CAR Power Sector Snapshot

Key power sector challenges:

- National power system is limited to the capital city: Bangui (around 800,000 inhabitants)
- Only one source of generation: Boali hydro partially unavailable
- Two substations 30 MVA for the entire capital city
- High technical and commercial losses
- 6 hours of power with frequent blackouts
- Manual dispatching. No control system
- Landlock country with difficult access (fuel supply is a very expensive option)

### Key Energy Sector Statistics

<table>
<thead>
<tr>
<th></th>
<th>SSA Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Access rate</strong></td>
<td>8%</td>
</tr>
<tr>
<td>Natural power system</td>
<td>Bangui</td>
</tr>
<tr>
<td></td>
<td>(around 800,000 inhabitants)</td>
</tr>
<tr>
<td><strong>Installed Capacity</strong></td>
<td>35 MW</td>
</tr>
<tr>
<td>(only 18 MW hydro and 7 MW diesel are operative)</td>
<td></td>
</tr>
<tr>
<td><strong>Annual Generation (2018)</strong></td>
<td>144 GWh</td>
</tr>
<tr>
<td>- From IPPs</td>
<td>0</td>
</tr>
<tr>
<td>- From Imports</td>
<td>0</td>
</tr>
<tr>
<td><strong>Transmission lines (2018)</strong></td>
<td>172 km - 66 kV</td>
</tr>
<tr>
<td><strong>Distribution lines (2018)</strong></td>
<td>877 km</td>
</tr>
<tr>
<td><strong>Transmission losses</strong></td>
<td>7%</td>
</tr>
<tr>
<td><strong>Distribution losses</strong></td>
<td>33%</td>
</tr>
<tr>
<td><strong>Bill collection rate</strong></td>
<td>67%</td>
</tr>
</tbody>
</table>
PURACEL project was designed to restore the power system

- Increase generation (solar)
- Improve reliability of the network
- Install a control system for generation, transmission and distribution
- Increase collection rate by installing prepayment meters
- Restore financial equilibrium to ENERCA
- Build capacity in the utility
Energy Storage within PURACEL

- The Government decided to look for alternative sources of generation to complement the limited hydro.
- Solar was a good alternative because the resource is abundant and international prices have declined drastically in the last years.
- However, the situation of the power system would not allow any variable generation without putting the stability in even a more dire situation.
- Energy storage was seen as the way forward for:
  - Supporting variable generation integration into a weak system by smoothing the solar generation.
  - Reasonably extending daytime generation to peak consumption times (early evening).
  - Providing some stability support to the grid.
- Project structure will be an EPC contract with 3 years O&M with capacity training for the national utility. After these 3 years, the utility will take over the plant (or extend the O&M contract).
- Specifically for energy storage, the RFP allows [preferently] the option of proposing a long-term capacity maintenance contract to ensure adequate capacity of the system throughout the lifetime of the project.
Project Description

• **Energy Storage System:** open technology with minimum requirements (maturity, temperature, efficiency)

• **Technical specifications:** size to be optimized by Bidders for dispatching requirements stated in the RFP. Initial estimation points to 25 MW/25 MWh.

• **Business model:** EPC + 3 years O&M. Preferred option to propose capacity maintenance agreement for the storage system for 15 years.

• **Environmental and social:** Studies were conducted. Land was government properties and not major issues were been encountered.
## Minimum technical specifications

<table>
<thead>
<tr>
<th>Feature</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of technologies (PV and BESS)</td>
<td>Open to bidders (all proposed Li-Ion)</td>
</tr>
<tr>
<td>Range of PV capacity (MWp)</td>
<td>Avoid excess of MWp to decrease LCOE</td>
</tr>
<tr>
<td>Minimum capacity of storage (MWh)</td>
<td></td>
</tr>
<tr>
<td>Requirements for technologies</td>
<td>Maturity of the technology</td>
</tr>
<tr>
<td>Minimum annual net generation</td>
<td>At point of interconnection (including RTE losses)</td>
</tr>
<tr>
<td>Production profile</td>
<td>20% of annual between 5 pm and 9 pm (5% each hour)</td>
</tr>
<tr>
<td>Network stability</td>
<td></td>
</tr>
<tr>
<td>Island mode</td>
<td></td>
</tr>
<tr>
<td>Storage degradation management</td>
<td>100% during the 3 years O&amp;M</td>
</tr>
</tbody>
</table>
Procurement process in CAR

