Commentary of 2016 Update Draft IRP assumptions and base case: Focus on energy storage

Public engagement workshop presentation – Limpopo

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BUSHVELD ENERGY

The draft IRP Update is a move forward for energy storage with one core amendment needed

Context

The recent draft IRP Update has taken a step forward in energy storage

- More technologies are included in the assumptions list
- Electrochemical batteries are considered in detail for the first time
- A distinct energy storage scenario (one of twelve) is planned to build on the Base Case

Commentary overview

One critical amendment is essential – namely that energy storage (ES) have its own distinct category and allocation in the IRP, similar to the distinct categories for generation technologies. This would include:

1. Recognition of growing need for and value from energy storage, as the power sector continues to transition in SA, in particular on the distribution grid;
2. Focus on distributed energy storage in particular, given its larger set of values for the system overall;
3. Being technology agnostic, taking into account emergence of new technologies and configurations;
4. Use of the most recent input data to calculate LCOE of storage and the technology's learning rates;
5. Value of the high local content and export potential from energy storage, as an emerging local industrial sector.

1. The only thing we know is that the power system is evolving and it will not be as it is today

Today

Today, we think of the power system as

- Distribution
- Transmission
- Generation
  - Base load
  - Mid-merit
  - Peaking
- Utility provides electricity and customers pay for energy and connection

In future (2020, 2035, 2050)

Multiple pathways, but definitively different

- Smart, responsive and resilient grids (less about hardware and more about control)
- More technology options
- Increasingly distributed generation and co-location of generation with load (less distinction among Gx, Tx and Dx)
- At utility level, more granular service provision and “pay per need” compensation

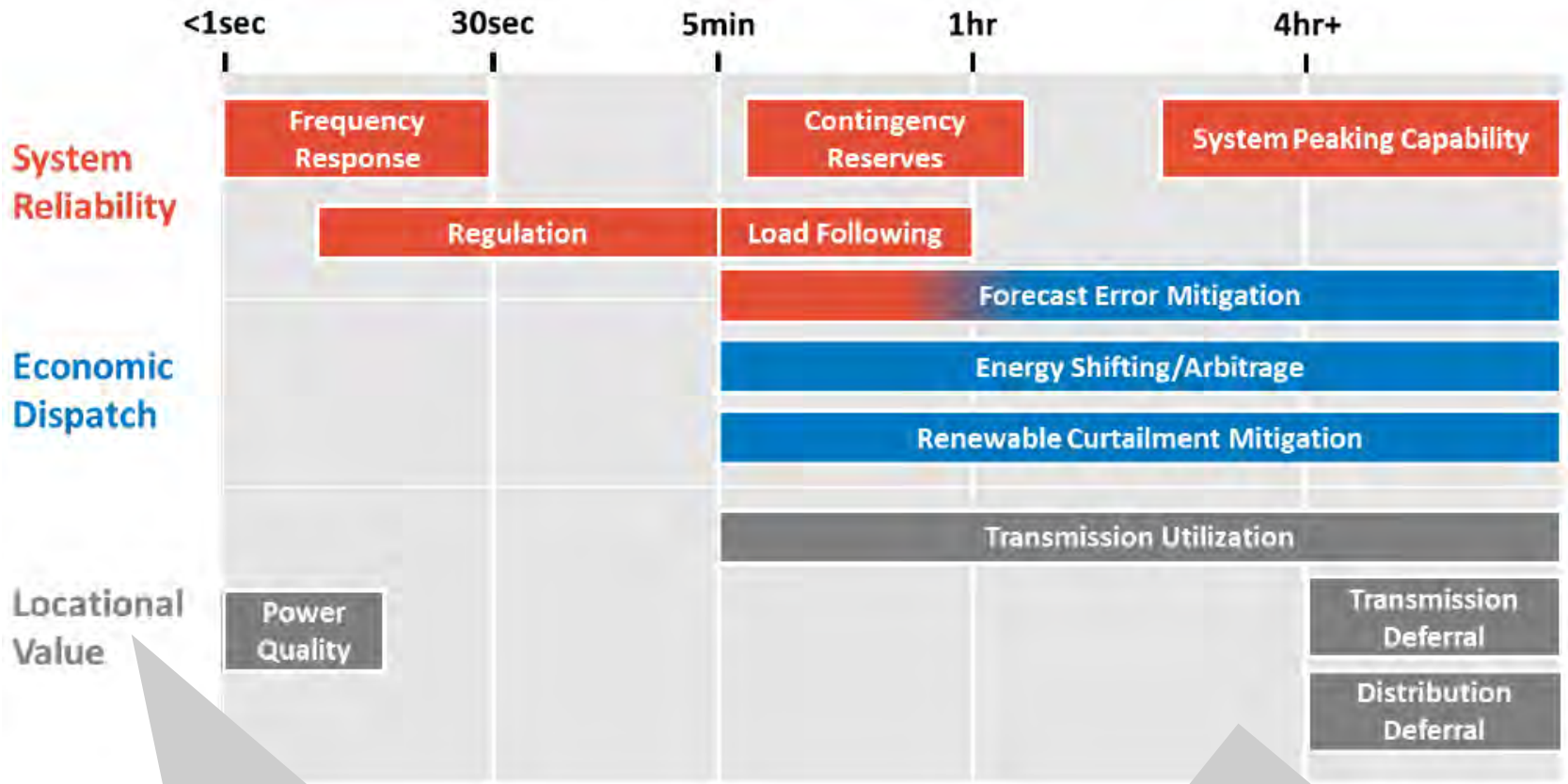
Recoginising the certainty in change but uncertainty in outcome, policy makers and planners have started to incorporate energy storage into their planned:

- PJM (US DoE)
- California
- China National Grid
- UK National Grid
- Japan’s METI
- …
- …
- South Africa?

Source: Press, agency websites

2. Battery storage in particular offers many confirmed benefits for a power system…

Energy storage use cases and their relevant time scales



Can only be provides by distributed storage technologies, usually of 1-10MW size

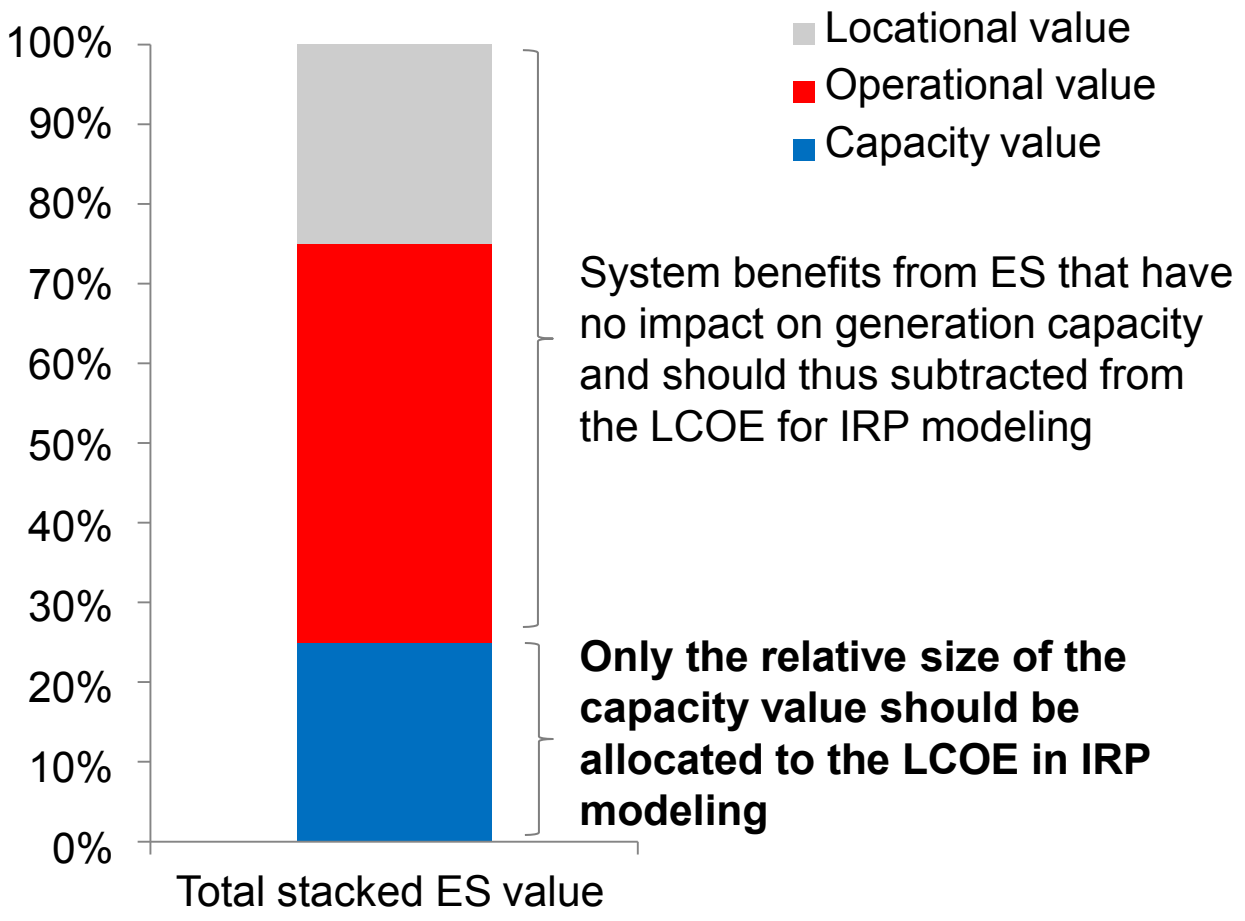
Other benefits such as
- Technical loss reduction
- Time shifting of losses
- System resiliency
- Customer UPS

