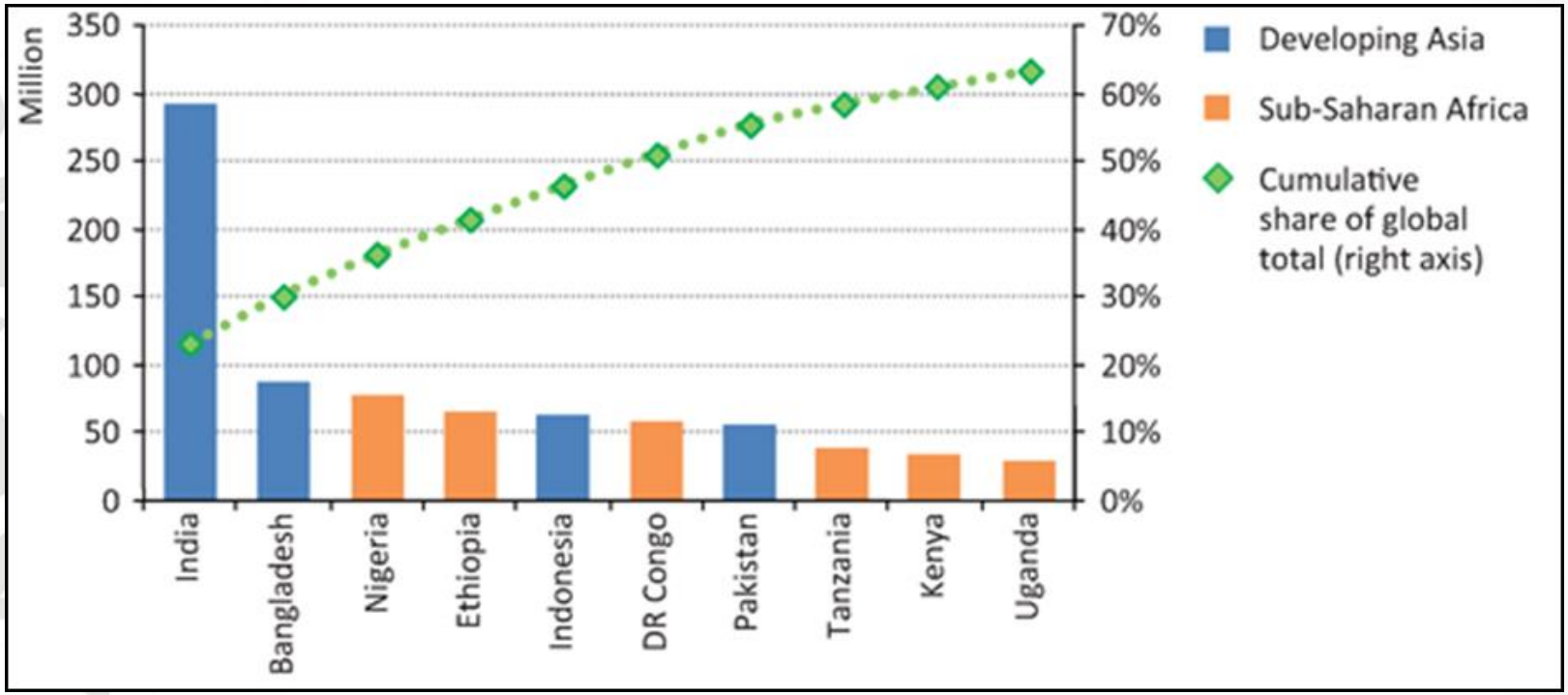
Electricity access in rural India using solar PV mini-grids

