Renewable Energy Programs for Rural Electrification: Experience and Lessons from India

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Electricity Access in India

- Average electrification rate for India is 75.3 %
- Rural area are having only 66.97% electrification

- Central grid is covering almost 95% of villages;
- Mini-grid covers remote or poorly elect villages
- Annual market potential of off-grid energy is $2 billion

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Conducive Policy framework

- REST Mission (2001)
  - Acknowledged role of RE based stand-alone & mini-grids systems
- Electricity Act-2003
  - Universal service obligation to provide electricity by both central and state Government
- Rural Electrification Policy (2005)
  - Decentralized Distributed Generation to be considered where grid extension is not feasible
  - No license required for generation and distribution - tariff can be determined based on mutual consultation with consumers
- Rajiv Gandhi National Rural Electrification Scheme (2005)
  - Decentralized Distributed Generation (DDG) and Supply
  - 1000 MW by 2017 and 2000 MW by 2022 of off-grid capacity

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Content & Methodology

• Captures the development of off-grid rural electrification through renewable energy in India
• Analyses the experiences and lessons, which can contribute to better program designing and policymaking
• Using extensive literature reviews, interview with key stakeholders & field visits
  – Coverage and management
  – Technical designs
  – Delivery models and O&M aspects

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Rural Electrification Options

Designated Rural Area

Areas with existing grid access
  - Licensee or franchisee for existing network
  - Parallel licensee u/s 14
  - Licence exemption u/s 13

Areas with no grid access
  - Off-grid collective system (combined generation and distribution)
  - Off-grid individual systems

Source: Palit & Sarangi, 2013

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Off-grid programs in India

- Remote Village Electrification Program (RVEP)
  - Started in 2001, targets areas where central grid extension is not feasible
  - Solar, biomass micro hydro used; solar constitute most
- Village Energy Security Program (VESP)
  - attempted to addresses the “total energy” need for the community, operational during 2004-2009
- Decentralised distributed generation (DDG) program
  - Under National Rural Electrification Program, started in 2009, target areas which cannot be covered through grid
- Rural Energy Access Program (REAP)
Coverage & Management

• Primarily been carried out under RVEP & VESP
• Mostly implemented through State Renewable Energy Development Agencies
• SHS and solar lanterns primarily implemented, also gasifier and micro hydro
• Two most successful cases –
  – Chhattisgarh – CREDA electrified around 35,000 households spread across > 1000 villages/hamlets;
  – West Bengal - WBREDA has 15 solar mini-grids supplying electricity to around 10,000 households
• NGO led programs – Lighting a Billion Lives
• Private sector led programs – Husk Power, MGP, Sun Edison, Gram Oorja etc.
Technical design

- Typical SHS - 37 Wp solar panel, 40Ah tubular plate lead acid battery and two CFLs of 7-9 Watt each
- AC Mini-grids of varying capacities (1 ~ 200 kWp)
- Different agencies adopting different design
  - Chhattisgarh - micro-solar PV plants (< 6 kWp), standardized to 2 inverter capacity for 1-6 kWp PV
  - Sunderbans, Lakshadweep – Solar PV (> 100 kWp)
  - Hybrid mini-grids – solar, wind, gasifier
- Biomass gasifier systems – 10 to 50 kWe
- Solar DC Mini-grids –
  - 24 V DC line, 5-7 h supply using LED lamps of 2-6 W/hh

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Delivery Models and O&M aspects
SHS Model

• SHS implemented mostly through partial subsidy, leasing and consumer financing
• Subsidy between 50-90% , depending on remoteness of the areas
• Combination of subsidy and bank financing from rural banks
• A cluster technician trained and designated for maintenance and users charged monthly service fee, but in most cases maintenance was absent
• Critical aspect was replacement of battery
Most of the mini-grids implemented under RVEP or VESP follow the community-based models.

Tariff is flat, INR 30 (0.5$) to 180 (3$) /connection / month.
CREDA follows a top-down approach with installation and O&M responsibility - three-tier maintenance framework

- Tariff rate is flat, INR 30/-;
- Govt. subsidizes INR 25/-
Mini Grid – Private Sector

- Private sector follow a commercial approach and are purely demand driven

- HPS tariff is based on load (kW) & not energy (kWh)
- Weekly pre-paid tariff by MGP

Source: Palit & Sarangi, 2013

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Cluster Based 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

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Specific Challenges

- After Sales
- Institutional
- Finance
- Policy

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Key Lessons & Conclusions

- Appropriate support systems should be a mixture of both ‘participatory approach’ & ‘top-down approach’
  - Opposed to popular approaches “let the community handle” - Each entity sticks to what it does best
  - Scaling up may need differentiated responsibility of stakeholders (e.g. operation & revenue collection done by separate verticals)

- Optimizing design – Adapt to local context
  - Technical features will require a degree of standardization, uniform delivery model may be counterproductive
  - Need for standard contracts and implementation processes to keep the transaction costs low
Key Lessons & Conclusions

• Alternative service delivery models
  – Energy Service Provider (ESP)
  – BOOM and BOM models
  – VEC can act as a local level regulator to negotiate tariff, biomass prices and resolve disputes

• Regulatory intervention
  – Mechanism is required to extend tariff fixation by electricity regulators in case of mini-grid projects and providing subsidy from a Universal Service Obligation Fund
  – To augment electricity supply situation in grid connected rural areas, DG can be combined with electricity delivery model e.g. rural electricity distribution franchisees
Key Lessons & Conclusions

• Effective maintenance - Cluster service delivery
  – Close interconnections exist between technical and non-technical matters – focus on these connections
  – Technology based on availability of skill-sets of local people; after-sales services should be rarely outsourced
  – Fruitful partnership between project proponent and System Integrators (penalty – incentive approach)
  – Structured communication channel

• Strong govt. support - Political will
  – Right political framework - removing uncertainty
  – Mix of subsidy driven and commercial model for successful operation (if not financially sustainable)
Thank You

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