Solar PV based lighting in South Asia region: Institutional and Technological Trends

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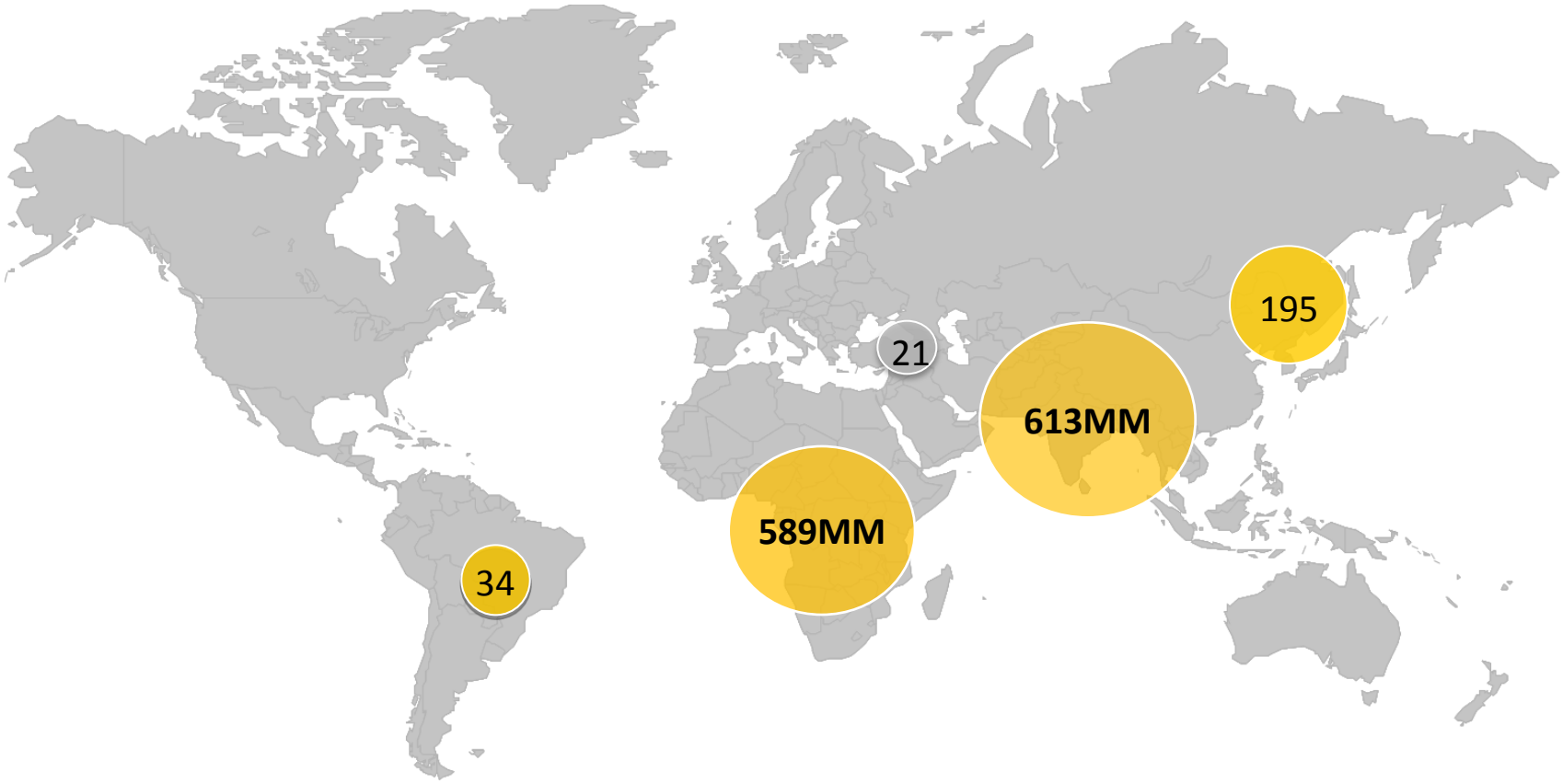
The Global Need



