Third Green Growth Green Growth Forum

20-22 November, Myanmar

Positioning Energy-Water-Food Nexus in Practice:
Regional Cooperation for Myanmar Resource Sustainability

Coordinated by IGES, Japan
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Opportunities for providing Off-grid solutions in Myanmar

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Structure of the Presentation

- Energy Access in Myanmar & Renewable Energy resources
- Some innovative business models from South Asia
- Off-grid opportunities in Myanmar
- Points to consider for developing off-grid delivery models
Energy poverty is a global problem that demands a global solution.

The pink region indicates population density. The white region indicates where modern energy is accessible.

1.9 billion people in Asia and the Pacific depend on burning traditional biomass for energy***

4.1 billion total population of Asia and the Pacific*

679 million people in developing Asia have no access to basic electricity services**

44 million w/o electricity access in Myanmar i.e 87%

*UNESCAP 2010 Statistical Yearbook for Asia and the Pacific 2008
**IEA 2011World Energy Outlook 2011
***IEA 2011 World Energy Outlook 2011
Electrification in Myanmar

- Average electrification rate is 16%
- National power grid network reportedly covers only 5% of villages
- Per capita electricity consumption ~ 131 kWh
- More than two-thirds of households use diesel lamps, batteries or candles for lighting
- Literature indicates grid tariff much lower than off-grid tariff

Solar and Small Wind in Myanmar

Average solar radiation of 4.5-5.5 kWh/m²/day

Source: Serm Janjai et. al, 2011

Source: Serm Janjai et. al, 2011
Biomass Energy Resources in Myanmar

- Rice husk - 4 million MT can possibly be used for generating electricity using gasification or combustion
- Other biomass resources include saw dust, cob and stalks of maize, bean stalks, etc.

Source: Holly K Gibbs et. al

<table>
<thead>
<tr>
<th>Type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice Husk</td>
<td>4,392 X 10^3 ton/year</td>
</tr>
<tr>
<td>Lumber Waste</td>
<td>1.5 million ton/year</td>
</tr>
<tr>
<td>Bagasse</td>
<td>2,126 X 10^3</td>
</tr>
<tr>
<td>Molasses</td>
<td>240 X 10^3 ton/year</td>
</tr>
<tr>
<td>Livestock Waste</td>
<td>34,421 X 10^3 ton/year</td>
</tr>
</tbody>
</table>
Defining energy access

- Household having reliable and affordable access to clean cooking facilities, a first connection to electricity and then an increasing level of electricity consumption over time to reach regional average (IEA)
- Means for providing energy access - central grid, mini-grid, small renewables/off-grid, diesel?
  - Is (clean) energy available
  - If yes, is it accessible
  - If yes, is it affordable
  - If yes, is it being used

Multi-tier framework under SE4All

<table>
<thead>
<tr>
<th>TIER 1</th>
<th>TIER 2</th>
<th>TIER 3</th>
<th>TIER 4</th>
<th>TIER 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task lighting AND phone charging (OR radio)</td>
<td>General lighting AND television AND fan (if needed)</td>
<td>Tier 2 AND any low-power appliances</td>
<td>Tier 3 AND any medium-power appliances</td>
<td>Tier 4 AND any high-power appliances</td>
</tr>
</tbody>
</table>
Off-grid Models – South Asian Experiences

Delivery models
- Entrepreneur Driven
- Community Based
- Pro-Poor PPP

Off-grid solutions
- Solar Charging Stations
- Solar DC Mini Grids
- Solar Multi Utility
- AC Mini Grids (solar, wind, biomass)
- Solar Home Systems
Lighting a Billion Lives (LaBL)

Commitment at the Clinton Global Initiative 2007

Official Launch by Hon’ble Prime Minister of India 2008

We commit to enable a billion lives to access light from solar technologies
Lighting a Billion Lives initiative facilitates setting up of micro solar utilities, which offer clean lighting solutions to energy poor villages.

- Provides reliable and clean illumination
- Replaces the use of polluting kerosene as a lighting fuel
- Catalyzes rural solar market
- Equips local human resources with technical and managerial skills

Source: TERI, 2008
Lanterns usage
DC distribution lines (voltage varies depending on distance) run along rooftops from the battery bank to households over a short distance to power lights, mobiles etc.

Source: TERI, 2012
Operation

No of connections per SMG: 10, 20, 40, 80, 100

Running time: 5-6 hours; 2 LEDs and Mobile charging

Installation Cost: $ 65 - $ 75 per HH

Tariff: (~ 2-3 $) per month, charged by the operators

Source: TERI, 2012
LaBL Global Presence

<table>
<thead>
<tr>
<th>Country</th>
<th>Households Reached</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afghanistan</td>
<td>6000</td>
</tr>
<tr>
<td>Kenya</td>
<td>360</td>
</tr>
<tr>
<td>Mozambique</td>
<td>2830</td>
</tr>
<tr>
<td>Myanmar</td>
<td>500</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>300</td>
</tr>
<tr>
<td>Republic of Congo</td>
<td>300</td>
</tr>
<tr>
<td>Pakistan</td>
<td>1700</td>
</tr>
<tr>
<td>Nigeria</td>
<td>8000</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>100</td>
</tr>
<tr>
<td>Uganda</td>
<td>600</td>
</tr>
<tr>
<td>India</td>
<td>&gt;100,000</td>
</tr>
</tbody>
</table>

Lives impacted (overseas) >1 Million
The Energy Access Continuum

LEVEL 1: BASIC HUMAN NEEDS
- Lighting, health, education, communication, community services, modern cooking etc.

LEVEL 2: PRODUCTIVEUSES
- Agriculture, water pumping, mechanized tilling, cottage industry energy needs etc.