Source: PGE IRP Draft (Nov 2016)

2. …, thus, costs should be allocated among the different uses, when one storage system serves multiple uses

IDICATIVE VALUES

Only the capacity portion of ES LCOE should be used for IRP modeling purposes



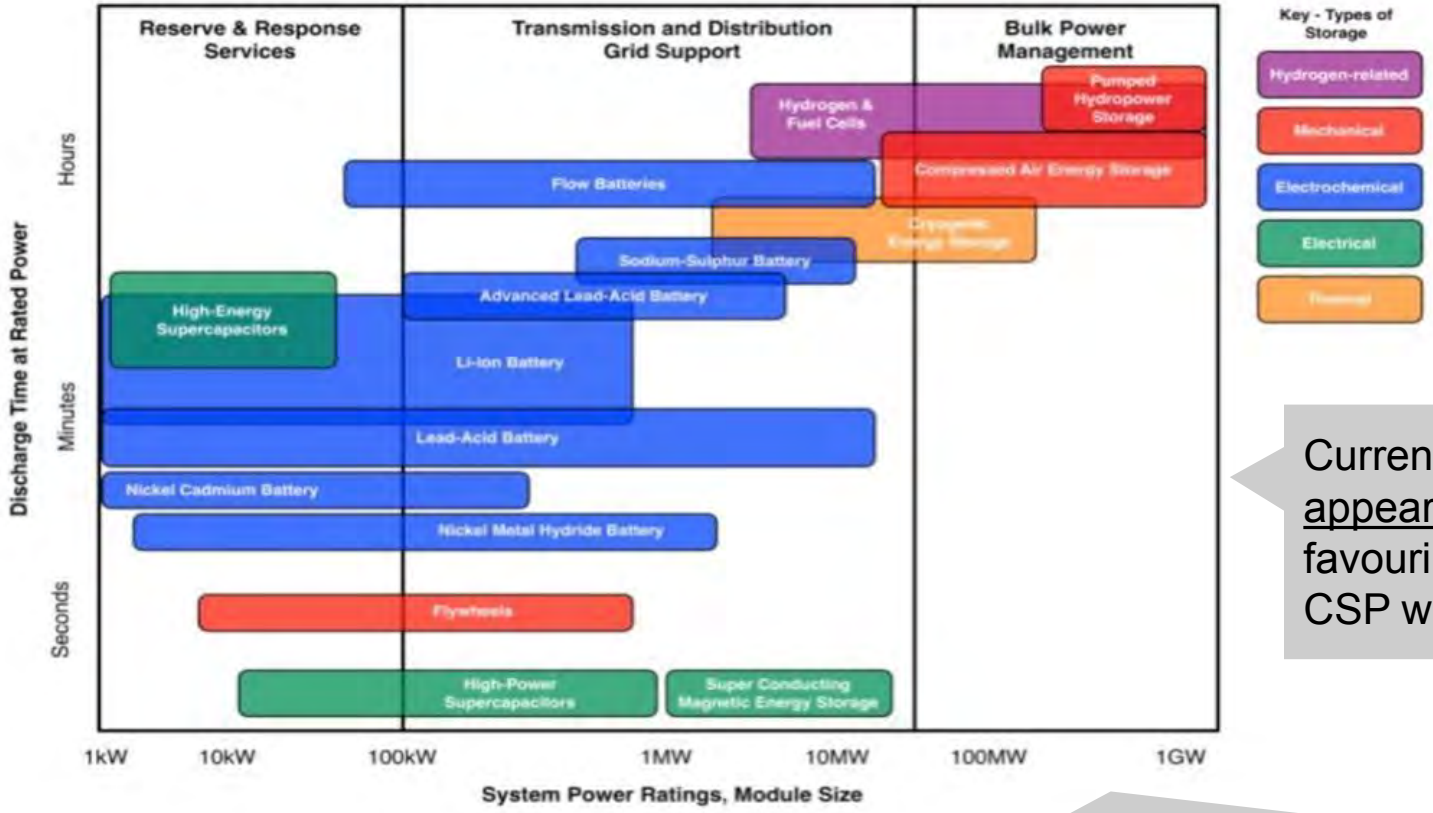
Notes:

- In this illustrative example, only 25% of the ES LCOE would be used for IRP modelling purposes
- These numbers are indicative and those specific to SA's grid are required
- International examples show the Operational value to be just over twice the Capacity value
- Data from the Energy Storage Industry Development programme (coordinated by IDC) can be used

Source: ESA IRP Primer v1.1; PGE IRP Draft (Nov2016)

3. It should be technology agnostic, as there multiple suitable ES battery technologies, including Vanadium Redox Flow (VRFB)

There are many ES technologies, including many commercially available batteries



Current IRP assumption appear exclusionary, favouring lithium-ion and CSP with storage

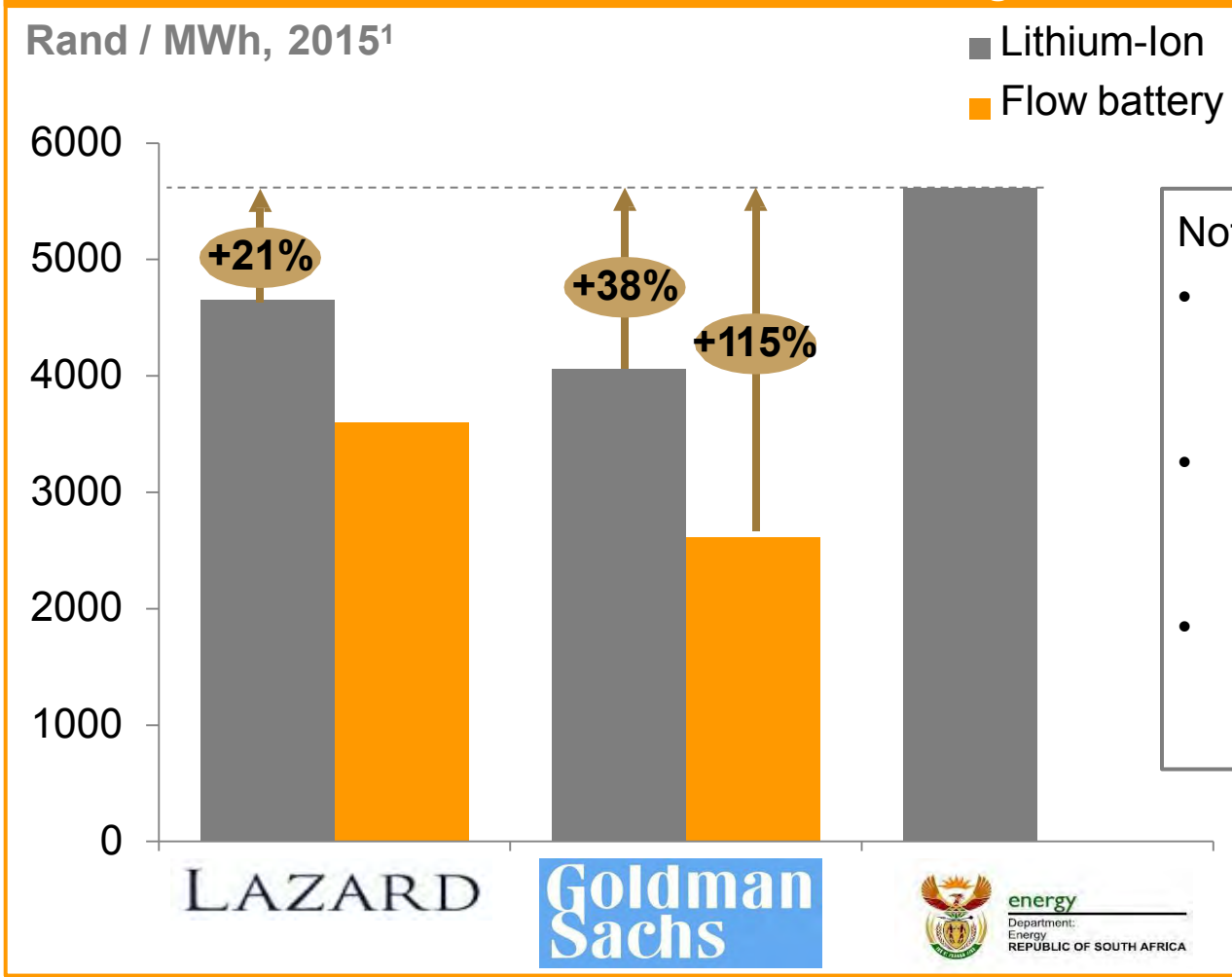
"*VRFB represents a mature and well understood energy storage technology that is well suited for energy intensive energy storage applications. The relative ease of vanadium electrolyte production and the availability of vanadium in South Africa further enhances the attractiveness of this specific flow technology*."