Without electricity access

South Asia

- Home to 1/5th of global population in 4% of world land mass
- Accounts for 42% of global population w/o electricity access
- One out of every two people in the rural areas - 614 million people – w/o access to electricity
- Solar PV is preferred option for RE after grid extension

Country	Total population (millions)	Population without electricity (millions)	Rural electrification (%)
Afghanistan	28.4	23.8	12.0
Bangladesh	156	95.7	28.0
Bhutan	0.69	0.2	40.0
India	1166	403.7	52.5
Nepal	28.5	16.5	52.5
Pakistan	176	68.0	46.0
Sri Lanka	213	4.7	75.0

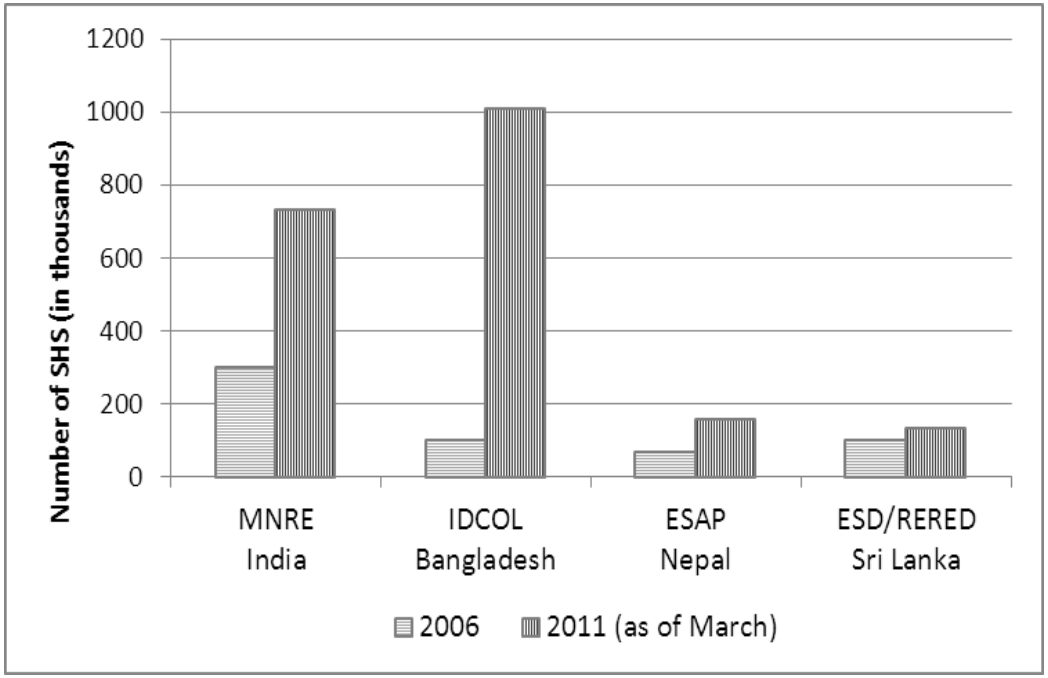
Source: IEA 2010

Scope of Presentation

- Current trends of Solar PV for rural electrification
- Solar program in Bangladesh, Nepal, Sri Lanka and India
- Comparative analysis to exploit cross learning potential
  - Policy and regulatory architecture
  - Technical design and sizing
  - Service delivery models
  - Pricing of systems
  - Access to Finance
  - Monitoring and maintenance
- Challenges & Way forward
- Conclusion

Solar PV in South Asia: Current Trends

- Mostly donor/subsidy supported projects, Also combination of free market and grant based models
- Decentralized solutions
  - Solar Home Systems (SHS) & solar lanterns (SL)
- Centralized solutions
  - PV mini grids (SMG)
  - solar charging stations

