Financing Universal Access to Energy

Where we are, and where we need to go

Itamar Orlandi, CFA

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# About Bloomberg New Energy Finance

## Clean Energy

- Solar
- Wind
- Storage
- Decentralized Energy
- Frontier Power
- Impact on Power & Utilities

## Advanced Transport

- Electrified Transport
- Autonomous Driving
- Shared Mobility
- Impact on Transport
- Impact on oil demand

## Commodities

- LNG & Gas
- Oil & Products
- Power
- Carbon

## Emerging Technologies

- Internet of Things
- Machine Learning & Analytics
- Advanced Materials
- Impact on Industrials and Energy
Global population by electricity access status

Million people

Source: Bloomberg New Energy Finance
Economic development on its own will not solve this

Electrification rates when reaching $1,000 GDP per capita

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Electrification rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vietnam</td>
<td>2011</td>
<td>96%</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>2015</td>
<td>85%</td>
</tr>
<tr>
<td>Pakistan</td>
<td>2008</td>
<td>85%</td>
</tr>
<tr>
<td>India</td>
<td>2006</td>
<td>68%</td>
</tr>
<tr>
<td>Lao PDR</td>
<td>2006</td>
<td>66%</td>
</tr>
<tr>
<td>Cambodia</td>
<td>2016</td>
<td>60%</td>
</tr>
<tr>
<td>Myanmar</td>
<td>2005</td>
<td>26%</td>
</tr>
<tr>
<td>Senegal</td>
<td>2003</td>
<td>53%</td>
</tr>
<tr>
<td>Ghana</td>
<td>2004</td>
<td>49%</td>
</tr>
<tr>
<td>Kenya</td>
<td>2012</td>
<td>27%</td>
</tr>
<tr>
<td>Mauritania</td>
<td>2002</td>
<td>23%</td>
</tr>
<tr>
<td>Zambia</td>
<td>2010</td>
<td>19%</td>
</tr>
</tbody>
</table>

Source: Bloomberg New Energy Finance, World Bank
India's quarterly rural household electrification

Million households

Source: Bloomberg NEF, India’s Ministry of Power
India's quarterly rural household electrification

Million households

Source: Bloomberg NEF, India's Ministry of Power
Cost of delivered energy

Cost of delivered energy for rural customers

$/kWh (real 2017)

- Retail tariffs + grid extension
- Retail tariffs
- Microgrid
- Microgrid with daytime load
Cost of delivered energy

Cost of delivered energy for rural customers

- Grid extensions more than double the cost of electricity
Cost of delivered energy

Cost of delivered energy for rural customers

- Grid extensions more than double the cost of electricity
- Microgrids are competitive with the grid

![Graph showing cost of delivered energy for different scenarios: Retail tariffs + grid extension, Retail tariffs, Microgrid, and Microgrid with daytime load.](image)
Cost of delivered energy

Cost of delivered energy for rural customers

- Grid extensions more than double the cost of electricity
- Microgrids are competitive with the grid
- Productive loads reduce the cost of microgrid electricity
Cost of delivered energy

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- Grid extensions more than double the cost of electricity
- Microgrids are competitive with the grid
- Productive loads reduce the cost of microgrid electricity
- Solar home systems need super-efficient appliances
Distribution makes up the majority of costs

Evolution of the typical cost per system ($)

Source: Bloomberg NEF
Cost of delivered energy

Cost of delivered energy for rural customers

- Grid extensions more than double the cost of electricity
- Microgrids are competitive with the grid
- Productive loads reduce the cost of microgrid electricity
- Solar home systems need super-efficient appliances
Africa will spend the most on off-grid solutions

Projected household electrification capital spend, base case scenario 2018-30

Source: Bloomberg New Energy Finance. Note: East Africa refers to the six countries of the East African Community. Numbers may not add up due to rounding.
The gap to universal access remains overarching

$ billion

- Grid extensions: 82
- Microgrid: 38
- Solar home systems: 26
- On-grid power generation: 16
- Base case scenario: 162
- Gap: 191
- Universal access to electricity: 353

Source: Bloomberg New Energy Finance
Venture financing rose steadily

Source: Bloomberg NEF. Microgrid financing refers to rural microgrids for energy access only. *YTD as of October 2018
Venture financing rose steadily, but is that sustainable?

