Smart Metering Options for Mini-Grids

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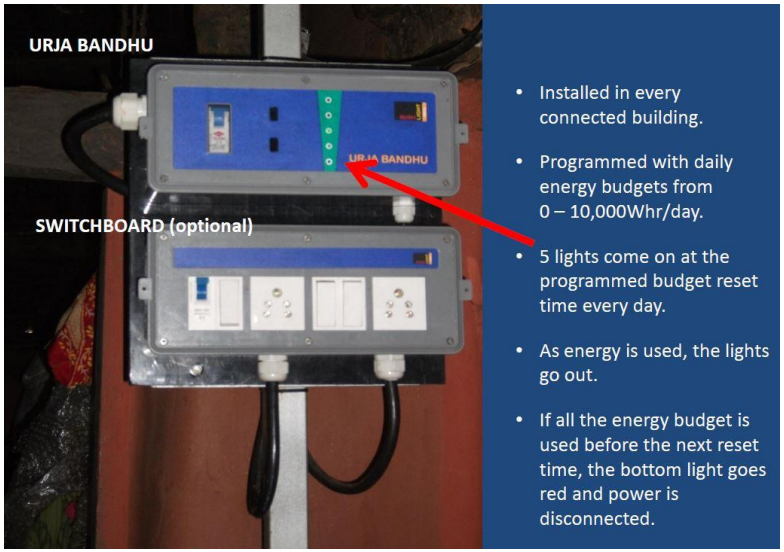
What do we need meters to do?



- Measure electricity consumption
- Enforce revenue collection using a prepay mechanism
- Safety and system management constraints on power and energy
- Inform consumers on their budget and the system state
- But more functions mean more cost

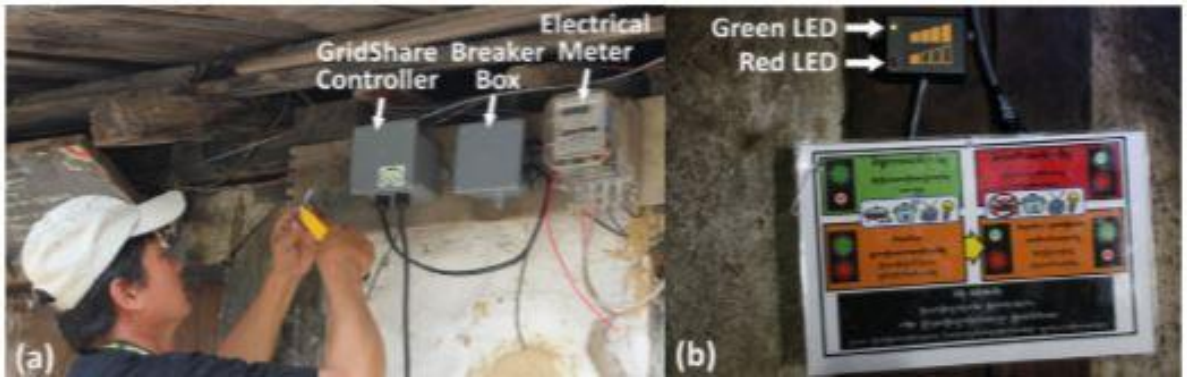
The two major issues in smart meter selection and design for mini-grids