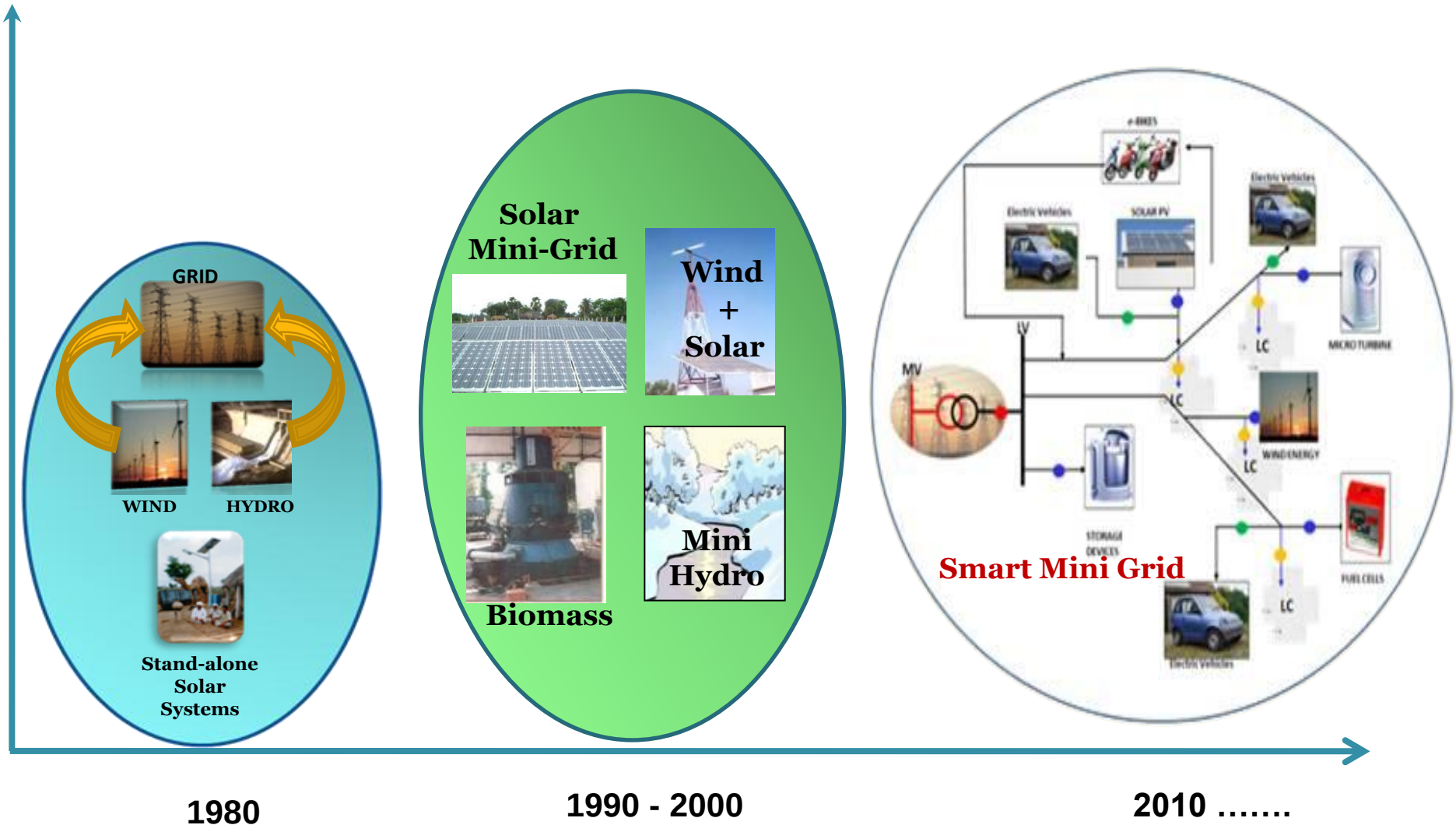


South Asia: Technologies & Business Models

Country	Technologies implemented	Business models	SHS pricing $/Wp
India	SHS, SMG, SL	Consumer financing, leasing, VEC, fee-for- service	7.5
Bangladesh	SHS	Consumer financing	6.5
Nepal	SHS, SSHS	Credit Sales	11.6
Sri Lanka	SHS	Consumer financing	9.6

