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Eating the sun*

Creating renewable energy solutions for rural homes

* Acknowledgement: Oliver Morton's book by the same title

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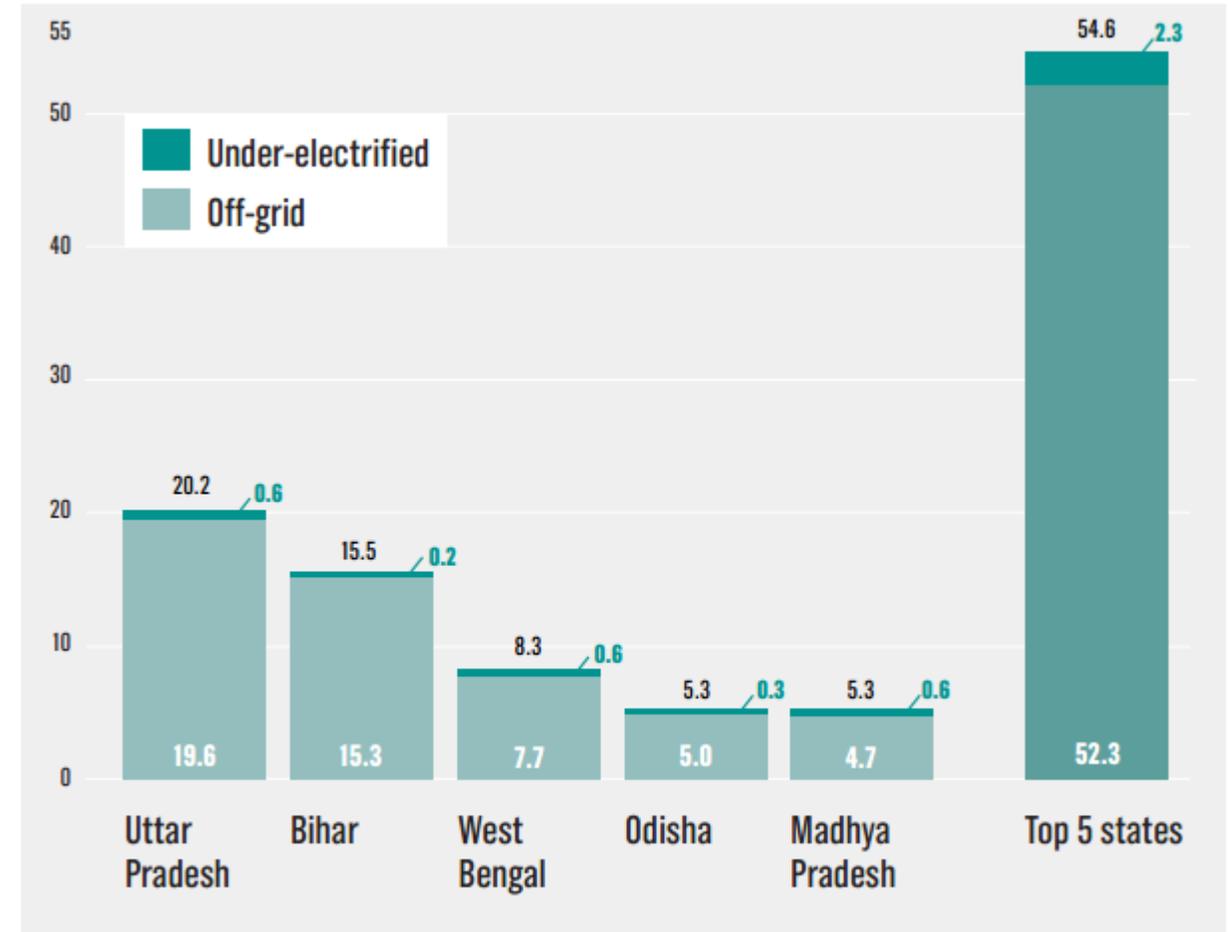
Let there be light. In the kitchen.

100W solar panel



Solar lighting for off-grid rural homes

- ▶ 80 Million households in India have little or no access to grid power*
- ▶ Another 20 Million households receive less than 4 hours of grid power
- ▶ More than half of the total underserved rural population lives in five states: Uttar Pradesh, Bihar, Odisha, West Bengal and Madhya Pradesh
- ▶ Reference:
http://www.theclimategroup.org/_assets/files/The-business-case-for-offgrid-energy-in-India.pdf



Split between off-grid and under-electrified households for all states is based on the national average.

Source: Population totals from India Census 2011; Electrification data (source of lighting) from India Census 2011.