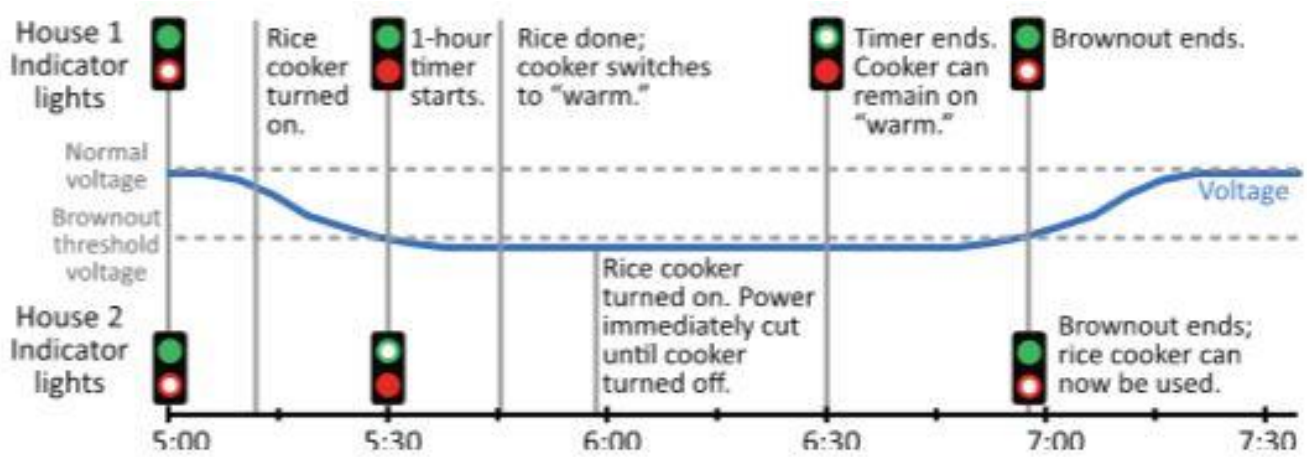
- Is the mini-grid power or energy limited?
- Is the management going to be cloud-based or localised?

Power limited systems

- Typically biomass or hydro systems
- Main cause of system failure (brown- or black-out) is overload at peak times

Gridshare – trialled on micro-hydro in Bhutan





- Smart controller cuts off consumers who ignore red LED.
- More info: http://www.schatzlab.org/projects/developingworld/gridshare.html

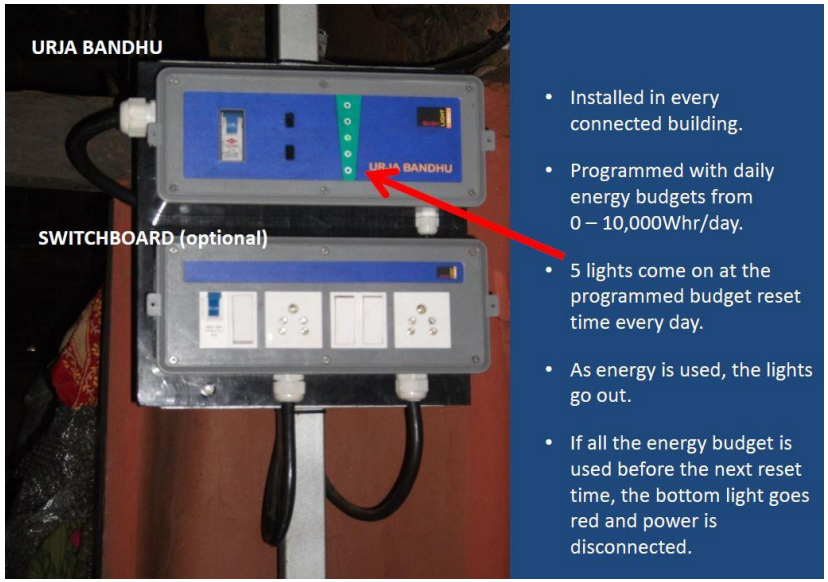
Issues with Gridshare

- Use of voltage to indicate overload – thresholds will vary depending on location in network
- Cuts off all power not just the rice cooker
- Timeouts might not be suitable for all loads
- Might be sufficient simply to signal generator status and rely on consumers to respond

Energy limited systems

- Typically photovoltaic or wind systems
- Main cause of system failure is battery exhaustion at unfavourable times of the year or bad weather
- Need to constrain energy use per day as well as power

