Off-Grid Solutions for Rural Electrification and Policies to support them

Michael Wollny
SMA Solar Technology AG, Germany
Director Technical Sales Off-Grid Systems
WFC-Workshop Addis Abeba, October 2009
A global opportunity for RES

» 1.6 billion people worldwide do not have access to electricity in their homes, representing more than one-quarter of the world population. Four out of five people without electricity live in rural areas of the developing world.

» World electricity demand is expected to double between now and 2030, with most of the growth in developing countries where electrification rates are not keeping up with the population growth.

» A total capital investment of 8.1 $ trillion, equivalent to an average of $300 billion per year is needed to 2030 for the developing and transition economies to meet their energy needs.

» Most developing countries offer excellent natural conditions for the use of RES for rural electrification. RES are more cost effective than traditional diesel generator sets. Moreover, they can make an important contribution against climate change.
Electricity in the world: The figures

<table>
<thead>
<tr>
<th>Global Electricity Access 2005</th>
<th>Population with electricity</th>
<th>Population without electricity</th>
<th>Electrification rate</th>
<th>Urban electrification rate</th>
<th>Rural electrification rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>million</td>
<td>Million</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Africa</td>
<td>891</td>
<td>337</td>
<td>554</td>
<td>37,8</td>
<td>67,9</td>
</tr>
<tr>
<td>Developing Asia</td>
<td>3.418</td>
<td>2.488</td>
<td>930</td>
<td>72,8</td>
<td>86,4</td>
</tr>
<tr>
<td>Latin America</td>
<td>449</td>
<td>404</td>
<td>45</td>
<td>90,0</td>
<td>98,0</td>
</tr>
<tr>
<td>Middle East</td>
<td>186</td>
<td>145</td>
<td>41</td>
<td>78,1</td>
<td>86,7</td>
</tr>
<tr>
<td>Developing Countries</td>
<td>4.943</td>
<td>3.374</td>
<td>1.569</td>
<td>68,3</td>
<td>85,2</td>
</tr>
<tr>
<td>Transition Economies and OECD</td>
<td>1.510</td>
<td>1.501</td>
<td>8</td>
<td>99,5</td>
<td>100,0</td>
</tr>
<tr>
<td>World</td>
<td>6.452</td>
<td>4.875</td>
<td>1.577</td>
<td>75,6</td>
<td>90,4</td>
</tr>
</tbody>
</table>

More than 43% of rural population in developing countries have no access to electricity.
PV Off-Grid Market in 2007

Off-Grid market:
300 MWp

- 152 MWp remote habitation application
- 25 MWp consumer power application
- 123 MWp remote industrial application

The Off-Grid market will grow with approximately 16% / year

Source: Navigant Consulting
Potential Market

- Diesel Genset: 10000 MW (95%)
- PV: 300 MW (3%)
- Wind, Water: 200 MW (2%)

Potential market size is 30 times bigger than today in MW

Source: Conergy
Off-Grid is a future market

» EPIA/Greenpeace Prognose up to 2030:
  - 105...281 GWp/year
  - 30% for Off-Grid sector

Off-Grid market will increase faster compared to the On-Grid market
Suitable technological solutions for rural electrification

1. Grid extension
2. Genset dominated supply (Petrol, Gasoline, Liquefied Petroleum Gas)
3. Solar home system (PV)
4. Hybrid or Mini Grid power supply systems based on renewables
Grid extension

- High cost
- Low consumption rate
Genset dominated power supply

(powered by gasoline, natural gas or LPG)

» Availability of productive power
» High maintenance effort
» High transport and fuel costs
» Unacceptable environmental impact

AC bus line
Genset dominated power supply supported by RES

- Fuel saver operation
- Reduced transport and fuel costs
- Uninterrupted running of generator
- Low comfort
Solar Home System

- No generator needed
- Individual energy supply
- Restricted economic development
Mixed DC and AC bus line

- AC and DC appliances
- Availability of productive power
- Redundant system design with generator
Modular hybrid design

- Grid quality electricity
- Easy expandability
- Backup solution
- Integration of different RES
- Standard components
Advantages of hybrid power systems based on AC bus line

» Higher flexibility by coupling all consumers and generators on AC bus line

» Standard AC used technology in the power range above several kilowatt

» Different local renewable and conventional energy sources are suitable to form a hybrid grid

» Simple expandability

» Extension of a diesel based power system

» Use as a backup solution for unstable public grids
Modular energy supply
Simple enlargement
Higher flexibility by coupling all consumers and generators on AC bus line
Different local renewable energy sources are suitable to form a hybrid grid.
Electricity in network quality
Economical comparison: Grid extension vs. hybrid systems

» The extension costs are primarily distance dependent

» The break even “distance” is therefore related to the demand

Source: Alliance of rural electrification
Economical comparison: diesel vs hybrid systems (life cycle costs)

Comparison:
Cumulative costs
diesel vs. PV/diesel hybrid system

Source: Alliance for Rural Electrification

PV-Hybrid Diesel-Grids is a cost competitive solution for rural communities
The efficient and climate friendly technology: Conclusions

The following principles are important when choosing a technology for rural electrification:

- Life cycle cost analysis
- The environmental dimension
- A long term perspective on fuel prices
- The socio-economic and cultural dimension
- Local infrastructure and manpower available
- Technical requirements of the system and measures to improve energy efficiency

Mini Grids based on hybrid systems are often the most cost-competitive solution

They can power small businesses, are reliable and environmental friendly
Rural Electrification: A political challenge

- Access to electricity must rank high on the development agenda.
- Access to electricity should follow a reliable long term strategy and the legal framework must allow for private and local initiatives.
- A close dialogue between policymakers, the private sector and representatives of rural communities is indispensable for sustainable policies.
Financing schemes for rural electrification

- Energy must be defined as a service rather than an installation.
- It is essential to ensure the O&M of the systems.
- Subsidies can be legitimate but should be phased out in the long run.
Financing schemes for rural electrification

**ARE recommendation:**

The **Regulated Purchase Tariff:**

Based on the FiT adapted to off/mini-grid

- Upfront costs of system is spread over a fixed period.
- Consumers pay fixed tariff
- Ongoing tariff payments are subsidized (by national government / international development finance) to make up the full costs

- Renewable IPP recovers costs plus marginal profits over the fixed period.
- Long-term contract obliges company to maintain the system (repairs, replacements eg)
Challenges at the local level

- Local ownership determines whether projects are successful.
- All stakeholders, community leaders, companies, aid organisations and public authorities have to be called upon to work together.
- The local community needs adapted financial support. A social network is appropriate for supporting community payments.
- Local technicians and trainings are indispensable.
- Electricity users have to be educated about the possibilities and limitations of their power system.
Engage in the global Off-Grid markets...

**Information:** Receive regular updates on new international projects and business opportunities.

**Marketing:** Underpin your commitment to quality and your technological expertise.

**Networking:** Get connected to the international Off-grid community. Raise your company’s profile vis-a-vis international development organisations and governments (World Bank, EU etc.).

**Public Relations:** Highlight your company’s commitment to improve access to energy and to deliver sustainable solutions.

**Lobbying:** Engage to shape the global Off-Grid markets.

**Join the Alliance!**
Let’s talk!

Alliance for Rural Electrification
Rue d’Arlon 63-65,
1040 Brussels, Belgium
T +32 2 400 10 52
dev.com@ruralelec.org
www.ruralelec.org

Photo credit: ARE members