Energy storage in RMIPP and beyond

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BUSHVELD ENERGY

Context about the speaker

Mikhail Nikomarov
Chief Executive Officer
Bushveld Energy

- Co-founder and Chief Executive Officer of Bushveld Energy
  - Investment in BESS supply chain, including SA manufacturing and international BESS OEMs
  - Developer of projects requiring long duration energy storage solutions
  - Part of London-listed Bushveld Minerals, an integrated vanadium company
- Chairman of the South Africa Energy Storage Association (SAESA)
- Chair of the Energy Storage Committee of Vanitec, the global association of vanadium producers
- Previously a consultant in Russia and across Africa, focusing on the power sector (strategy and plant operations) and economic development

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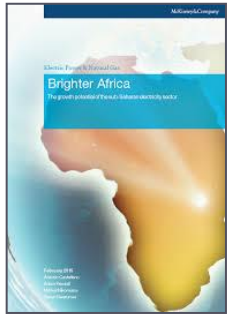


RMIPP procurement round built on a nascent but rapidly growing energy storage market in South Africa

- The energy storage (ESS) sector in South Africa is nascent, but has a strong foundation and significant momentum.
- Significant appreciation exists for storage:
  - Nearly 3GW of pumped hydro storage already on the grid.
  - 300MW of thermal storage procured with CSP and molten salt storage in previous IPP rounds.
- Battery ESS (BESS) deployments are starting to sprout:
  - Increased load shedding led consumers and businesses to start installing behind the meter storage (usually with solar PV).
  - Eskom started a 1,400 MWh BESS procurement programme in 2020, with the issue of a first tender for 80MW / 320 MWh of BESS storage.
  - Municipalities will follow.

The RMIPP design was especially favourable for battery storage, as it required dispatchability – not just not energy, as did prior IPP rounds

Dispatch-ability

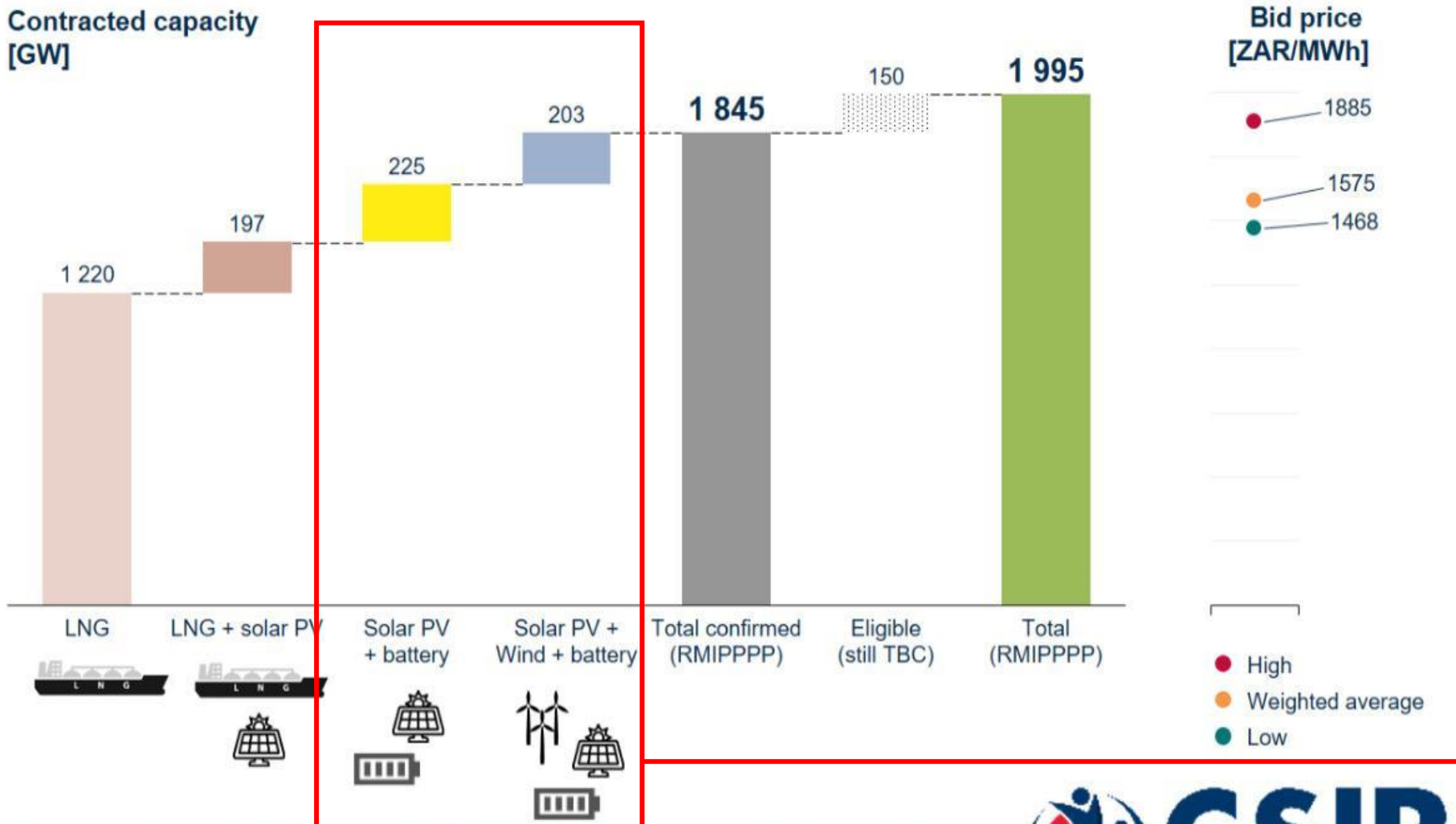
- A **dispatchable** source of electricity is one that can be turned on or off, particularly at the request of the system operator;
- The RMIPP tender design required over 17 hours of daily dispatchable capacity, necessitating bidders to use
  - A dispatchable generation technology, such as gas;
  - Renewable energy generation that would be made dispatchable through (a lot) of storage;
  - A combination of the above.

