Mini-grids in Africa: experience from the field

Pablo Muñoz, Technical Support Manager
Summary of the presentation

- Studer Innotec
- Mini-grids in Africa
- Case Study 1 – 3 Mini-grids in Chad
- Case Study 2 – 5 Mini-grids in Ghana
- Why Studer
Studer Products Family

HYBRID SYSTEMS

Xtender
Multifunctional and bidirectional inverter/chargers, for systems from 0.5 to 72kVA.

VarioTrack VarioString
MPPT solar charge controllers with 65A to 120A battery charge current, for PV arrays from 1-105kWp.

SOLAR HOME SYSTEMS

AJ Series
Sine wave inverter from 200 to 2400VA (230V/50Hz & 120V/60Hz)

ACCESSORIES
Applications of the Studer Products

- **SOLAR APPLICATIONS**
  - Remote areas
  - Self-consumption

- **MOBILE ENERGY APPLICATIONS**
  - Maritime applications
  - Land applications

- **24/7 SECURITY APPLICATIONS**
  - Backup Systems
  - Telecom

- **OTHER APPLICATIONS**
  - Industrial market
  - Mini-grids

Applicable in any field and for special applications
Studer’s Partners around the world
Studer’s Reference Installations

Register yours at www.studer-innotec.com
Mini-grids in Africa

Source: Global Tracking Framework 2017, SE4All

- Global electrification rate at 85.3% (2014)
- Europe, North America and Central Asia universal access achieved
- Latin America, Asia-Pacific and Arab Region around 90%
- Africa (excluding North Africa) remains at 37%

Distributed Paradigm -> Example of the Mobile Phone Sector
Mini-grids – Technology

Several existing mini-grids → Mature technology
Mini-grids – Financial model

CAPEX

- Energy Generation (Wp)
- Energy Storage (kWh)
- Power Conversion (kVA)
- Distribution grid (km)
- Users connections (user)
- Back-up Generator (kVA)

OPEX

- Preventive O&M
- Corrective O&M
- Operation management
- Insurance, taxes
- Equipment replacements

Anchor Business Community (ABC)
- Community
- Hybrid – Public Private Partnership (PPP)
- Private concessionaire
- Independent Power Producer (IPP)
- Local Entrepreneur
- Private ESCO
- Clustering
- Franchise

Tariffs, service fee, PAYG, Loan, Deposit, Subsidy, Grant, etc.

Anchor Business Community (ABC)
- Cluster}

Clustering
- Local Entrepreneur
- Private ESCO
- Independent Power Producer (IPP)
- Community
- Hybrid – Public Private Partnership (PPP)
- Utility

Investment Return
- Operation management
- Insurance, taxes
- Corrective O&M
- Equipment replacements

Utility
- Preventive O&M
- Corrective O&M
- Operation management
- Insurance, taxes
- Equipment replacements
Mini-grids – Social aspects

Access to energy is key for socio-economic development

- Switch the energy source
- Energy uses: lighting, phone charging, water pumping, health, education, etc.
- Accompanying activities
- Tools to promote business
- Empower vulnerable groups

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**Case Study 1**

"Promoting renewable energy based mini-grids for rural electrification and productive uses"

<table>
<thead>
<tr>
<th></th>
<th>MOMBOU</th>
<th>DOUGUIA</th>
<th>GUELENDENG</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar Power STC (Wp)</td>
<td>&gt; 39 600</td>
<td>&gt; 44 640</td>
<td>&gt; 36 720</td>
<td>&gt; 80 780</td>
</tr>
<tr>
<td>Inverter Nominal Power (VA)</td>
<td>36 000</td>
<td>36 000</td>
<td>36 000</td>
<td>108 000</td>
</tr>
<tr>
<td>Battery capacity (Wh)</td>
<td>441 000</td>
<td>441 000</td>
<td>220 500</td>
<td>1 102 500</td>
</tr>
<tr>
<td>LV Distribution Line (km)</td>
<td>3.9</td>
<td>2.15</td>
<td>4.5</td>
<td>10.55</td>
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<tr>
<td>Street lighting</td>
<td>11</td>
<td>11</td>
<td>30</td>
<td>52</td>
</tr>
<tr>
<td>Back-up Generator (kVA)</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>150</td>
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<tr>
<td>End-user connections</td>
<td>133</td>
<td>53 + 16</td>
<td>26 + 19</td>
<td>247</td>
</tr>
<tr>
<td>Commissioning</td>
<td>June 2014</td>
<td>June 2015</td>
<td>June 2015</td>
<td></td>
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</table>
Ghana Energy Development and Access Project (GEDAP) is focusing on rural electrification of isolated communities by Mini-grids.

