challenges that were unique to Kudagaon. Natural events such as floods, cyclones, and severe rains dismantled makeshift roads and derailed project efforts for many months. On the other hand, engineering issues necessitated auxiliary efforts to investigate the potential boring depth for irrigation pumps, but it was extremely difficult for heavy machinery to access the island and conduct sound tests on the fragile clay-soil layers. The residents had a chequered experience — with gratitude for first-time energy use but also a constant chase to understand the complexities of power usage.

Transformational strides

In due course of time, the Kudagaon project could provide enough motivation to trigger a reverse migration of families to populate their ancestral homes. The pilot is a successful example of energy-driven social-economic transformation. A post-impact assessment survey revealed a switch from kerosene lamps to LED lights in most homes. Thus, villagers experienced a better indoor quality of life, especially after sunset. Importantly, electricity also gave children more hours of study, with a choice of time. This has motivated more village students to pursue education. On the other hand, lit-up roads have enabled safe movement of residents — including women — post sunset, and have brought about a significant reduction in snake-bite incidents. This, in turn, has encouraged more social gatherings and village cultural events at local commercial venues, improving the overall quality of life. With more awareness, the aspirations for house electronics such as televisions, coolers, additional bulbs, etc. have also grown. Although many families struggled to understand the differential billing for various electronics, and debated its correctness, their understanding has improved with time.

The Kudagaon mini-grid has been in operation since March 2019 (when it was commissioned). Initially, it supported 59 households. Over time, the grid has

prompted several families to return to the island village, becoming a successful demonstration of the ‘Build, Own, Operate, and Maintain’ or BOOM model. The project also received the ‘ISGF innovation of the year smart grid’ award in 2020, besides several others.

Though each mini-grid project is distinct, our experience in Kudagaon tells us that the key to the success of any such project lies in creating harmony between the proposed technologically-driven changes and their community acceptance, with a clear outcome of the project in view. With a techno-social matrix in place that elicits a sense of community ownership and support from village administration, any mini-grid can stand the test of time, and the associated ecosystem can grow organically on its own.

In the next and final article of the series, we will delve deeper into the grueling challenges of executing the Kudagaon Pilot, and how we got the better of them.