- Lower system cost in Bangladesh & India due to local assembly & manufacturing

Technology Transition



Challenges in Solar PV Sector

- High cost of technology and or service
  - Not within the reach of lower strata of society
- Untested products – creating negative impact
- Maintenance of systems – A critical determinants for limited success of many programs in the region
- Wherever responsibility outsourced to equipment suppliers (such as govt. programs) dissatisfaction with timeliness of the maintenance reported
- Single Window model vis-à-vis Two Window model
  - Loan repayment directly impacted by improper service

Institutional and Policy Challenges

- No long term policy instruments for solar PV in countries
- Dissemination suffers from uncertainty in the political framework conditions
- SHS not considered as a means of rural electrification
  - India and Bangladesh as they cater only to lighting needs
- Absence of standard set of guidelines for implementation
- Credit provided independent of income level
  - Financial mechanisms are not in line with income level of poor HHs (the section w/o electricity access)

Technology & Institutional Model

- ✓ Fee-for-service model may be closer to need of poorer HHs
  - Renting of lantern from a SCS
  - Providing only lighting service from a solar DC micro grid
- Use high efficient LEDs to bring down cost
  - Reduced panel size, freight & storage cost
  - Around 30% cost reduction achieved in terms of lumen-hour under TERI's LaBL
- ✓ Hybrid model of Solar Charging Station – DC micro grid
  - An ideal enterprise based model for providing lighting & value added energy services

Lighting a Billion Lives

A commitment to improving the quality of lives of rural communities

- Sets up solar charging stations in energy poor villages that offer certified, bright, solar lanterns for rental to the local people.
- A trained local entrepreneur operates and manages the charging station and rents the solar lanterns every evening for a affordable fee.

Technical Model

Charging stations are expandable to solar energy hubs providing :

- Battery charging
- Mobile charging
- Lantern charging
- Water purification

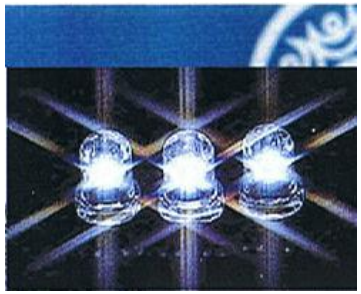
A typical Solar Charging Station

Innovating at LaBL

- CONTINUOUS IMPROVEMENTS in solar lantern designs, driving down cost, improving efficiency & quality
- CHARGING STATIONS EXPANDABLE TO SOLAR ENERGY HUBS, providing services like water purification, mobile & battery charging
- TECHNOLOGY RESOURCE CENTRE, an after-sales service network for responsive repair services through local community representatives