Shruti Deorah & Anshuman Lath

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



www.worldenergyoutlook.org, 2010

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

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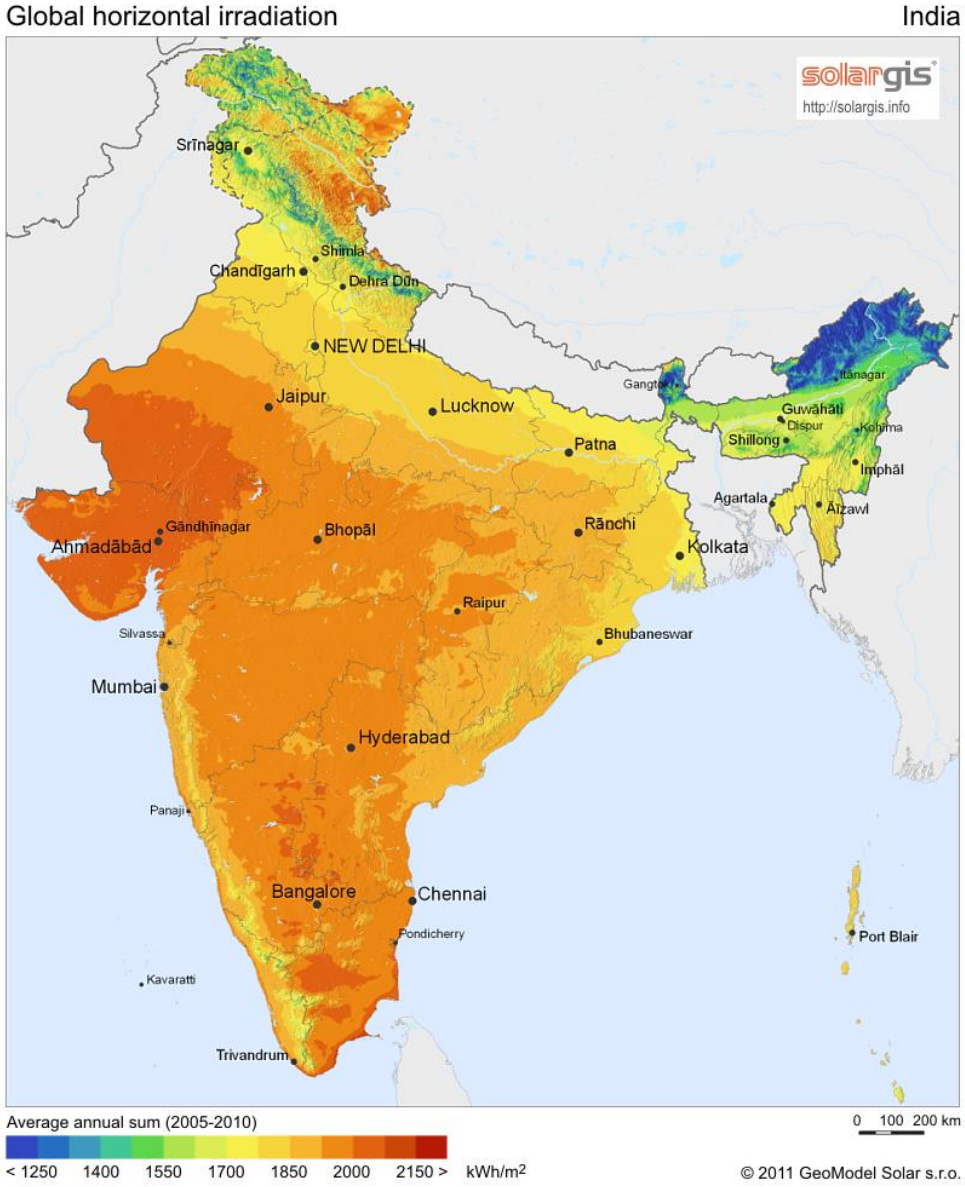
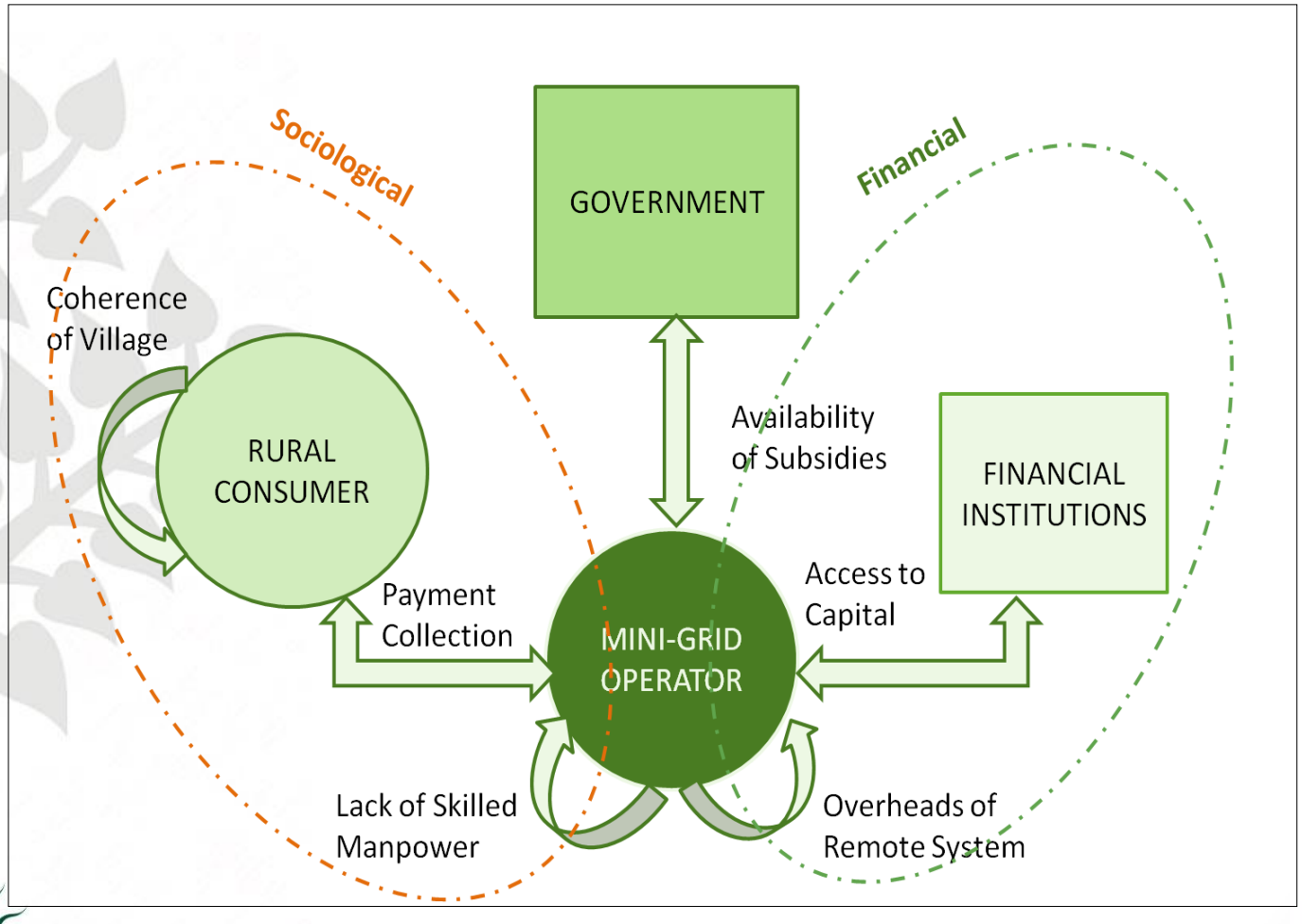
Abundant solar resources- solar photovoltaic based mini-grids can help tackle the energy access problem



