Hybrid PV+Batteries in Central African Republic (CAR)

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CAR Power Sector Snapshot

Key Energy Sector Statistics		SSA Rank
Access rate	8%	**38**
Installed Capacity	35 MW (only 18 MW hydro and 7 MW diesel are operative)	**40**
Annual Generation (2018)	144 GWh	**36**
- From IPPs	0	
- From Imports	0	
Transmission lines (2018)	172 km - 66 kV	**29**
Distribution lines (2018)	877 km	**28**
Transmission losses	7%	
Distribution losses	33%	
Bill collection rate	67%	

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)

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

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

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

	CAR
Supply	18 MW (hydro)
Interconnection	None
Reserve capacity	Hydro baseload
System control	None
PV project	20 MWp
BESS requirement	High. Due to lack of interconnection
Preliminary BESS	20-25 MWh
T&D investments	Reinforcement in same IDA project
System control	New SCADA in same IDA project

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?

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 (*)

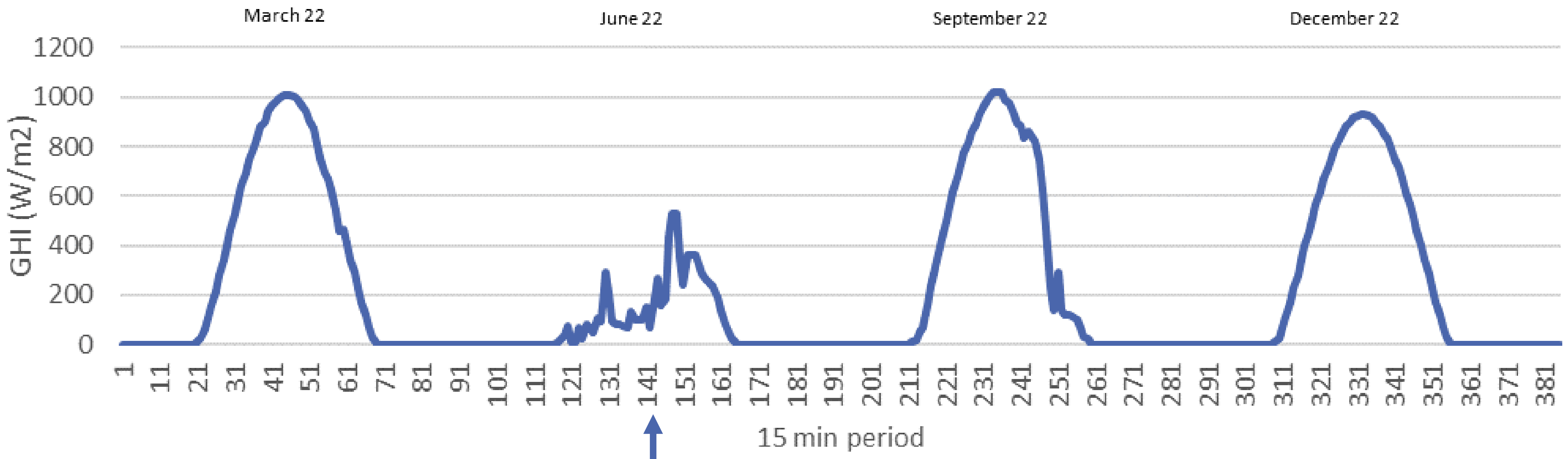
Easy and cheap O&M