• Challenging environment with understaffed PIU
• Hands-on implementation modality (WB support a procurement specialist)
• Procurement modality: RFQ+2 stages
  • Selection of appropriate bidders (4)
  • Only prefeasibility was conducted, the Bidders prepared a technical proposal in phase I
  • Only one Bidder was disqualified in RFP1
  • Lowest bid was abnormally low
• After RFP1 the technical configuration was fixed in around 25 MWp + 25 MWh
Main issues

• Technical capability on BESS by the implementation team
• Definition of needs is controversial without a proper analysis
• Analysis of technical proposal without a clear definition of needs
• Economic evaluation methodology
• Auditing of BESS suppliers proposed by Bidders
• Comparison of economic value vs cost
Evaluation

- Technical score based on features: 30% (All should comply with the minimum technical specifications)
- Economic score based on LCOE: 70%
- Lowest evaluated bidder (Bidder 3) was considered an abnormally low bid and was disqualified (OPRC approval)
- Finally awarded to Bidder 2
- Contract signed in December 2020 and awaiting construction
Lessons learnt

• Adequate previous feasibility is recommended

• A general expert consultant is needed along the process:
  • Feasibility
  • Technical specs
  • Bidding documents
  • Evaluation

• Clear requirements in terms of technology (BESS) is required

• Economic evaluation should be tested (real economic value for the system vs pure cost)
Thank you!

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Additional slides about weak power systems
Situation power system in CAR

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<thead>
<tr>
<th></th>
<th>CAR</th>
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</thead>
<tbody>
<tr>
<td>Supply</td>
<td>18 MW (hydro)</td>
</tr>
<tr>
<td>Interconnection</td>
<td>None</td>
</tr>
<tr>
<td>Reserve capacity</td>
<td>Hydro baseload</td>
</tr>
<tr>
<td>System control</td>
<td>None</td>
</tr>
<tr>
<td>PV project</td>
<td>20 MWp</td>
</tr>
<tr>
<td>BESS requirement</td>
<td>High. Due to lack of interconnection</td>
</tr>
<tr>
<td>Preliminary BESS</td>
<td>20-25 MWh</td>
</tr>
<tr>
<td>T&amp;D investments</td>
<td>Reinforcement in same IDA project</td>
</tr>
<tr>
<td>System control</td>
<td>New SCADA in same IDA project</td>
</tr>
</tbody>
</table>
Weak power systems vicious circle

- Scarce supply capacity – not covering demand, mainly during peak hours (evening)
- Unreliable networks with low T&D capacity and high technical losses
- Frequent outages and blackouts
- Reduced or inexistent reserve capacity
- Absence of network control systems
- Reduced resources for O&M activities
- Limited interconnection with other systems (island mode)
- Complicated integration of cheap and clean VREs
- Continuous unsustainable and unfriendly generation
How hybrid systems can break the circle?

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- Generation can be shifted to peak time
- Provides stable generation and may differ T&D investments
- Provide ancillary services
- Provide reserve capacity to stabilize the grid
- Investment in Control systems (*)
- Easy and cheap O&M
- Facilitate the operation as island mode

- Deployment of hybrid system VRE (solar) + storage
- Continuous and sustainable generation
Typical generation profiles

15 min period

Instable generation in days with irregular radiation
Generation profile with hybridization (PV+storage) – Smoothing mode
Generation profile with hybridization (PV+storage) – Flat mode