LEVEL 3: MODERN SOCIETAL NEEDS
- Domestic appliances, cooling heating, transportation etc.

Scaling up basic lighting
Multiple Energy Sources
- Solar PV
- Wind Aero Generators
- Biomass Gasifier
- Hybrid Systems

Multiple Applications
- Charging lanterns
- Powering computers,
- Charging cell phones
- Water purification
- Micro enterprises

Located near the energy utilization points in a village to provide electricity services as per the community’s need

Source: TERI, 2012
Solar Multi Utility (SMU)

Self Help Groups, Farmer’s Associations & Individuals from surrounding villages access the SMU & utilize services for a fee.

Source: TERI, 2012
Sustainability – going beyond technology

Technical/Social

- Need based design (SCS, SMG, SMU etc.) with standard procedures for operation
- Energy efficient system & intelligent load management for reduced peak demand
- Involvement of local youths as entrepreneurs

Financial

- Variable Grant (CSR): Equity (Operator) : Debt (Local Rural Banks) ratio
- Customized pricing strategies/rent to suit particular end-uses and livelihood activities

Institutional

- Creating linkages with local developmental programs/marketing agencies
- Catalyze local capacities for operation, management & post installation maintenance service
Mini-Grids in India

- Pioneer of Mini-Grid system
  - First solar mini-grid commissioned in nineties in Sunderbans Islands
- State-of-the-art system designs available & use of components, continuing till date
- Mostly cooperative model of service delivery
  - Involvement of local community from planning stage
- Policy enablers from time to time
- Around 5000 villages covered through mini-grids, serving more than 50,000 HHs
- Multiple technology adopted
Mini-grids

- Either AC or DC
- Typically 1kWp to 500 kWp
- Technologies
  - Solar PV
  - Biomass gasifiers
  - Mini/micro hydro
  - Biogas
- Usually community managed
- Covers around 50 - 500 households
Solar PV Mini-grid

Source: CREDA and TERI
Control Room, Battery Bank, Grid

Source: TERI
Biomass Gasifier Power System

- Fuel Preparation
- Biomass Gasifier
- Cooling cleaning train
- Engine – Alternator
- Biomass drying
- Power evacuation

Source: TERI
TERI’s work in Myanmar

- Thermal Gasifier Application in Myingyan Township (2004)
- Power Gasifier Application in Myingyan Township (20 kWe)
- Gasifier Systems for Village Electrification in the Cyclone affected area in Myanmar (2010-11)
  - 20 X 10 KWe systems in the cyclone affected areas in 8 townships
    - Kun Chyangone, Phoiarpon, Bogalay, Daedaye, Maw Lamyine Kyun, Laputta, Hakhar, Tonzian, Teetain
  - Total 460 households connected for supply of electricity
  - 20 street lights also connected in each township
- 3 x 10 kWe gaisifers installed at the General Hospital, Sittway for supplying electricity to the operation theatres, general wards and the administrative block
Some glimpses
Managing Mini Grids

FUNDING AGENCY

- Grant from Central Government
- Equity by PIA/NGO or Beneficiaries

Consultant (DPR, system design, TA support)

PIA

- System Engineering.
- System Owner

Power Plant

- Installation & Commissioning

System Supplier

$ VEC

- Organize VEC

Village Energy Committee (VEC) Model

- System custodian
- O&M
- LT line Maintenance

VEC

- Revenue: Tariff, billing, collection

Consumers

Electricity

Source: TERI
Addressing single resource - Hybrid System

55 kW Solar and 3.5 kW Wind Electric Generator based hybrid system

Source: TERI
Managing Mini Grids: Addressing low load

[Diagram showing the flow of money and power from VEC to Gasifier Power Plant, then to Economic Activities, and back to users.]

Source: TERI, 2009
Cluster Based Service Delivery

Village Cluster
- 15 Villages
- 50 Customers / Village

H: Service Hub
( Base station )
- Technician / Helper
- Spares / Consumables

V: Villages in the Cluster

Source: CREDA, 2010
Off-grid opportunities in Myanmar

**Level 1 - Basic needs**
- Lighting
- Communication
- Cooking
- Heating

**Level 2 - Productive uses**
- Agriculture (water pumping, mechanized tilling etc.)
- Public health centres
- Education (Schools, tuition centres etc.)
- Street lighting
- Sewing, cottage industries
- Grain grinding

**Village-scale mini-grids**
*Ideal for larger or more developed villages*

**Level 3 - Modern society needs**
- Modern domestic gadgets and appliances for space cooling, heating etc.
- All productive applications for 24/7 usage
- Transport

**Mini-grids coupled the main grid**
*Ideal for cluster of villages*

**Small scale RETs**
*Ideal for isolated and vulnerable communities*

Facilitate

Defines

Could develop into

Facilitate
Takeaways

• Defining success - not just financial but should also consider operational and outcome - benefits to community

• Service delivery models to be structured considering the uniqueness of the region within which the plant is to be installed - *Today off-grid, grid-connected tomorrow*

• Contrary to prescribed models of off-grid electrification, *top-down approach/organized structure* seems to be working better than community model - *Scaling up may need differentiated responsibility*

• Anchor load may be useful for meeting the fixed costs - not necessarily energy costs - to reduce overall cost of supply from small capacity systems
Takeaways

- Cost of supply may be considered as the metric for comparison and not cost of generation, while designing projects.
- Designing variable tariff structures considering both *ability to pay* as well as *operational expenses*.
- Strong regulatory & policy regime supports development of projects - *Viability gap funding/Results based aid*.
- Low cost/Patient capital required for scale up.
- Need to *build local capacity and adopt clustering* for effective maintenance & viability of operation.
- *Most importantly - recognition by country political set up*.
Any Questions?