– insight from Parsons Engineering (part of USTDA RTM, April 2016)

Source: IRENA "BATTERY STORAGE FOR RENEWABLES: MARKET STATUS AND TECHNOLOGY OUTLOOK" (2015); USDTA / Parsons Engineering RTM, April2016

4. The current cost of storage is much less than what is used in the IRP and come down 15-25% per annum

Draft IRP LCOEs for lithium ion storage are 20-40% above 2015 levels and more than double other technologies



Notes:

- IRP assumptions materially higher than other reports, even using older data
- 2016 and future levels will be even lower with learning rates of 15-25% p.a.
- Cheaper technologies, such as flow batteries, should be considered

1 Assumed exchange rate of ZAR 14.5 = 1 USD

SOURCE: Lazard's Levelised Cost of Energy Storage Analysis – Version 1.0 (November 2015); Goldman Sachs "The Great Battery Race" Equity Research Report (October 2015); IRP 2016 Draft

5. Experience with energy storage from other regions suggests advantages of early and proactive action

Description

Context to California mandate

- Between 2010 and 2013, the California set a 1.3GW energy storage target to be met by 2020
- California produces ~197,000GWh of energy annually, or 10% less than Eskom (with a more flexible, gas oriented fleet and import/export ability)
- Due uncertainty, specific technologies were not mandated, although some restrictions and assumptions ensured that distributed forms of energy storage would be built to take advantage of the technology's value beyond "peak shaving," especially in electricity distribution

Economic impact beyond electricity

- California firms have become US market leaders in hardware, software, financing & development
- Major winners of the mandate are "*storage technology creators and companies that develop and build storage projects" as well as "banks or other investors who are willing to gamble in this new market*." – Gigaom.com

Lessons for us

- **Acceptable, even advantageous to move forward without complete data**
- **Consider not just local content but export potential, when evaluating "the creation of jobs and localisation"** (e.g. Bushveld is targeting up to 80% local content for VRFBs and exports to Africa)

SOURCE: CAISO; Gigaom.com; CESA - CALIFORNIA ENERGY STORAGE MARKET UPDATE (Sep2016)

In summary…

In the immediate time (current IRP Update) – distinct category for energy storage that is technology agnostic, independent of generation and focuses on the capacity benefits of storage. This will enable cost effective and early adoption.

In the medium term (next three years) – develop the IRP modelling further to use more granular resourcing that incorporates not just capacity benefits but other services (frequency, etc.) and includes the locational values. This would also include local costing from initial procurements.

Thank you for your attention and contribution.