Electricity Access in Rural India using Solar PV mini-grids

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The Beauty and Challenge of remote locations: Horses transport Solar Panels and equipment to a village in Ladakh.
India has the largest population of people without access to electricity: 300 Million

Over 90% of these people are in villages that are *on-paper* “electrified”; about 10 million in remote areas where grid unlikely to reach in next 10 years.
Abundant solar resources- Solar Photovoltaic based Mini-grids can help tackle the energy access problem.
Challenges of deploying and scaling Solar PV mini-grids*

* Community level systems, typically of size 1-100 kWp
Biggest challenges are on policy and financial fronts

- Policy still leaves small entrepreneurs out
  - Several schemes, each with its shortcomings:
    - Decentralized Distributed Generation (DDG) scheme of Ministry of Power (MoP) has under-delivered and suffers from a variety of issues, including unsustainable tariff design
    - In the past, overlapping of schemes from Ministry of New and Renewable Energy (MNRE) and MoP have created confusion

- Mini-grids need high upfront investment, but lack business viability for standard debt financing => capital must come from the government
The case of Darewadi- a 9.36 kWp Solar PV mini-grid running for 20 months
Salient learning from Darewadi can be applied to thousands of Villages

1. Setting the stage: Interaction with the Community
2. Designing to meet future aspirations
3. Devising a sustainable tariff
4. Minimizing Battery backup
5. Meeting safety and quality standards: grid-ready installation
6. Closing the loop: complete transfer of ownership
1. Setting the stage: deep interaction with the community

- Assess the needs and willingness of the TG.
- Inherent leadership in the community, if any, comes to the forefront.
- Get the women on-board.
- Building trust and goodwill is essential.

*This stage could be the most significant cost apart from hardware.*
2. Designing to meet future aspirations

- Once on-demand power is provided, people discover and add new use for electricity.

- Utilization of the system steadily increases.

- Lifestyle changes and livelihood opportunities warrant high loads that must be planned for
  - In Darewadi, a flour mill, two Computers and a Water Pump account for ~16-18 units per day.
  - Water Pumps have transformed the lives of women by eliminating 4-5 hours of work during dry months.
  - Water pumps will enable some farmers to graduate from an annual crop to two crops per year.
Total consumption trending up, steadily.

Fortnightly average up by 47%
3. Devising a Sustainable Tariff

- Metered consumption based charging is essential for
  - Accountability
  - Discipline
  - Load Management

- Creating a Corpus with billing collections is essential for
  - Battery Replacement
  - Day-to-Day O&M

- DDG tenders prescribe low fixed tariffs irrespective of consumption- failure of CREDA mini-grids
Example of Monthly Electricity Bill (in Darewadi)

Battery Bank (in Darewadi)
100% Collection Rate

Monthly bill collection

Projected numbers

Beyond the tipping point
4. Minimizing battery backup: through feeder-line separation

- Minimizing battery storage has several advantages
  - Reduced upfront investment
  - Reduced Battery replacement costs
  - Minimizing environmental impact

- Manual optimization through separate feeder lines for household, commercial and street-lighting loads
  - Enables better management during periods of low generation
Feeder line circuits

Darewadi during Monsoons
5. Meeting Safety & Quality standards: a grid-ready installation

- The installations should meet safety standards as per utility specifications
  - Higher upfront investment but longer term sustainability
  - Possibility of interconnection with the grid, depending on future policy
  - Ensures safety of people and cattle
  - Helps meet the psychological need of being connected to the world
6. Closing the loop: complete transfer of ownership

- Entrepreneurs cannot stay engaged indefinitely for day-to-day management, resolving disputes etc.

- A representative Trust or Village Council plays a critical role in the success of the project.

- People more likely to maintain if they feel like owners.

- Anecdotal evidence from Darewadi.
Ensuring Sustainability

- Community interaction
- Battery sizing
- Tariff structure
- Design for aspirations
- Ownership transfer
Mini-grids should be considered as infrastructure rather than as business

- Mini-grids are essentially infrastructure solutions for remote locations and deprived communities.

- Payback on several fronts—development, ecology, internal security, agriculture and migration to urban centres.

Darewadi shows a solar PV mini-grid can be self-sufficient once installed
A Village that is transforming from darkness to development
A new picture of development of rural areas is emerging.

Thousands of such mini-grids can bring about an Energy Revolution.

Darewadi: 9.36 kWp

Viral: 5 kWp
Thank You!

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