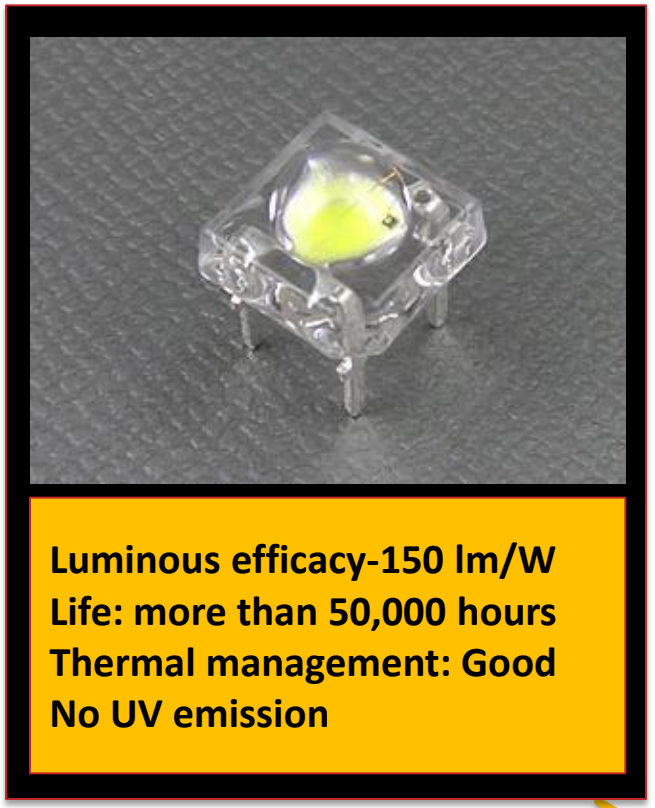
Trend in LED development

State-of-the-Art LEDs at competitive price



Luminous efficacy-30-70 lm/W
No UV emission

Luminous efficacy-110-120 lm/W
Life: 50,000 hrs & 70% remaining
No UV emission



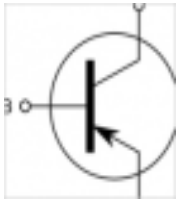
Luminous efficacy-150 lm/W
Life: more than 50,000 hours
Thermal management: Good
No UV emission

Upto 2006 | **2008** | **2010**

Courtesy: Nichia Corporation

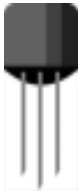
Trend in electronics development

Enhanced reliability, efficiency, flexibility in electronic circuitry



- Basic battery charger used with no profiling
- Large no of components used, more failures, less efficiency

Upto 2007



- Compact integrated solutions with Highly efficient LED drivers
- Basic battery charger with no profiling but with better circuit protections
- Efficiency: 70-80%

2007-09

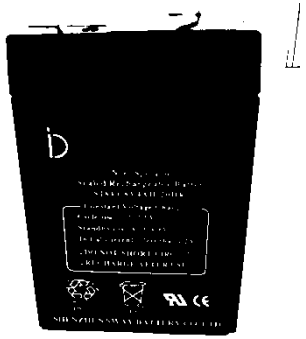
- Compact integrated solutions with Highly efficient LED drivers
- Microcontroller based intelligent charge controllers with battery profiling and higher flexibility
- Efficiency: 85%
- Micro-switch / touch panel based systems improving reliability

2010

Courtesy: Texas Instruments

Trend in battery development

Incorporating long-life, environment friendly batteries



Commonly used SMF Battery

Better quality SMF | **Li-Ion/ Li-polymer** | **NiMH**

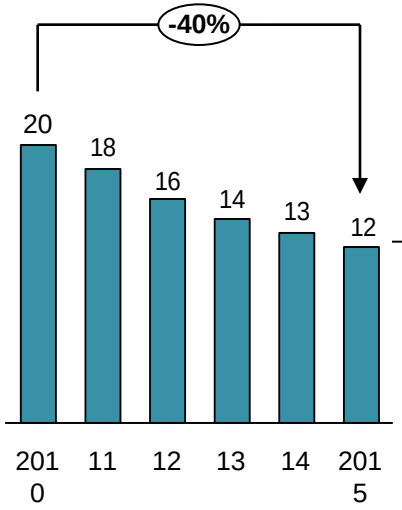
- Light weight
- High energy density
- Wider operating temp. range
- Longer life
- Environmentally sound

