MINI-GRID, THE MISSING MIDDLE, AN OPPORTUNITY!

Abidjan, March 2017
NESP AT A GLANCE

- **Technical cooperation** programme
- Aim: Enabling framework for RE, EE and **Rural Electrification** (focus on mini-grids).
- Funded by **European Union and Germany**
- Implemented by FMPWH, states (Niger, Ogun, Cross River, Plateau, Sokoto) and GIZ
- Duration: **5 years** (03/2013 – 02/2018)
- As concerns our mini-grid activities, we cover the full spectrum (holistic approach)
  - TA on policy (e.g. PPP Guidelines) and regulation on State and Federal levels
  - TA on electrification planning (provides market intelligence to private sector)
  - TA and capital grants to private sector for mini-grid development
  - TA to financiers and investors interested in investing in the mini-grid sector
WHAT IS A MINI-GRID?

Definition: Any electricity supply system with its own power generation capacity supplying electricity to more than one customer connected via a low or medium voltage distribution grid and which can operate in isolation from the main grid. Interconnected mini-grids are also possible.

Three major components:
- Production: Generation (renewable energy and diesel genset - for backup), Storage (batteries and charge controller), Converters (e.g. inverter), system management (IT equipment) and bus bar (wiring connecting for all production equipment)
- Distribution: subsystem distributing the produced electricity to the users consisting of wiring (DC/AC and single or three phase and overhead or underground)
- Load: all the equipment on the end-user side (e.g. meters/load limiters, internal wiring, grounding and the electric appliances)

Link to Renewable Energies: Mini-grids can be powered with conventional energy systems such as diesel generators. However, technology development in the renewable energy sector and the resulting drop in the price of RE components has led to the progressive replacement of diesel generators as main the power generation source for mini-grids.

EXAMPLE OF A SOLAR MINI-GRID – POWERSTATION

Photo: INENSUS GmbH
EXAMPLE OF A SOLAR MINI-GRID – POWERSTATION

Source: Rubitec Utilities, Solar Hybrid Mini-Grid in Ogun, 2016
Mini-grid space

Most reliable solution (24/7) for large villages far away from main grid with productive users, but development is resource intensive leading to high tariffs.

Source: EUEI-PDF, Mini-grid policy toolkit, 2014
Off grid systems supports many levels of energy need

<table>
<thead>
<tr>
<th>Africa progress panel</th>
<th>Tier 0</th>
<th>Tier 1</th>
<th>Tier 2</th>
<th>Tier 3</th>
<th>Tier 4</th>
<th>Tier 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy service</td>
<td>Task lightning, phone Charge</td>
<td>General lightning, TV and fan</td>
<td>Tier 2 and medium powered appliances</td>
<td>Tier 3 and high powered appliances</td>
<td>Tier 4 and very high powered appliances</td>
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<tr>
<td>Capacity</td>
<td>&lt; 12 Wh</td>
<td>&lt; 200 Wh</td>
<td>&lt; 1 kWh</td>
<td>&lt; 3,4 kWh</td>
<td>&lt; 8,3 kWh</td>
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<tr>
<td>Solar product</td>
<td>Solar lantern</td>
<td>Solar lantern + charger</td>
<td>Small SHS</td>
<td>Large SHS</td>
<td>Larger SHS</td>
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<td>Mini Grid</td>
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### Comparison of rural electrification technologies

<table>
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<tr>
<th>ADVANTAGES</th>
<th>MAIN GRID</th>
<th>MINI-GRID</th>
<th>STAND-ALONE</th>
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<tbody>
<tr>
<td></td>
<td>• Cheapest solution (near urban areas)</td>
<td>• Flexibility in technical design and operational models</td>
<td>• Independent solution</td>
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<td></td>
<td>• CAN provide unlimited power supply</td>
<td>• Reliable power supply</td>
<td>• Easy to install and replicate</td>
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<td></td>
<td>• Most scalable option</td>
<td>• Scalable</td>
<td>• Can be deployed on a purely commercial basis</td>
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<tr>
<td></td>
<td>• Cheapest solution (near urban areas)</td>
<td>• Can power productive users (tier 4 and 5)</td>
<td>• Provides a very limited power supply</td>
</tr>
<tr>
<td></td>
<td>• CAN provide unlimited power supply</td>
<td>• Cheap in rural areas</td>
<td>• Most expensive solution (at least in Nigeria)</td>
</tr>
<tr>
<td></td>
<td>• Most scalable option</td>
<td>• Technology advancing rapidly (lower cost/kWh)</td>
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<table>
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<tr>
<th>DISADVANTAGES</th>
<th>MAIN GRID</th>
<th>MINI-GRID</th>
<th>STAND-ALONE</th>
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<tbody>
<tr>
<td></td>
<td>• Expensive in the rural areas</td>
<td>• Resource intensive projects</td>
<td>•</td>
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<td></td>
<td>• Not a target area for DisCos (slow expansion)</td>
<td>• Dependent on regulation (agreements between partners)</td>
<td>•</td>
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<td></td>
<td>• Depends on the backbones from DisCo, TSP and GenCo</td>
<td>• Need subsidies</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>• Expensive in the rural areas</td>
<td>• Limited power supply (Mgt. of demand)</td>
<td>•</td>
</tr>
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<td></td>
<td>• Not a target area for DisCos (slow expansion)</td>
<td>• Higher tariffs than main grid</td>
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This programme is funded by the European Union and the German Government
## Advantages and disadvantages of mini-grid models