* International Finance Corporation. "Assessment of the Off Grid Solar Appliance Lighting Market in India." Market research report, New Delhi, India, 2015

Minimum requirements

- ▶ 4 lamps of 5W each, average usage of 4 hours per day
- ▶ 5 days of backup for low-light / monsoon conditions
 - ▶ $5W * 4 * 4 \text{ hours} * 2.5 \text{ days} = 20 \text{ AH}$
- ▶ Daily usage: 4 lamps of 5W each, average usage of 4 hours per day
 - ▶ $5W * 4 * 4 \text{ hours} = 8 \text{ AH}$
- ▶ Per day charging:
 - ▶ 100W panel @ 17V = 1.3 Hours, at full light for 8 AH of charge

Solution

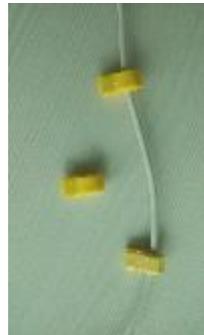
- ▶ DC 12V distribution (no inverter, no AC power)
- ▶ 100W solar panel, poly crystalline (1032mm x 672 mm, 8 kgs)
- ▶ 40 AH lead acid battery
- ▶ Solar charge controller
- ▶ 4 LED lamps of 5W each
- ▶ Mobile charger (built-in into CCU)
- ▶ Wires (20m of 2.5 sq mm wire, 30 meters of 1.0 sq mm wire), switches, and installation accessories
- ▶ Total cost: Rs 14,000/-

**All critical components are from MNRE approved vendors.
Other components meet or exceed MNRE requirements.**

Installation



- ▶ Solar panel installed on roof
- ▶ Charge controller and DC bus bar installed on a nylon panel
- ▶ Battery installed inside house
- ▶ Run a single 2.5 sq mm bus through the house (12V DC, at 20W less than 2A of current)
- ▶ Use wire taps (see picture) for lamps at tap points



Accessories

- ▶ Available DC lamps are of very low quality and will not last the distance
- ▶ Usually, low-income households use wood fire for cooking and walls and roof are covered with soot
- ▶ Need a high brightness LED cluster (5W) to light up a room (say 10ft x 10ft)

Operational model

- ▶ Total cost of kit: Rs 14,000/-
- ▶ Add Rs 1,000/- as installation and maintenance
- ▶ Someone pays Rs 15,000/- for the kit to be installed, as charity/CSR activity
- ▶ Empower one person in a village to install
- ▶ Rs 1,000/- goes to this person for installation and maintenance
 - ▶ Creates a new job in the village
- ▶ Activities to be done:
 - ▶ Installation, routine maintenance (distilled water top up every 3 months), and fault isolation and fixing (on demand)
- ▶ Each household keeps aside Rs 100/- to 200/- per month for battery replacement (every 3-4 years, Rs 4,000/- per battery)
 - ▶ Recurring deposits for 60 months in the nearest bank

Future direction

- ▶ Water purifier (RO, or UV+Particle filter)
- ▶ DC Fans
- ▶ DC-based home appliances
 - ▶ Water pump, Mixer/Grinder, DC TV
- ▶ Home router / Internet access / Laptop
 - ▶ Low power (1-2W) routers can be used for Internet access
- ▶ Better batteries
 - ▶ VRLA batteries require maintenance and have capacity fade
 - ▶ Li-ION batteries can be used in place of VRLA batteries

Open issues

- ▶ Securing the battery
 - ▶ Single most valuable and trade-able item. Battery equals cash
 - ▶ Probably the most valuable item in the household as well

Standards

- ▶ SHS - solar home solution
- ▶ [https://energypedia.info/wiki/Technical_Standards_for_Solar_Home_Systems_\(SHS\)](https://energypedia.info/wiki/Technical_Standards_for_Solar_Home_Systems_(SHS))

Existing commercial solutions

- ▶ Loop solar
 - ▶ Cost around Rs 20,000-30,000/-. Li-ION batteries, small panel (10-20W), does not include in-house cabling costs
- ▶ Visionary Lighting & Energy India (VLE)
 - ▶ Multiple kits available, same issues as Loop (incomplete kit)
- ▶ Boond
 - ▶ Not enough info on lighting
- ▶ Simpa Networks
- ▶ And many others ...

Existing commercial models

- ▶ Based on pay-as-you-go commercial model
- ▶ Incomplete kits, needs accessories and local purchases for installation
- ▶ No local involvement for maintenance and upkeep

Acknowledgements

- ▶ Vasantha Chandra, Vinova Energy (vinova.in)
 - ▶ Solar panel, battery, solar charge controller, all technical help
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 - ▶ Inspiration and technical help
- ▶ Mohana Sundaram, Sakthi Accumulators Pvt Ltd
 - ▶ Batteries for solar application
- ▶ Sreenivas, Aditya Mitra Lights
 - ▶ LED tube lights
- ▶ Friends
 - ▶ Inspiration, finance, hands / feet and for the laughter

Our role

- ▶ This PPT and the first install has been done purely out of charity
- ▶ We have no commercial interest in getting the model to work
- ▶ We reserve no rights on the model, the items put together
- ▶ Anyone is free to use this material, and we are more than willing to help someone commercialize this
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