Urja Bandhu and Circutor



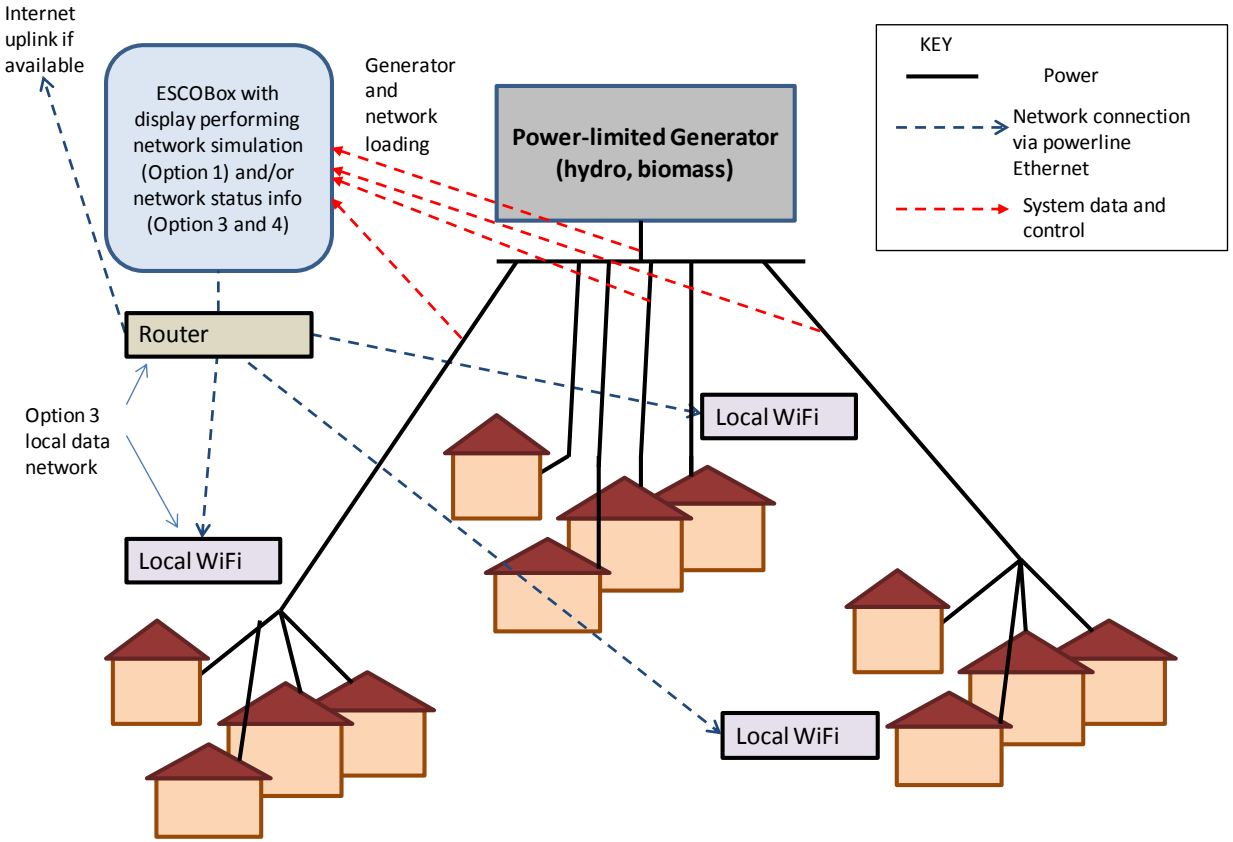
- Installed in every connected building.
- Programmed with daily energy budgets from 0 – 10,000Whr/day.
- 5 lights come on at the programmed budget reset time every day.
- As energy is used, the lights go out.
- If all the energy budget is used before the next reset time, the bottom light goes red and power is disconnected.

- Allow energy budget per day to be set, cut off when exhausted.
- Circutor allows unused budget to be carried forward
- More info: http://circutor.com/docs/CirMagazine2012-03-EN-Cabo-Verde.pdf ; http://www.direc2010.gov.in/pdf/The%20Bushlight%20India%20Project.pdf

Issues with Urja Bandhu and Circutor

- Both cut off all power, Circutor recovers if load falls below “trickle charge”, Urja Banhu waits till next reset time.
- Fixed energy budget, but Circutor allows some energy budget to be transferred to another meter
- Really need to be able to vary energy budget depending on the available energy resource, so that good days can be fully exploited – need to communicate with consumer.

