



A Comparative Analysis of the Solar Energy Programs for Rural Electrification: Experiences and Lessons from South Asia

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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

Acknowledgement

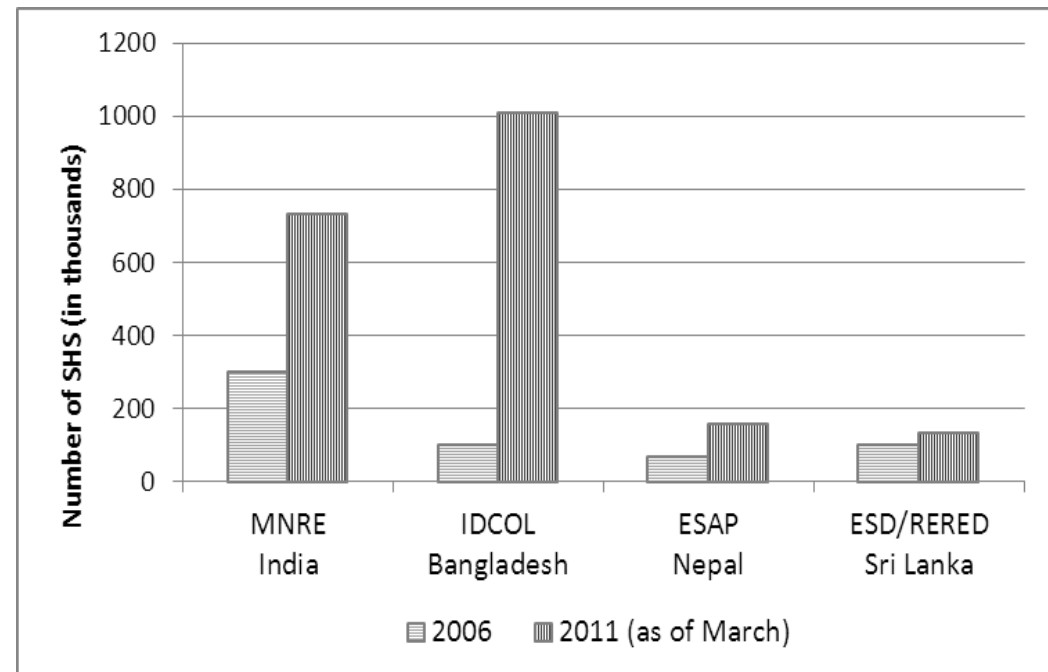
- Based on review of off-grid rural electrification efforts in the South Asian region, conducted as part of the project '**Off-grid Access System in South Asia**', supported by Engineering and Physical Sciences Research Council (EPSRC) / Department for International Development (DFID) research grant (EP/G063826/1) from Research Council United Kingdom (RCUK) Energy Program

The OASYS Project Objectives:

- ✓ Are there cost-effective and reliable off-grid electricity supply solutions that can meet the present & future needs, are socially acceptable, institutionally viable and environmentally desirable?
- ✓ Do these local solutions have the scaling-up and replication potentials and can these solutions be brought to the mainstream for wider electricity access in the developing world?

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	Consumer financing/ credit sales	11.6
Sri Lanka	SHS	Consumer financing	9.6

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

Bangladesh

- SHS program for off-grid areas, implemented by IDCOL, through its Partner Organizations (PO)
- PO's main role is to select areas & potential customers, offer micro-lending, install systems, provide after sales support, and training to users and local technician
- IDCOL achieved financing of 1,008,854 SHS as of June 30, 2011; > 50% of total SHS installed by Grameen Shakti alone
- Long term loan packages from donors to national government - government 'on lend' to IDCOL at soft rate
- Innovative model by REB – HHs pay monthly bill for energy used from a SHS, but never own the system

Nepal

- ESAP (Energy Sector Assistance program) has been instrumental in promoting SHS
 - ESAP 1 installed 69,411 SHS, against target of 40,000
 - 83 percent of the installed SHS are of smaller capacity, indicating that these are mainly used for lighting
 - *Solar tuki* – a unique product promoted in Nepal
 - Successful in putting in place quality assurance and monitoring systems
 - ESAP II aims to cover 150,000 households with SHS and about 250,000 households by solar tuki systems

Sri Lanka

- One of the most impressive market-based solar PV program
- Promoted through ESD and RERED program through Participatory Credit Institutions (PCIs)
- ESD installed 20953 SHS against target of 15000 systems
- RERED electrified > 130,000 rural households through SHS
- Consumers avail the finance from the PCIs and procure systems from solar firms, thereby having to deal with two different agencies



India

- Implemented under the aegis of Ministry of New and Renewable Energy
- Achievements
 - 733,245 SHS and 831,604 SL
 - SMGs (1 - 500 kWp): Cumulative 8.16 MWp
 - NGOs and small solar companies also complimenting MNRE's efforts to augment energy access with solar PV
- TERI's Lighting a Billion Lives Initiative
 - Launched in 2008 (<http://labl.teriin.org>)
 - Around 40 000 lanterns spread across 840 villages in India

South Asia: Financing of Solar PV

- Large bouquet of financing mechanisms
 - micro-credits schemes
 - interest rate buy-downs
 - fee-for service
 - with or without any subsidies
- Majority availed micro-credit/consumer credit, a quarter used state or donor funded subsidies and fee-for-service and only few (5%) used cash purchase
- Financing mechanism used related to organization type
- Lack of suitable financing mechanism is regarded as most significant barrier to the uptake of SHS

South Asia: Maintenance of Systems

- 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
- IDCOL (single window model) reported more success than ESD (two window model)
 - Loan repayment directly impacted by improper service
- Technology Resource Centres model in TERI's LaBL
 - An option for responsive repair of decentralized systems

South Asia: Carbon Financing

- Limited number of projects have received carbon benefits
- Solar PV systems replaces small amount of kerosene/diesel,
 - Only 1% of cost of SHS can be recovered annually from CERs
- How to meaningfully bundle the number of systems operating in a country to make it a viable
- Solution could be with Program of Activities (PoA) model
 - Flexibility of one time registration with its duration extending upto 28 years and addition of any number of CPAs during this duration, which have been developed using the same approved baseline & monitoring methodology for a particular technology
 - Physical boundary of a PoA may extend to more than one country, thereby getting benefits of economy of scale
- Renewable Energy Certificates for decentralized projects



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
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- ✓ Proper policy enablers at country level
 - Jawarlal Nehru National Solar Mission in India
 - ✓ Regional level policy cooperation & sharing knowledge
 - ✓ Robust institutional structure for implementation

Financing: Challenges & Way forward

- Credit provided independent of income level
 - Financial assistance from government programs not reaching the lower income HHs
 - Financial mechanisms are not in line with income level of poor HHs (the section w/o electricity access)
 - Assessing finance from rural banks is sometimes tiresome due to long approval process
- ✓ Rationalizing of the interest rate for micro-lending to cover poorer households.
- ✓ Creating mechanism for easy access to credit and financing through simpler process & better accountability mechanisms

Technology: Challenges & Way forward

- High cost of technology and or service
 - Not within the reach of lower strata of society
- ✓ 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

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