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
    - Lack of focus by Ministry of New and Renewable Energy (MNRE), and overlapping of schemes creates confusion
  - Clear mandate is there: MoP and MNRE must come together to create an ecosystem
- 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 learnings from Darewadi can be applied to thousands of villages

- Setting the stage: interaction with the community
- Designing to meet future aspirations
- Devising a sustainable tariff
- Minimizing battery backup
- Meeting safety and quality standards: grid-ready installation
- 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

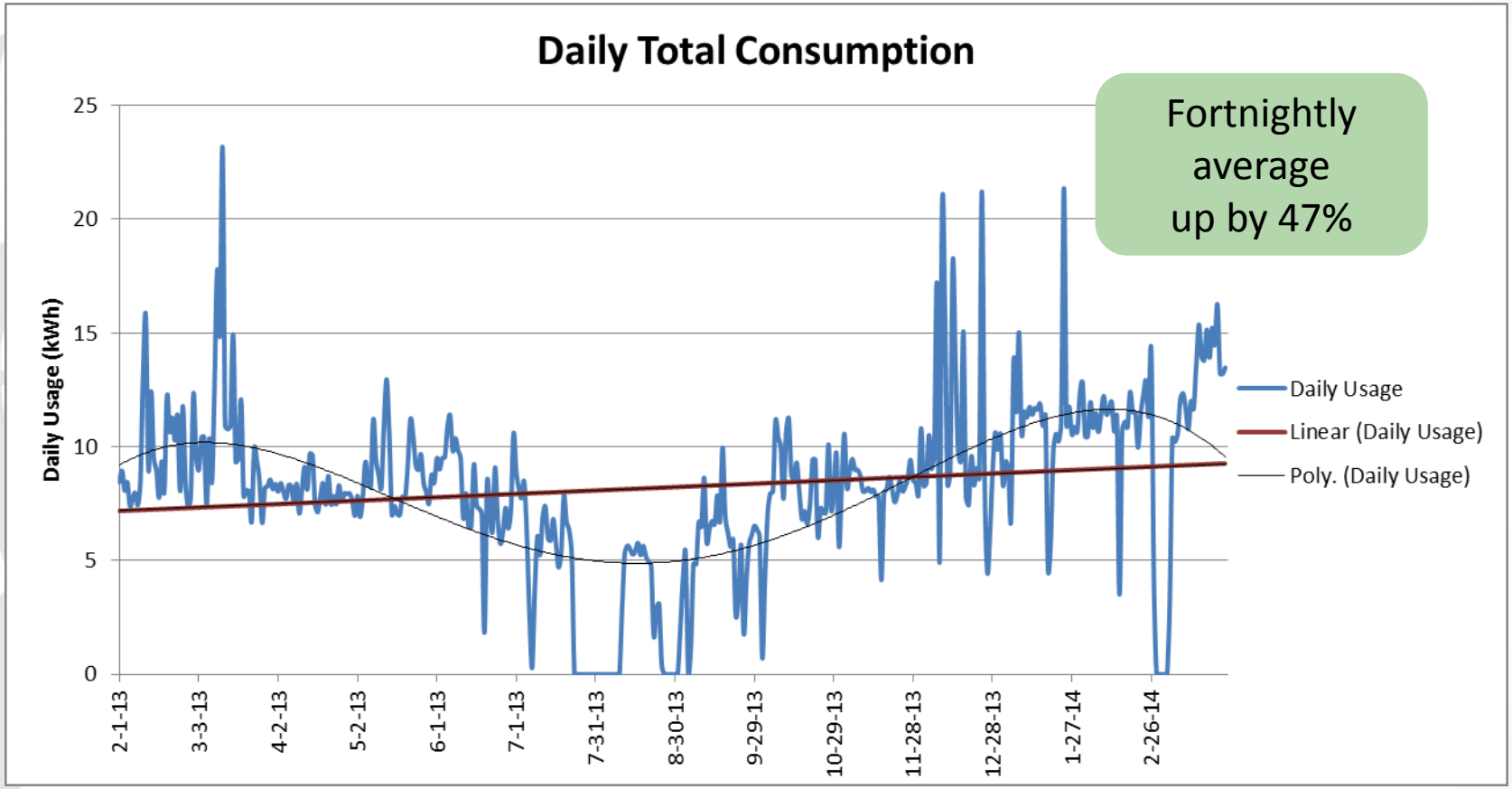
This stage could be the most significant cost apart from hardware

2. Designing to meet future aspirations

Once on-demand power is provided, people discover and add new uses for electricity:

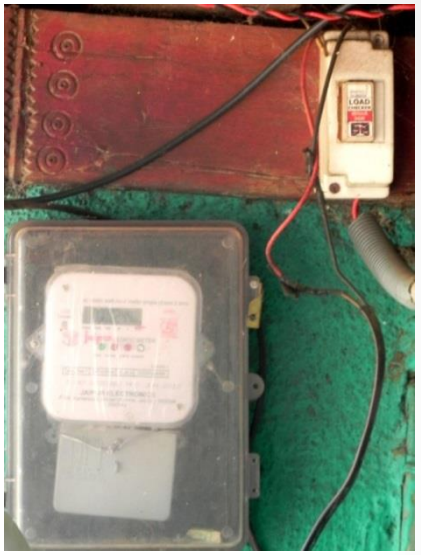
- Utilization of the system steadily increases
- Lifestyle changes and livelihood opportunities warrant high loads that must be planned for
  - In Darewadi, a flour mill, two computers and a water pump account for ~16-18 units per day
  - Water pumps have transformed the lives of women by eliminating 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

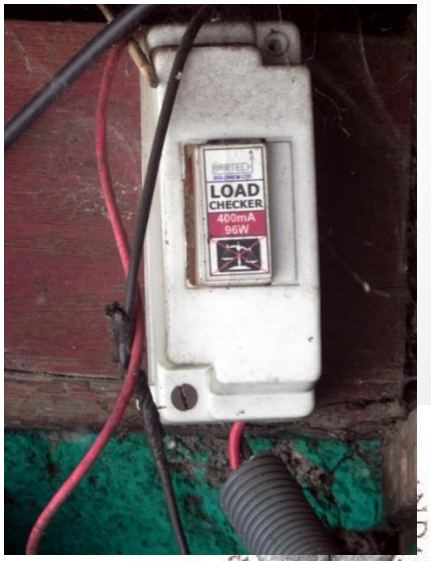
Total consumption trending up, steadily

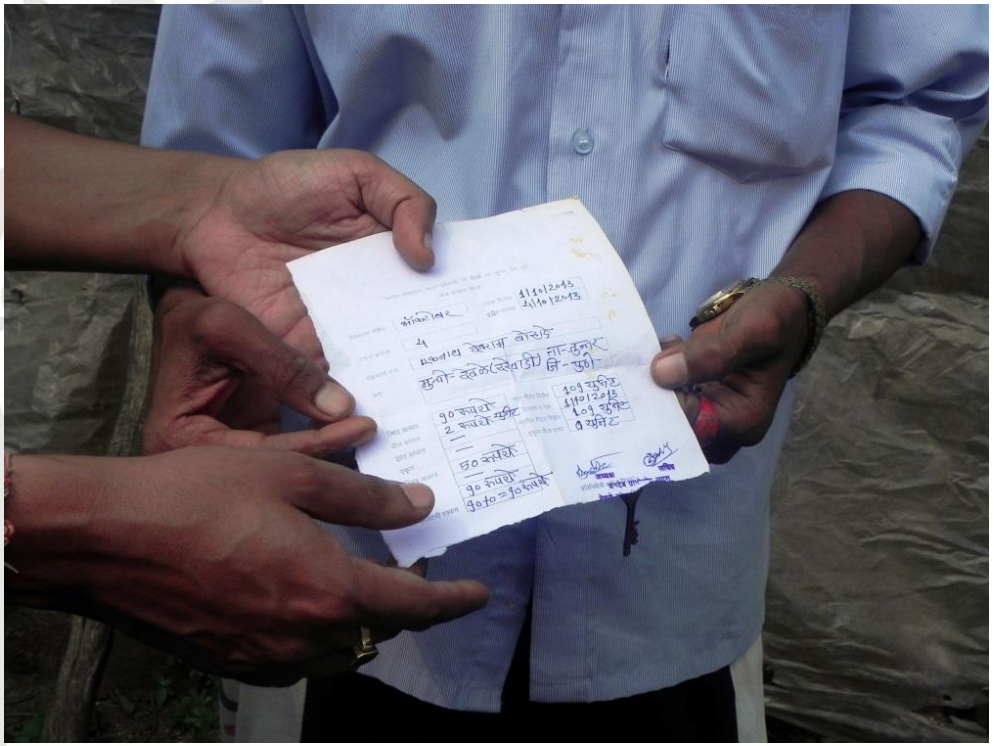


3. Devising a sustainable tariff

- 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





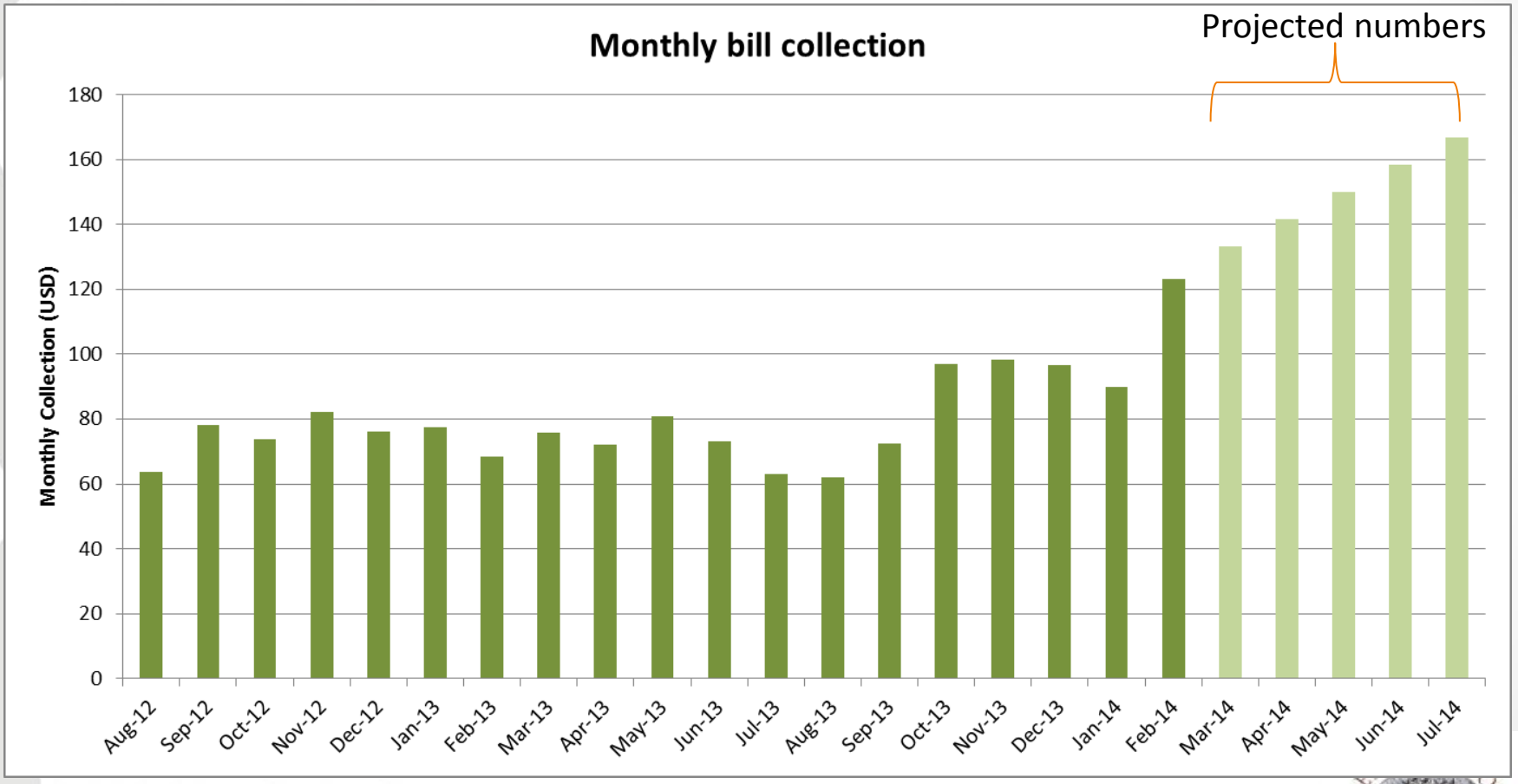


Example of monthly paper bill (in Darewadi)