2009 → **2010**

Decline in costs with technology development

$, Dollars

Total Manufactured Cost



% of total cost

31%

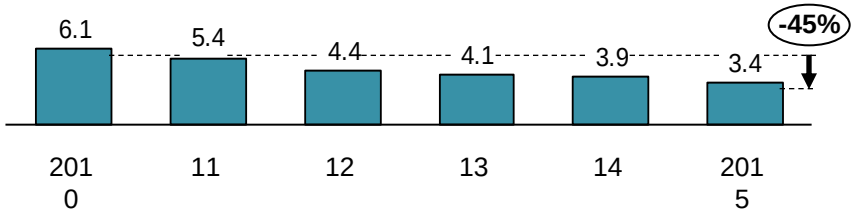
19%

23%

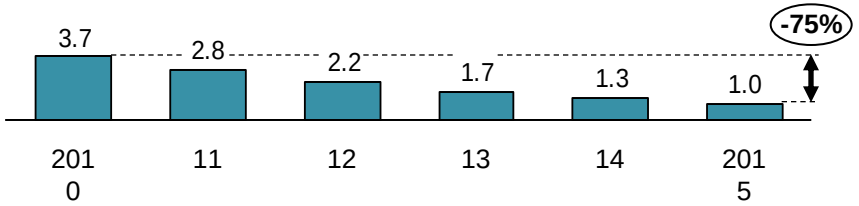
27%

Component trends

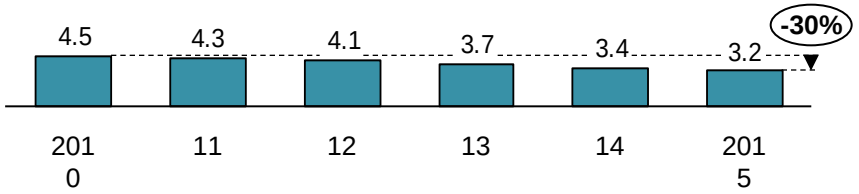
Solar

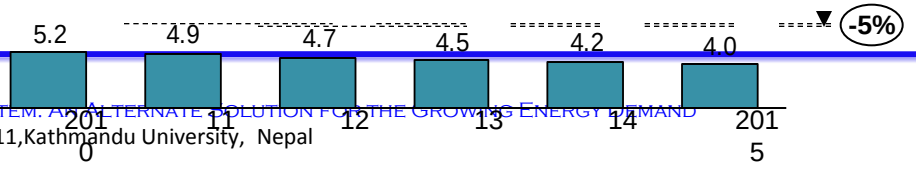


LED



Battery





Source Dalberg analysis

Journey so far……

Laltini **represents the goal of rural enlightenment through LaBL**

350 000 lives impacted

70 000 solar lanterns

1200 villages covered

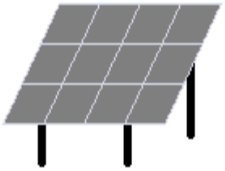
17 states in India

6 countries

> 1200 green jobs created

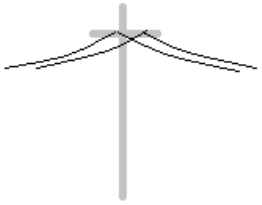
> 60 NGOs involved

New Technology: Solar DC Micro Grid



Renewable Power Generation: 100 households would require 500-700 watts-peak of solar panels. Panels are installed on the rooftop of a village house.

Battery Bank: 100 households would require around 500 Amp-hours of storage capacity. Batteries are stored in a cabinet inside the same house or distributed battery storage at individual households



Power Distribution: DC distribution lines run along the rooftops from the battery bank to households within the village. Power is distributed for 8 hours each night at 24 volts.

LED: Each household having 2 or 4 LED lamps (3 levels)

Policy: Challenges & Way forward

- Dissemination suffers from uncertainty in the political framework conditions
- SHS not considered as rural electrification
  - India and Bangladesh as they cater only to lighting needs
- Absence of standard set of guidelines for implementation

✓ Proper policy enablers at country level
  - Jawarlal Nehru National Solar Mission in India

✓ Regional level policy cooperation & sharing knowledge

✓ Robust institutional structure for implementation

Conclusion

- Catalyst for scale up
  - Improved access to capital/financial innovation
  - Development of local after-sales service infrastructure
  - Customer centric market development
  - Regular stakeholder involvement
- Improved design efficiency, economy of scale
  - Adopt LEDs without compromising quality and level of illumination
- Need to remove barriers to supply, demand & scalability
- Adopt standard process and metrics for scaling up
  - Reduced cost
  - Easy to attract investment