Battery Storage Market Structure in Emerging Economies
1018 MW in operation & construction
Lekela in Senegal

- Parc Eolien Taiba N’Diaye (PETN):
  158 MW wind farm, commissioning starting this month

- Battery storage offering
Utility-scale storage pipeline in Africa and the Middle East

Egypt: 20 MW solar + 30 MW storage

Senegal: (IPP) > 80 MWh in development (some solar embedded)

The Gambia: (IPP) 50 MW solar + storage

Guinea Bissau: (IPP) 2 MW solar-diesel-storage

Nigeria: (IPP) 15 MW solar + 5 MW storage

Central African Republic: 25 MW solar + 25 MWh storage

Lebanon: (IPP) > 210 MW solar + > 70 MW storage

Jordan: (IPP) 30 MW / 60 MWh storage Solar + 4 MW / 12 MWh storage

Lebanon: (IPP) 30 MW / 60 MWh storage Solar + 4 MW / 12 MWh storage

Chad: (IPP) 60 MW solar + 4 MWh storage

Kenya: (IPP) 40 MW solar + storage

Zambia: (IPP) 100 MW solar + storage

South Africa: 360 MW / 1.2 GWh storage
Regulatory challenges for storage in Africa

- PPAs for existing generators contracted at 100% capacity
- No electricity markets
- No ancillary services markets
- High regulatory uncertainty and future power sector reform
In emerging markets, grid operator, not the market, decides storage strategy

- How many MWs?
- Allow degradation or fixed capacity?
- For how many years?
- What services needed?
- Who owns it?
- Who dispatches it?
### Storage in fully liberalized power sectors

Possible revenue streams for battery storage:

<table>
<thead>
<tr>
<th>Network value:</th>
<th>Cost recovery via regulated revenues of the SO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market value:</td>
<td>Revenues from bidding into competitive markets</td>
</tr>
<tr>
<td>State subsidies</td>
<td>(mainly for pilots)</td>
</tr>
</tbody>
</table>

Storage regulation is only evolving. Challenges include:

- Classification of storage
- Valuing revenue stacking
- Grid code design
- Creating markets for storage to bid into
## Storage business models

Market design, ownership and contractual structure determine which value storage may add:

<table>
<thead>
<tr>
<th>Owner Value harvested</th>
<th>System operator</th>
<th>IPP (capacity sales, tolling agreement, merchant)</th>
<th>IPP (hybrid models, storage-as-a-service)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network value</td>
<td>T&amp;D deferral System and ancillary services</td>
<td>Capacity for provision of T&amp;D services contracted with the SO</td>
<td>–</td>
</tr>
<tr>
<td>Market value</td>
<td>–</td>
<td>Energy arbitrage Bidding into ancillary services markets</td>
<td>–</td>
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</tbody>
</table>
What policies and regulations are needed now?

- Start the first projects quickly!
  - Grid instability costs Senegal > $100m per year
- Long term capacity leases if market opportunities are absent
- Update grid codes
  - Create market instruments that capitalise the fast response speed of batteries
  - Incentivize storage to replace expensive peak generation