Battery bank

100% collection rate

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

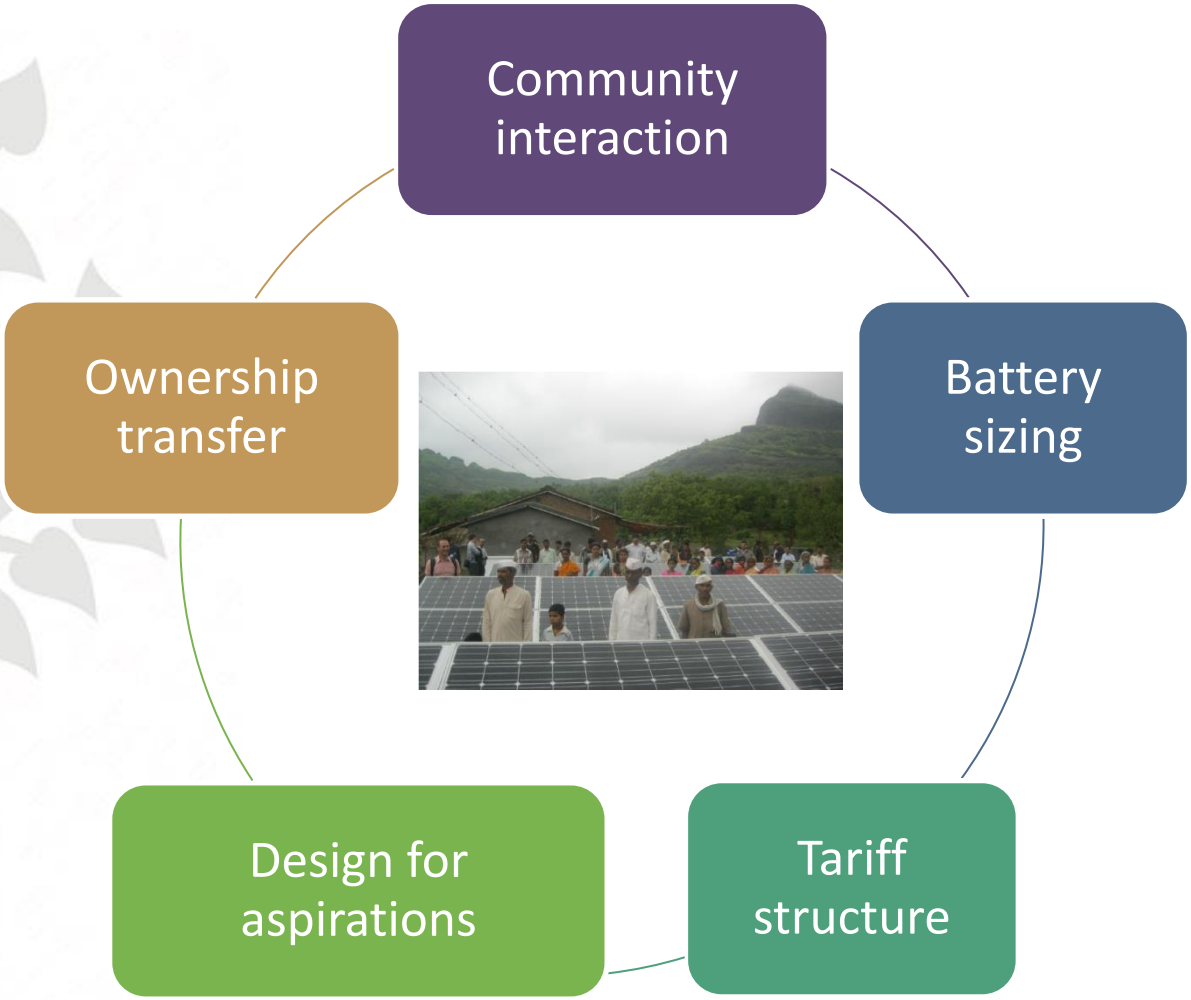
5. Meeting safety & quality standards: a grid-ready installation