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<th>Africa progress panel</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
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</table>
| **Utility model**     | - Experience  
- Access to policymakers  
- Uniform tariff  
- Scalable | - Lack incentives  
- Inefficient  
- Public finance only |
| **Private model**     | - Good competences  
- Market driven  
- Decentralized mgt.  
- Can attract priv. finance | - Upfront finance  
- Sector lacks experience  
- Tariffs and relations  
- Policy and reg. framework |
| **Community model**   | - Community buy-in  
- Meet the demand  
- Empower local people | - Lack of technical experience  
- Lack of management skills  
- Decision-making slow |
| **Public-private model** | - Combines advantages  
- Responsibilities optimized | - Difference in management sys.  
- Strong framework required |
What is the demand

- IEA estimates that 140 M people in Africa will gain access to mini-grids in Africa. Requiring installation of 4000 – 8000 mini-grids a year in 25 years!
- Nigeria: 4000 sites – 13 Million people (GIZ mapping on GIS)
- Benchmark in Nigeria: Euro 572/house hold connection
- Investment need in Nigeria: 2 billion Euro
- Capacity: 1,8 GWp
Productive loads key to scale

INTEGRATION
- Productive loads allow for economies to scale
- This in turn improves the profitability

CHALLENGES
- Social
  - Change of habits
- Economic
  - Productive tariffs need to compete against diesel
  - Investment hurdle related to mechanization
- Technical
  - Load/Demand management, e.g. avoid pumps and/or mills etc. running on batteries

KEY PRODUCTIVE USERS

Photos: GIZ India
This programme is funded by the European Union and the German Government

ENABLING FRAMEWORK FOR PRIVATE MINI-GRIDS

- **Strong interest** on federal and state levels as concerns off-grid solutions
- **Deep understanding** of mini-grids at key MDAs (e.g. FMPWH or NERC)
- Conducive **legislative and policy frameworks** for private mini-grids
- Mini-grid **regulation** (supported by NESP) has been approved by NERC
  - Compensation for mini-grid operators in case of main-grid connection
  - Tariff calculation methodology allowing for reflective tariffs
- NESP partner states are developing mini-grid **PPP frameworks**
- **Financiers**, some supported by NESP, are lending (e.g. BoI, bettervest)
MARKET HAS MATURED

• When NESP started
  ▪ Privately-led *mini-grids in operation* (but 100% grant funded)
  ▪ Technically and financially *capable local companies*

• In 2015, NESP carried out nationwide *Guided Idea Competition* to pilot *PPP model*
  ▪ Out of 100+ companies, 8 were retained, *4 PPPs signed* and *5 pilots*
  ▪ NESP provides *TA* and *grant* to offset ~40% of project’s capital expenditure
  ▪ Private partners contribute with their *manpower* as well as *debt/equity*
  ▪ State Governments contribute by covering *regulatory costs*

• Attracted by conducive framework, *international companies* now scouting market
Light emission image of Nigeria
This programme is funded by the European Union and the German Government

Clusters in Ogun State
Electrification maps

Example of electrification map for Niger State

Disclaimer: Preliminary results of an ongoing intervention which may not correspond completely to the current electrification status of Niger State.
Now that market is mature, we need to concentrate on scale!!!!

13M Nigerians living in areas viable for off-grid PV mini-grids

Potential for nearly 4000 mini-grids with a PV capacity of 1.8 GWp

Potential capital investment estimated at 2 billion Euros

Source: NESP, “Preliminary analysis for off-grid PV capacities for the whole of Nigeria”, 2015
NESP plans for roll out phase

- Support preparation of **replication strategies**
  - Up to 10 projects per private partner – ~50 projects in total
  - Total investment portfolio = 25M EUR
- Support **20 new projects** with 40% capital grant and TA
- Seek **collaborations with investors** to match-make them with its private partners
- Provide **technical, financial and legal advice** to investors
Thank you!

Nigerian Energy Support Programme (NESP)

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