Empowering Rural India: Expanding Electricity Access by Mobilizing Local Resources

Analysis of Models for Improving Rural Electricity Services in India through Distributed Generation and Supply of Renewable Energy

Mumbai - February 15, 2011
Rural Electricity Access – A Critical Development Challenge

- 56% of rural households and 400 million people without electricity access
- Rural areas face major challenges of low per capita consumption and inadequate power supply: *6-8 hours of supply and poor quality of service*
- Several initiatives to improve access and quality of electricity in rural areas
  - Electricity Act 2003: Government obligated to supply electricity to rural areas. Distributed generation through stand-alone energy systems specified as a mode for rural electrification in addition to grid extension
  - Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) - Envisioned electrifying all villages, providing access to all rural households and free connections to all to below-poverty-line (BPL) families
  - Decentralized Distributed Generation (DDG) Program: Capital & operating incentives to off-grid distribution generation projects in villages without grid connections
  - National Electricity Policy: Decentralized distributed generation facilities with local distribution network wherever grid based electrification is not feasible

*Existing options to increase electricity access focus either on enhancing centralized generation or improving efficiency in the distribution business*
The Approach

- Detailed analysis of various possible options to enhance access in 2 sites each in Haryana and Maharashtra

- Electricity Demand Assessment and Coping Cost Survey undertaken in selected states (Maharashtra - Radhanagari Taluk of Kolhapur district)

- Economic and Financial Analysis to assess commercial viability of Distributed Generation and Supply (DG&S)

- Interaction with Key Stakeholders: Government, Private Developers/franchisees, Power Utilities, Renewable Energy Development Agencies, Financial Institutions, State Regulators and Industry Associations
Combining Generation & Distribution: Potential to be an Important Part of the Solution

DG&S Combines generation and distribution, i.e., in addition to distributing power and collecting revenues, the franchisee also generates power locally and supplies to the franchised area.
Distributed Generation and Supply (DG&S) is Economically Viable & Encourages Inclusive Growth

- Current coping cost higher than economic cost of DG&S based on renewable energy
  - Average rural household spends almost Rs 11/kWh to meet its lighting needs, significantly higher than about Rs 4.6/kWh for small hydro, Rs 5.7/kWh for biomass, and Rs 6.1/kWh for wind.
  - Economic cost of Diesel-based generation system is higher than most expensive renewable source for commercial and industrial consumers.

- Facilitates Rural Development and Inclusive Growth
  - Significant impact on socio-economic status of rural population due to improved power supply.
  - Encourage local entrepreneurship and innovation in rural areas.
  - Enhance income generation and job creation by providing new opportunities for commercial/industrial activities.
DG&S: Win-Win For All