- 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



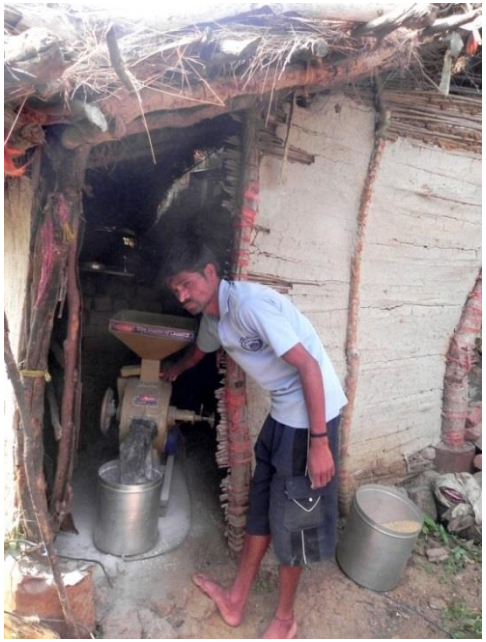
Mini-grids should be considered as infrastructure rather than as business

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



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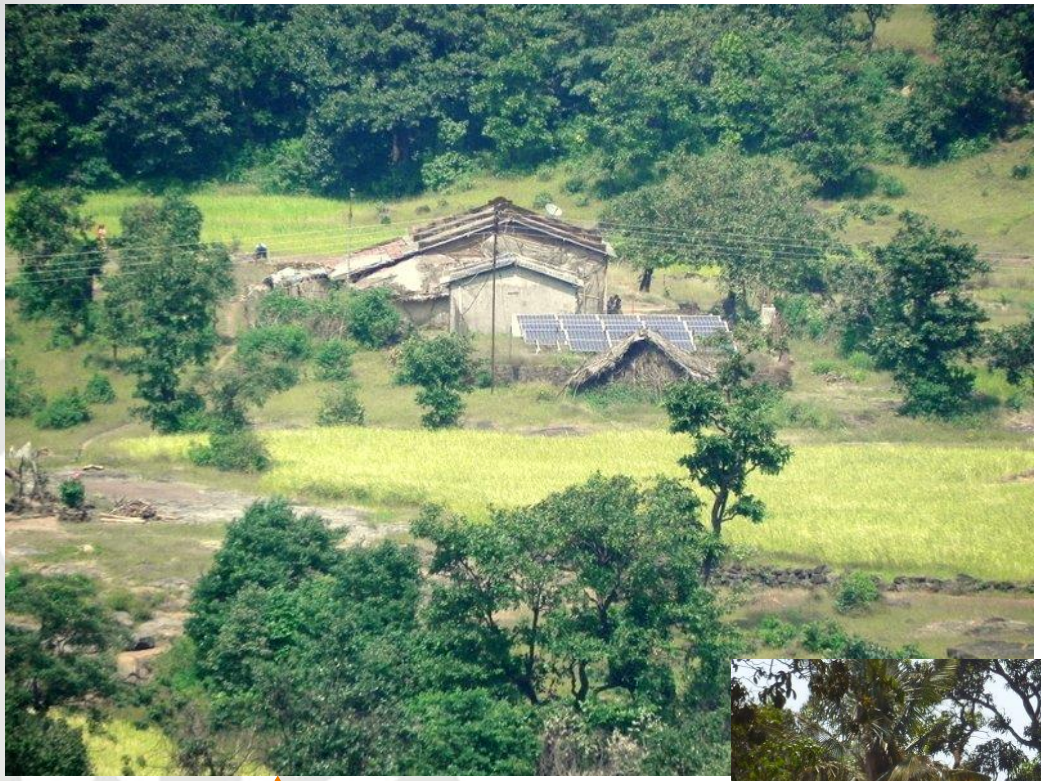

Darewadi: 9.36 kWp

A new picture of development of rural areas is emerging

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

Viral: 5 kWp

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THANK YOU

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