Best Practices for Sustainable Rural Electrification Programs

NRECA International
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NRECA International

- An affiliated institution of the National Rural Electric Cooperative Association (NRECA) representing 940 distribution utilities that serve over 42 million Americans
  - 4 million km of distribution line, over 60,000 MW of capacity
- Has provided assistance to rural electric utilities in developing economies since 1962
- Has established and supported some of the most successful rural electrification programs that now provide service to more than 110 million consumers served by more than 250 rural utilities in Latin America, Asia and Sub-Saharan Africa
- Provides a wide spectrum of services including business planning and institutional capacity building; design/construction supervision; grid expansion planning; and establishing rural utilities
Projects versus Programs

- Projects are most often individual investments, with costs, benefit streams – most often are reviewed from a transaction perspective.
- Programs are often comprised of groups of investments and rely on establishing policies, practices, procedures and standards to achieve success across many projects.
- Electrification programs focus on increasing access to affordable and reliable service – require not just infrastructure, but institutions that can manage infrastructure.
- Process versus transaction orientation.
Overview of Rural Electrification Programs

- Successful programs build from high population density to lower: rural programs often lag urban electrification by two or more decades.
- Rural electrification has historically included a combination of grid expansion and off-grid service.
- Micro-grids are not new – just a new name for a paradigm that has been in use for over a century, albeit with much improved control technology.
- Sustainability of electrification projects/programs centers on good business practice and robust management of generation.
- Failed projects most often occur due to inadequate revenue recovery: poor billing/collection practices and/or inadequate tariff design.
- So – know your market, choose technology wisely, and ensure you use good business practices.
Characteristics & Challenges of Rural Electrification

- Lower load density than urban areas, meaning lower sales per kilometer of line
- Lower economic activity often means lower financial capacity of consumers and lower consumption
- Longer distances between consumers also means higher construction costs
- In Sub-Saharan Africa, rural can often mean isolated generation, resulting in higher delivered cost of energy
To Address these Challenges, One Needs:

- **Access to long-term, low-cost financing.**
- **Low-cost construction standards.** Urban design/construction standards are far too expensive for rural construction.
- **Standardized and simplified business systems.** Rural utilities are most often run by local managers and technicians who do not have sophisticated business training.
- **Generation systems selected to suit load.** Generation technology for smaller systems must be dimensioned to follow load and to operate on the upper end of the efficiency curve.
- **Use of renewable technologies can lower cost.** This is not universally true, but well-designed hybrid systems can reduce fuel consumption by up to 60%.
- **Training & technical assistance.** Rural utilities employ local people – and they likely will require significant training, as well as technical assistance in all phases of operations.
Electrification Challenge in Somalia

- Very low access rates: 15% nation-wide, 4% in rural areas
- Power sector is a work in progress: no central power stations, no transmission, no formal power utilities
- No standards, no national planning, high power costs, little experience as of yet in program management
- What’s needed?
  - Establish a vision
  - Define a pragmatic strategy (service providers, technology mix, financing)
  - Develop a rational expansion plan (grid & off-grid)
  - Evaluate resource options and develop capacity to support expansion
Rural Electric Service Model Options

- Four options are generally considered for most electrification programs:
  - State-owned utilities: few have the resources and incentives to manage large scale expansion well. Many state-owned utilities are very slow to expand and respond to consumer needs.
  - Municipal utilities: with a few notable exceptions, these are often very poorly managed due to the temptation to use utility revenues for non-utility purposes.
  - Electric cooperatives: have had remarkable success in some but not all programs. They require a strong electrification agency with transparent planning and financing, and tariffs that allow cost recovery.
  - Private service providers: have not played a major role in electrification programs – electrification is seldom a lucrative business. A more likely role might be as a management contractor.
What will work here?

• To be determined. Private sector appears to be the principal player in urban areas so it will no doubt have involvement in rural programs.

• However, willingness to pay for service is a determining factor – until market analyses are performed, the level of private involvement will remain in question

• Cooperatives are an option – can tolerate much lower rates of return on investment. However, they require capacity building, technical assistance, oversight and capital.
Market Town Electrification in South Sudan

- Financed by USAID, electric generation-distribution systems established in Yei, Kapoeta and Maridi
- Cooperative established in Yei
  - Significant local interest and support
  - Significant resistance from local government
  - Required three years to register
  - Has been well-governed without significant local political interference
- Cooperative-like institutions in Maridi and Kapoeta, but state governments own own infrastructure
- Locally owned service provider with board of directors and local management teams
Technical Characteristics

- Power plants were standardized using a utility-grade 400 kW C18 Caterpillar power generation set with synchronizing capability.
- Energized at 11 kV using standard postpaid meters three phase backbone & single phase laterals.
- US-style service drops with fully enclosed meter bases. Theft has not been an issue.

<table>
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<tr>
<th>Town</th>
<th>Capacity</th>
<th>MV line</th>
<th>Customers</th>
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<tbody>
<tr>
<td>Yei</td>
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<td>25 km</td>
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<tr>
<td>Maridi</td>
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<td>18 km</td>
<td>800</td>
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<tr>
<td>Kapoeta</td>
<td>800 kW</td>
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Operational Achievements

- All three utilities achieved collection rates above 95%, with losses ~8-10%
- Very high service quality (voltage 98-102% of nominal) and very low outage rates (less than 20 hours/consumer-year)
- Focused on hiring very modest staff (10-14 per utility) with heavy emphasis on training
- In all three cases, these power systems significantly stimulated local economic growth
Challenges

- High staff turnover, especially for linemen and financial personnel (were highly trained and found better-paying jobs)
- In early years, needed small diesel generator due to growing but low load (250 kW would have been appropriate)
- Routine engine maintenance has been challenging – air filters, radiator cleaning, and buying high quality lubricants has been problematic
- Fuel cost and availability has been very problematic: these systems really need to have significant solar arrays
- Access to capital for expansion: power systems need to expand with the community so continued access to capital is extremely important
Challenges in Somalia will be similar

- All rural utilities face similar challenges: lower economic activity means lower energy sales
- Lower revenues means modest staffing levels and inability to attract well-educated team members
  - Accountants, billing clerks, customer service personnel and technicians must gain experience through intensive training
- Market conditions will likely result in very modest margins
- Investment for expansion will likely have to be provided by external sources
- Conflict in engaging private sector investors: will government or development agencies choose to invest in infrastructure that is owned or operated by private sector?
Profile of Bankable Utilities

- **Organizational robustness**
  - Clear & effective leadership
  - Technical proficiency

- **Effective service delivery**
  - Established and reliable hours of service
  - Voltage +/- 5% of nominal, stable frequency, low outages

- **High cost recovery**
  - Collections above 90% of billings
  - Clear tariff model that is cost reflective

- **Accountability**
  - Standardized accounting methods
  - Auditable financial statements
Financing is More Readily Available Where

- Utilities present with established business models
- Utilities serve defined & robust market
- Formal licenses are granted to supply the market
- Demonstrated reasonable engineering practices, operating competency, and sound business practices
- Evidence of financial accountability – audited financial statements
- Technical, financial and commercial performance monitoring