### Community PV Rural Mini-grids in Volta Islands in Ghana

<table>
<thead>
<tr>
<th>Community</th>
<th>End-users</th>
<th>PV capacity (kW)</th>
<th>Wind capacity (kW)</th>
<th>Battery capacity (kWh)</th>
<th>Inverter Power (kVA)</th>
<th>Commissioning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pediatorkope</td>
<td>144</td>
<td>39,0</td>
<td>11,0</td>
<td>338</td>
<td>48</td>
<td>Feb 2016</td>
</tr>
<tr>
<td>Atigagome 1</td>
<td>69</td>
<td>25,5</td>
<td>-</td>
<td>203</td>
<td>16</td>
<td>Apr 2016</td>
</tr>
<tr>
<td>Atigagome 2</td>
<td>51</td>
<td>22,5</td>
<td>-</td>
<td>203</td>
<td>16</td>
<td>Apr 2016</td>
</tr>
<tr>
<td>Aglakope</td>
<td>124</td>
<td>48,0</td>
<td>-</td>
<td>338</td>
<td>40</td>
<td>Apr 2016</td>
</tr>
<tr>
<td>Kudorkope</td>
<td>175</td>
<td>54,0</td>
<td>-</td>
<td>407</td>
<td>48</td>
<td>Apr 2016</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>563</strong></td>
<td><strong>189</strong></td>
<td><strong>11</strong></td>
<td><strong>1489</strong></td>
<td><strong>168</strong></td>
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</tbody>
</table>
Technical aspects

- Added value solutions
- Transportation, assembly, installation
- Pergola structure
- Battery temperature
Technical aspects II

- Local capacity building
- Involving the local community in the installation works
- Preassembled, prewiring, labelling
Management Model

- Service-based tariff model
- Energy Daily Allowance (EDA) & dispensers
- Local delegated management
- Demand sizing
- Precontract, contract, service operation

<table>
<thead>
<tr>
<th>Tariffs</th>
<th>Code (Tky)</th>
<th>Monthly cost (CFA)</th>
<th>EDA (Wh/day)</th>
<th>Maximum power (kW)</th>
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</thead>
<tbody>
<tr>
<td>T11</td>
<td>4.100</td>
<td>550</td>
<td>0.5</td>
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<tr>
<td>T21</td>
<td>11.200</td>
<td>1.100</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>T41</td>
<td>22.000</td>
<td>2.200</td>
<td>0.5</td>
<td></td>
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<tr>
<td>T72</td>
<td>38.600</td>
<td>3.850</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>T82</td>
<td>43.900</td>
<td>4.400</td>
<td>1.0</td>
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Service-based tariff model

- "Bonus" and "restriction" periods according to energy availability
- It can be done through communication ports/cable or frequency
- Users: electricity price signals sent through Dispensers
- Non-critical loads through auxiliary relay

EDA effects on consumer habits (SESAM-ER Project Cape Verde), Source: TTA

"Mini-grid" Function by Studer
- Battery cycle voltage reference (per example 27.2 floating voltage)
- Battery under voltage level
- Voltage range to work:
  - 0.5V for 12V system
  - 1V for 24V system
  - 2V for 48V system
Operation and Maintenance

**Level 1**
Local Management

- Local management adapted to the context
- Specialized technicians involved from the inception
- Training on the job, capacity building

**Level 2**
Specialized Technician

Some results from the operation:
- Upgrades
- 100% Payment ratio
- Modules broken
- Multiplying effect in neighbour communities
- Change in habits

**Level 3**
Operator / Service Agent
Logistics

- Transport to the project site (material and personnel)
- Customs
- Personnel management (personnel sourced locally, team mobilization, etc.)
- Equipment, tools for installation: specific tools to be transported, material that can be sourced locally, etc.
- Contacts at the project site and local institutions
- Local regulations
- Material storage during construction
- Security
Social Aspects

Social aspect is the key for success
- Adapting to the context
- Community engagement, sense of belonging
- Capacity building
- Empowering beneficiaries
- Make the best out of electricity
Why Studer

- Added value solutions
  - Robust, reliable
  - Scalable, modular, flexible
  - Remote monitoring (SMS, GSM, LAN)
  - System Analysis Tool
  - Frequency Mode, Mini-grid function
  - Automatic start of the generator
  - Maximizing the use of excess energy
- Products adapted to the customer
  - Technical Support
  - Tailored training
Thank you for your attention

Meet our team

• Products showroom
• Demonstrations
• Product introduction training
• “Minigrids with Studer” sessions
• Tailored training

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