Facilitate the operation as island mode

Deployment of hybrid system VRE (solar) + storage

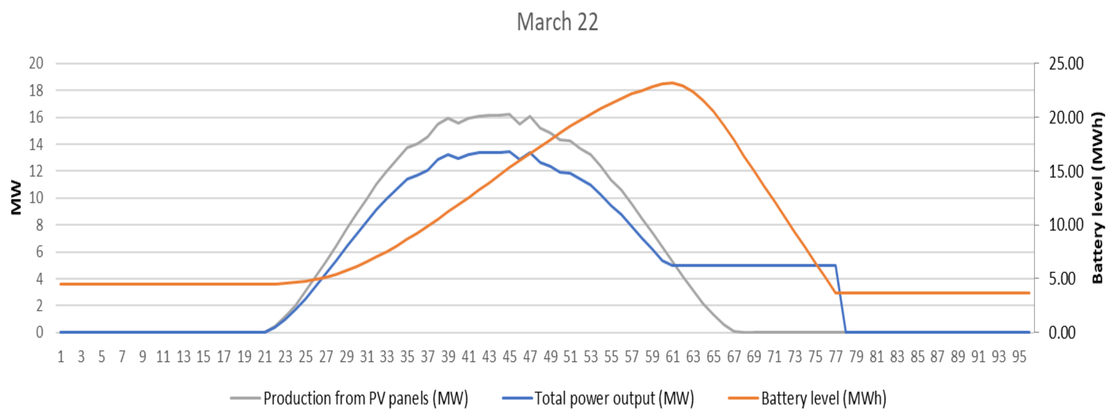
Continuous and sustainable generation

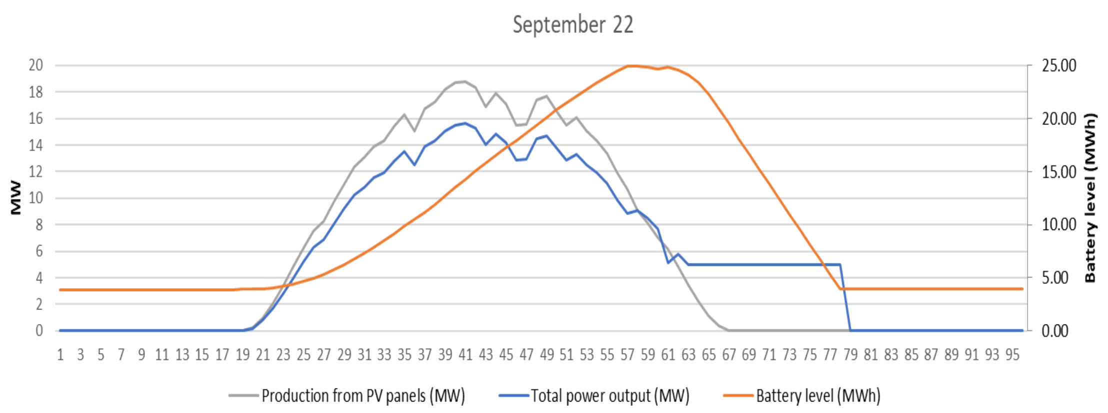
Typical generation profiles

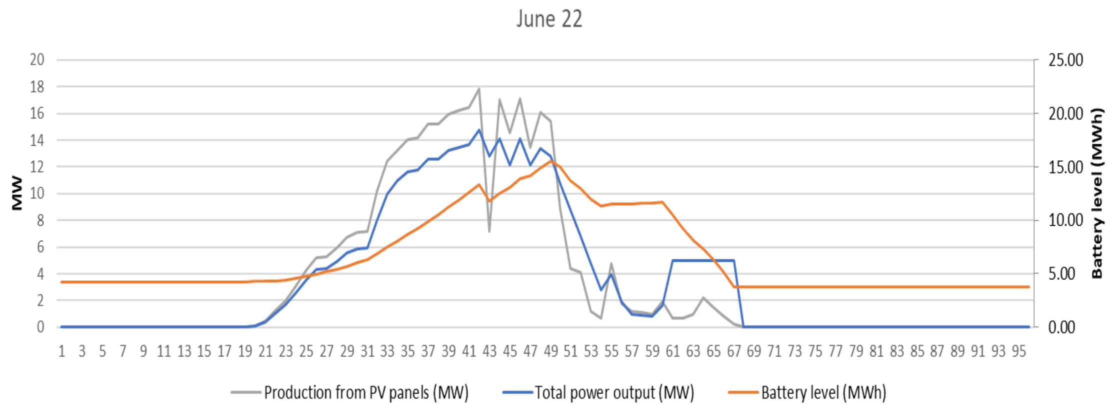


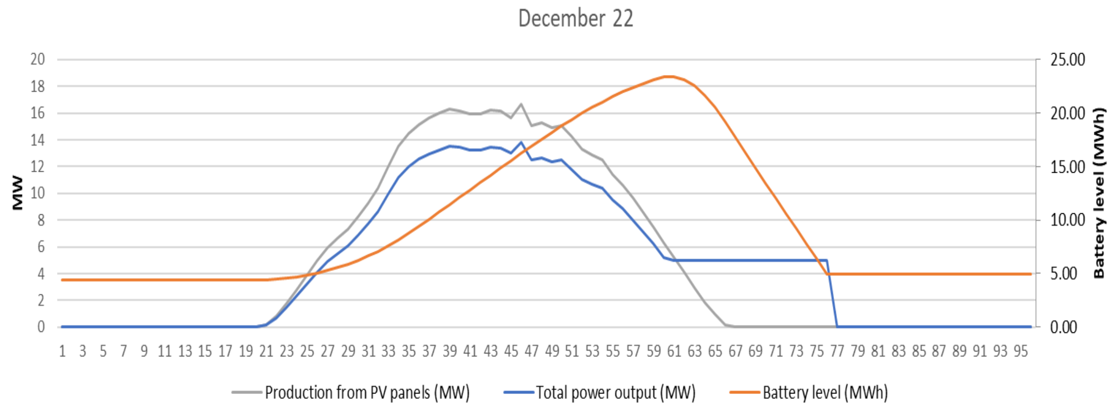
Instable generation in days with irregular radiation

Generation profile with hybridizatio (PV+storage) – Smoothing mode

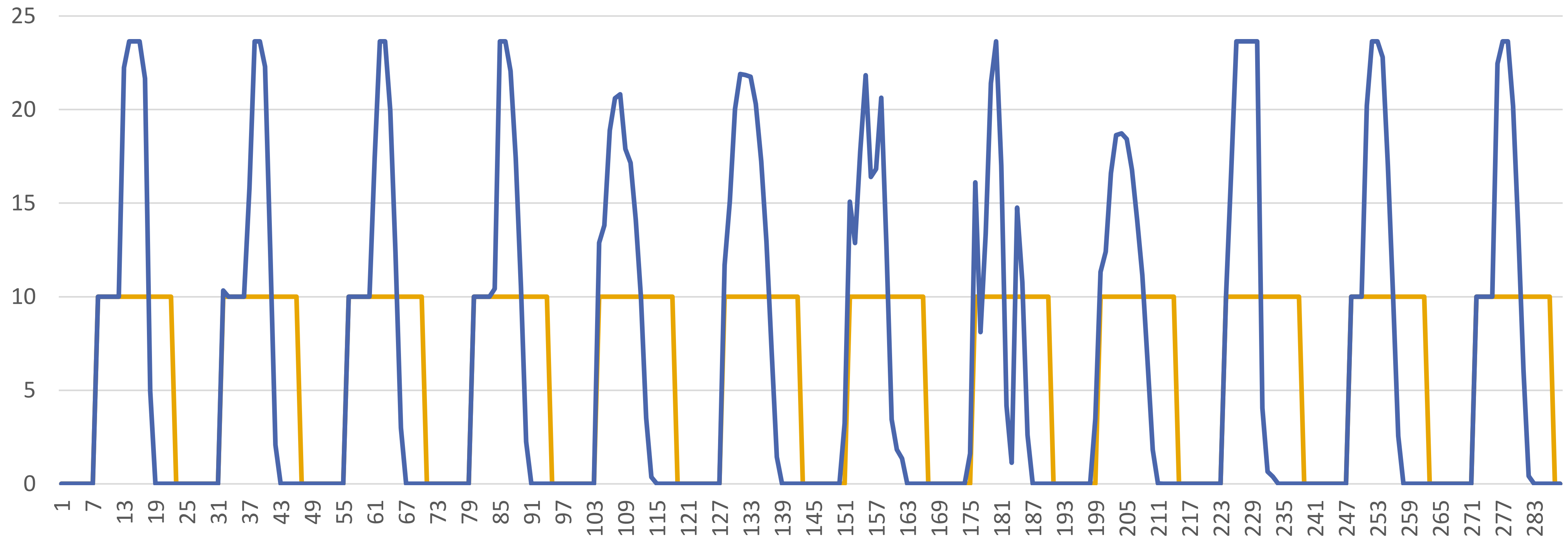








Generation profile with hybridization (PV+storage) – Flat mode



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