Source: Bloomberg NEF. Microgrid financing refers to rural microgrids for energy access only. *YTD as of October 2018
European energy majors are investing in energy access

<table>
<thead>
<tr>
<th>Company</th>
<th>Million people reached</th>
<th>Notable activities</th>
<th>Company</th>
<th>Million people reached</th>
<th>Notable activities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Top-5 utilities in EMEA</strong></td>
<td></td>
<td></td>
<td><strong>Top-5 utilities in AMER</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Enel</em></td>
<td>1.7</td>
<td>Microgrids in Africa, Latin America, Asia Pacific</td>
<td><em>Nextera Energy</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Iberdrola</em></td>
<td>3.9</td>
<td>Investment in off-grid solar firms, microgrids in Brazil</td>
<td><em>DUKE Energy</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>ENGIE</em></td>
<td>2.4</td>
<td>Acquired Fenix International, EPS</td>
<td><em>Southern Company</em></td>
<td></td>
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<tr>
<td><em>EDF</em></td>
<td>0.2</td>
<td>Off-grid solar in South Africa, Ivory Coast and Ghana.</td>
<td><em>Dominion Energy</em></td>
<td></td>
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<tr>
<td><em>National Grid</em></td>
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<td></td>
<td><em>Exelon</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Top-5 utilities in APAC</strong></td>
<td></td>
<td></td>
<td><strong>Top-5 oil majors globally</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>CyPC</em></td>
<td></td>
<td>Rural electrification in villages in Sabah, Malaysia</td>
<td><em>ExxonMobil</em></td>
<td>54</td>
<td>Investment in off-grid solar and microgrid startups.</td>
</tr>
<tr>
<td><em>Kajima Towngas</em></td>
<td></td>
<td></td>
<td><em>Shell</em></td>
<td>Unknown</td>
<td></td>
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<tr>
<td><em>CLP</em></td>
<td></td>
<td></td>
<td><em>Chevron</em></td>
<td></td>
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<tr>
<td><em>PERUSA</em></td>
<td></td>
<td></td>
<td><em>Total</em></td>
<td>10</td>
<td>Off-grid solar kits distribution through its partners in Africa.</td>
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<tr>
<td><em>NTPC</em></td>
<td></td>
<td></td>
<td></td>
<td>25</td>
<td></td>
</tr>
</tbody>
</table>

*SDG7 commitment with specific target* | *SDG7 commitment without specific target* | *No mention of the SDG7 in most recent annual report*

Source: Bloomberg New Energy Finance
There is a lot of potential for cross-sector partnerships

<table>
<thead>
<tr>
<th>Company 1</th>
<th>Company 2</th>
<th>Company 3</th>
<th>Company 4</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>BBXX</td>
<td>fenix intl</td>
<td>ENGIE</td>
<td>orange</td>
<td>Pay-as-you-go trial</td>
</tr>
<tr>
<td>PEG</td>
<td>BIMA</td>
<td>PRUDENTIAL</td>
<td></td>
<td>Micro health insurance</td>
</tr>
<tr>
<td>mobisol</td>
<td>TECNO</td>
<td>MTN</td>
<td></td>
<td>$2.4/month smartphone plans</td>
</tr>
<tr>
<td>SOLAR KIOSK</td>
<td>ZIB</td>
<td>SES</td>
<td></td>
<td>WiFi – enabled kiosks with cold drinks</td>
</tr>
<tr>
<td>Azuri</td>
<td>zuku</td>
<td></td>
<td></td>
<td>Pay-as-you-go 24” satellite TV</td>
</tr>
</tbody>
</table>

Source: Bloomberg New Energy Finance
Potential alternatives for last-mile connectivity

- **Cell Tower**
  - Grid or solar hybrid
  - (1,500 – 3,000 Watts)

- **Small Cell Antenna**
  - Solar
  - (50-100 Watts)

- **Wifi Hotspot**
  - Solar
  - (50-100 Watts)

*Source: Bloomberg New Energy Finance, Facebook*
Developing countries are only starting to adopt mobile data

Microgrid dispatch profile with an evening peak...

Source: Bloomberg New Energy Finance.
Developing countries are only starting to adopt mobile data

Microgrid dispatch profile with an evening peak...

...and with added midday demand

Source: Bloomberg New Energy Finance.
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