Our solution to the communications problem



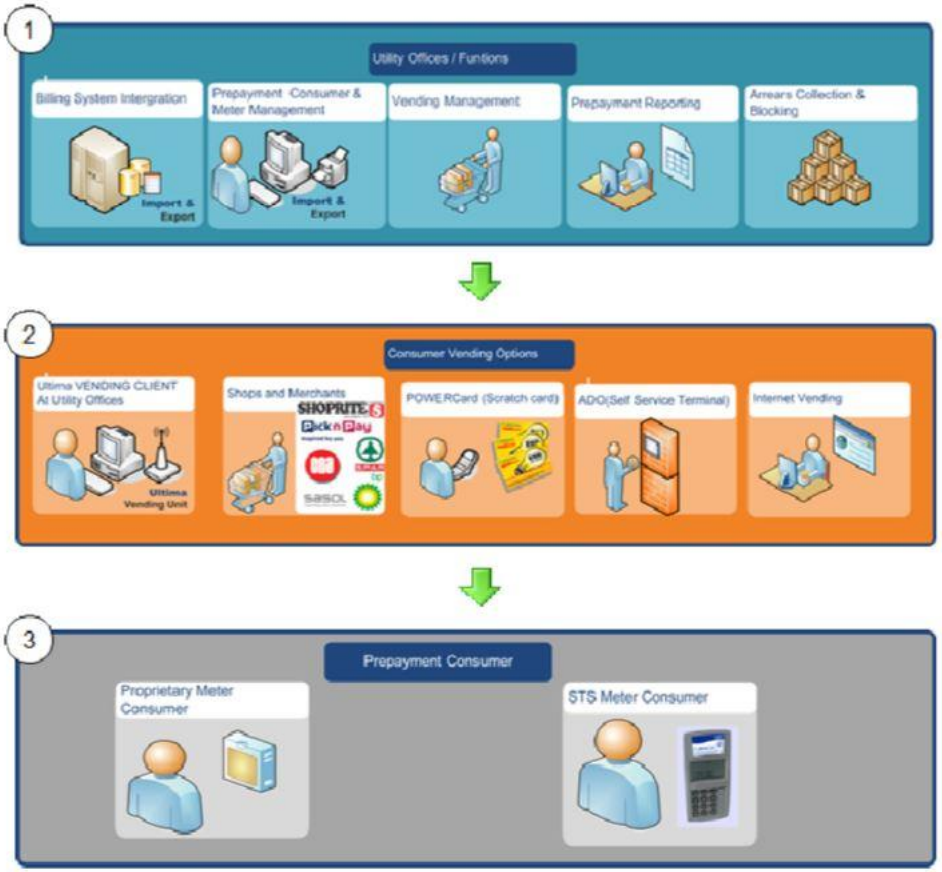
- Provide a local information network to update people (via their phones) and smart meters
- Relies on smart phones and cheap tablets coming into common use

Local or cloud management?

- Many mini-grid metering and payment business models rely on pre-pay meters with a centralised internet based payments and monitoring system – e.g.:
  - Gram Power http://www.grampower.com/solutions/
  - Lumeter Networks http://www.lumeter.net/
  - Husk Power Systems http://www.huskpowersystems.com/index.php?pageT=Home&page_id=1
- **Advantage** – standardised service lowers cost, eliminates fraud, scales up easily.
- **Disadvantages**
  - little ability to vary service offer to suit location, culture, priorities
  - less local ownership and commitment
  - reliant on internet connection which may be lost in extreme weather.

Some local options (1)

Conlog (www.conlog.co.za)offer a complete package of management system, vending system, and meters



Some local options (2)

Inensus (www.inensus.de)offer a “micro utility” package of management system and smart meter

Micro Power Manager (MPM)

INENSUS

MPM for rural electrification: Prepaid meter and limiter of both energy and power with integrated load management used in micro-grids.

Summary

- Different smart meter solutions needed and available for power and energy limited systems
- Smart mini-grid really needs modern telecoms to link management system to smart meter
- Is cloud-based prepayment the right answer? Local options exist!