Example: Raddhanagari subdivision in Maharashtra

<table>
<thead>
<tr>
<th></th>
<th>Utility supply</th>
<th>Short- Term PPC</th>
<th>DG&amp;S (Biomass)</th>
<th>DG&amp;S (small hydro)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Distribution loss</td>
<td>%</td>
<td>36.81%</td>
<td>36.81%</td>
</tr>
<tr>
<td>2</td>
<td>Per unit Power Purchase Cost (including transmission charge)</td>
<td>Rs/kWh</td>
<td>2.82</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>Power purchase cost (with loss)</td>
<td>Rs/kWh</td>
<td>4.46</td>
<td>11.08</td>
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<tr>
<td>4</td>
<td>Distribution cost</td>
<td>Rs/kWh</td>
<td>0.48</td>
<td>0.48</td>
</tr>
<tr>
<td>5</td>
<td>Return</td>
<td>Rs/kWh</td>
<td>Included in PPC &amp; distribution costs</td>
<td>0.55</td>
</tr>
<tr>
<td>6</td>
<td>Franchisee fee @3% average revenue</td>
<td>Rs/kWh</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>7</td>
<td>Average cost of supply (3+4+5)</td>
<td>Rs/kWh</td>
<td>4.94</td>
<td>11.56</td>
</tr>
<tr>
<td>8</td>
<td>Average tariff</td>
<td>Rs/kWh</td>
<td>4.21</td>
<td>4.21</td>
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<tr>
<td>9</td>
<td>Collection efficiency</td>
<td>%</td>
<td>91</td>
<td>91</td>
</tr>
<tr>
<td>10</td>
<td>Average revenue collected (8X9)</td>
<td>Rs/kWh</td>
<td>3.83</td>
<td>3.83</td>
</tr>
<tr>
<td>11</td>
<td>Tariff or full cost recovery (7 X9)</td>
<td>Rs/kWh</td>
<td>5.2</td>
<td>12.17</td>
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<tr>
<td>12</td>
<td>Gap (11-10)</td>
<td>Rs/kWh</td>
<td>1.37</td>
<td>8.33</td>
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<tr>
<td>13</td>
<td>Gap met by utility</td>
<td>Rs/kWh</td>
<td>1.37</td>
<td>1.37</td>
</tr>
<tr>
<td>14</td>
<td>Viability Gap (12-13)</td>
<td>Rs/kWh</td>
<td>0.57</td>
<td>Nil</td>
</tr>
</tbody>
</table>

- May help meet RPO target or generate cash with trading of Renewable Energy Certificates
- Extension of RGGVY capital subsidy to this model could also reduce Viability gap
Huge potential for economic savings for Maharashtra using DG&S

- Total unexploited potential:
  - Wind: 2828 MW
  - Biomass: 551 MW
  - 9400 MU

- Economic gain if this power replaces kerosene and other current expensive sources

Savings in Coping Costs = Rs 4700 Crore
Implementing the model with adjustments to current schemes would bring economic benefit

- Capital subsidies under RGGVY to (i) strengthen distribution and (ii) promote DDG (Decentralised Distributed Generation) to be extended to localized Generation and Supply

- Second option is to have Viability Gap Funding in the form of Operating Subsidies that is competitively determined can bridge the financial viability gap.

- Significant unmet demand in rural areas
  - At National level, with average retail domestic tariff of Rs 3-4/kWh, utility loses Rs 6-9/kWh if it uses Short Term power to increase supply to rural areas
  - With DG&S operator, the gap is likely to be maximum Rs 4/kWh with most expensive RE resource
Specific Actions required to operationalise DG&S model in Maharashtra

Mahadiscom/Govt. of Maharashtra

- Select DG&S operator through competitive framework
- Provide access to distribution network and substations
- Monitors DG&S operator to ensure regulatory compliance
- Create Viability Gap fund to provide operating subsidies for bridging gap between cost of supply and tariffs if any
- Pursue extension of capital subsidies under RGGVY and DDG scheme to DG&S model

Maharashtra Electricity Regulatory Commission

- Ensure appropriate technical standards to synchronize DG plants along with standard interconnection process
- Guarantee “take-or-pay“ for surplus after meeting service obligations
- Promote transparent and competitive framework for cost-effective solutions at the embedded network level

Maharashtra Energy Development Agency

- Select site for DG&S operator based on resource availability
- Streamline approval process of setting up of DG plants in selected site
International Experience in Combining Generation & Distribution Successful in Increasing Rural Access in Large Countries

- **China**
  - Extended electricity grid and exploited hydropower & solar to achieve electrification rate of 99% in rural areas (2009) compared to 50.6% (1975)
  - In about 800 of 1467 counties, almost 80% supply is met through small distributed renewable projects

- **Philippines**
  - Off-grid electrification with private-sector participation covers areas that distribution utilities waive off as financially unviable for the utility to serve
  - Small-scale energy generation with various attendant services offered to community entrepreneurs. The project also recovers US$0.26/kWh from the subsidy fund as the difference between the full cost recovery rate and the existing tariff
Thank You