Delivery time

- The objective of the round was to put power on the grid ASAP, requiring delivery timelines of under 18 months;
- This severely limited technology options for energy storage, with only a very few specific types of battery technologies able to meet the deadlines;
- Given the nascent state of the SA ESS sector, it also doomed any material local content participation.

SOURCE: DMRE

Indeed, the RMIPP awarded projects includes gas, renewables plus storage or renewables plus gas



- 428MW in capacity was awarded to projects using BESS
- Half of the winning bids and 23% of the awarded capacity used BESS

NOTES: Minimum annual capacity factor is 50% (as defined in DMRE RMIPPPP RfP); Maximum offtake is based on 16.5 hrs/day dispatch window
3% of Contracted Capacity is reserved for instantaneous reserve provision
Sources: DMRE; CSIR analysis

Touching lives through innovation

Four major insights can be drawn from the bid results

Long duration

- While full details of the project designs are not out, BESS durations of anywhere from 6 to 16 hours were considered by bidders to meet the dispatchability requirements;
- In comparison, in the USA, the average BESS project is ~2 hours in duration

Technology selection

- Only battery ESS was used by successful bidders (and likely all bidders);
- The most likely successful technology is LFP (lithium ferro phosphate); however, NMC (nickel manganese cobalt) or NCA (nickel cobalt aluminium) are also possibilities as other types of lithium battery technologies

Costs

- The lowest bid was solar plus storage at R1,46/kWh (or just under USD 0.10/kWh), demonstrating that renewables plus storage is already the cheapest option for electricity generation in South Africa;
- The ESS-based bids might have been even more competitive
  - The renewable energy and BESS were larger and could benefit from further economies of scale (e.g. these were on average less than 1/3rd the size of the gas bids)
  - Other ESS technologies may be even cheaper for long duration
  - Bid rules permitted partial charging from the grid (as Eskom's BESS tender rules do)

Local content

- Similar to the Eskom BESS, local content will be limited to some civils and electrical interconnection work, with likely only 10-20% of the gross BESS capital expenditure realised in SA due to the compressed timeline

SOURCE: Bushveld Energy

Looking forward, the 2019 IRP's dedicated allocation for ESS alone is significant - over 2000MW of new capacity within 8 years

	Storage
Current Base	2 912
2019	
2020	
2021	
2022	513
2023	
2024	
2025	
2026	
2027	
2028	
2029	1575
2030	
TOTAL INSTALLED CAPACITY by 2030 (MW)	5000
% Total Installed Capacity (% of MW)	6.35
% Annual Energy Contribution (% of MWh)	1.2*

Existing capacity in South Africa of 2,912MW, principally Pumped Hydro (PHS)

New capacity of 513MW in the next 2 years, but it is unclear whether this includes or excludes:

- Eskom's BESS programme (350MW)?
- ESS co-located with generation, such as those in the RMIPP?

Further 1, 575 MW capacity of 513MW over the following 7 years

- Despite allocation in one year, may well be distributed over preceding years;
- May change over time, if newer IRP versions are promulgated in future;

- Total capacity of 5,000MW or 6.35% of entire power system;
- 1.2% of total electrical energy will go through storage in South Africa.

SOURCE: SA IRP2019; SAESA

The actual upside for storage within the IRP is higher due to solar, wind, embedded and "emergency" allocations

	PV	Wind	CSP	Gas & Diesel	Other (Distributed Generation, CoGen, Biomass, Landfill)
Current Base	1 474	1 980	300	3 830	499
2019		244	300		Allocation to the extent of the short term capacity and energy gap.
2020	114	300			
2021	300	818			
2022	400 1000	1600			
2023	1000	1600			500
2024		1600		1000	500
2025	1000	1600			500
2026		1600			500
2027		1 600		2000	500
2028	1000	1 600			500
2029	1000	1 600			500
2030	1 000	1 600			500
TOTAL INSTALLED CAPACITY by 2030 (MW)	8288	17742	600	6380	
% Total Installed Capacity (% of MW)	10.52	22.53	0.76	8.1	
% Annual Energy Contribution (% of MWh)	6.3	17.8	0.6	1.3	

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- The actual upside for storage within the IRP could be quite higher.
  - There is no detail on whether new storage is standalone or whether it includes storage that may be co-located with a generator.
  - Eskom's battery programme features both, with most of the storage in Eskom's plan standalone.

- There are three sources of potentially even higher amounts storage through co-location with:
  1. Solar PV – which is expected to add a further 6800 MW in generation through 2030;
  2. Wind – which is expected to add nearly a further 16000 MW in generation through 2030;
  3. Embedded generation –is an opportunity for small and medium sized storage.

SOURCE: SA IRP2019; SAESA

THANK YOU FOR YOUR ATTENTION

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