Ecoult submission to the Australian Energy Market Commission

Five Minute Settlement

Reference: ERC0201

Stage: Consultation on request for rule change

Proponents: Sun Metals Corporation Pty Ltd

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Enquiries: robert.stevenson@ecoult.com

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Ecoult makes the following submission to the AEMC in respect of the proposed rule change (reference: ERC0201.)

It is Ecoult's view that the proposed rule change, if adopted, is likely to increase opportunities for applications on the Australian grid where energy storage is the most cost-effective solution to managing grid variability and peak pricing.

1. Existing grid storage

Today there is a considerable amount of battery energy storage on the world's electricity grids in the form of stand-by power. This is typically an application performed by high quality lead-acid batteries. In the USA there is in excess of 20 GW of power available on the grid from banks of lead-acid stand-by batteries (Australian figures are not known but are likely to be commensurate in magnitude with respect to the size of the Australian economy.)

Typical customers for such applications are data centres, utilities, hospitals and other critical loads.

The provision of stand-by power is a relatively steady-state application. The batteries are kept fully charged and are only discharged if the grid fails. Conceivably, therefore, the batteries may be only used very infrequently over their lifetime and as such, while they perform a useful service to the battery owner, they do not benefit the grid operator or the wider community in the way that more "active" storage could.

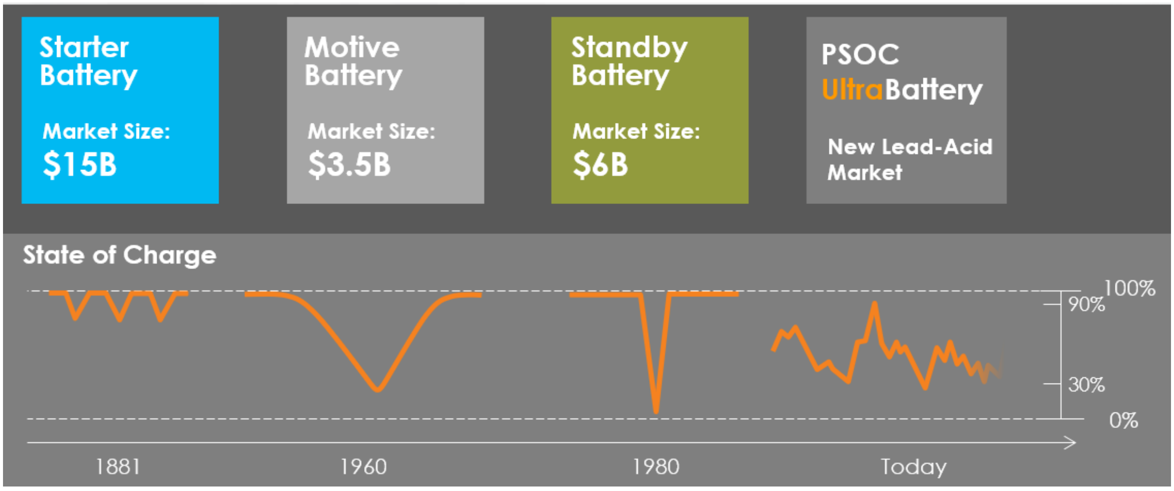
2. Variability management

Traditional lead-acid batteries are well suited to the steady-state applications described above. However, there are now battery types more suited to active applications – which may be loosely termed "variability management" applications.

These applications may include the provision of grid ancillary services (for instance: frequency regulation, demand management, and the creation of synthetic inertia) as well as renewable smoothing and microgrid management.

The CSIRO-invented UltraBattery (Ecoult's technology) is particularly suitable for grid-scale variability-management applications because it combines a lead-acid cell with a high-rate ultracapacitor. This means it can perform all the "steady-state" functions of traditional lead-acid batteries but can, in the same installation, also partake in one or more variability-management applications. Furthermore, UltraBattery can be installed directly into any previous battery location as it has very similar characteristics and the same safety features as traditional lead-acid batteries.

The following diagram describes the types of application that lead-acid batteries have been suited to over the past 150 years. The first three are all "steady-state" applications where the battery spends significant time at full charge:



The fourth graph in the diagram represents a battery operating in continuous partial-state-of-charge. This is the operation required for variability management applications.

There are other battery chemistries also suited to variability-management applications; the numerous lithium-ion chemistries are examples.

3. Variability-management applications on the grid

It is well-documented that variability-management through battery energy storage can be positive for the grid as a whole. The California Energy Storage Alliance (CESA) reports research by Pacific Northwest National Laboratories (PNNL) in the USA that shows that replacing traditional fossil fuel frequency regulation with fast response frequency regulation (e.g. batteries) can save more than 40% of the total frequency regulation requirement.[1] In Australia frequency regulation is typically a fossil fuel application.

[1] Lin, J. "Energy Storage—a Cheaper, Faster, & Cleaner Alternative to Conventional Frequency Regulation." *Prepared for the California Energy Storage Alliance, February* 16 (2011).

In 2012 PNM, the largest regional transmission organization in the USA, introduced a pricing structure for frequency regulation where it would pay based on performance (i.e. speed of response) rather than purely on the amount of energy served. The introduction of this payment structure has made it possible for battery storage to compete with fossil generation to provide frequency regulation services.

It is important to note that variability-management applications (such as the regulation of grid frequency) will generally require an energy sink just as frequently as they require an energy boost.

Unlike traditional generators, batteries can provide energy to the grid when it is undersupplied *and* store energy from the grid when it is momentarily oversupplied – energy that would otherwise be dissipated as heat through i^2R losses. Overall (i.e. because batteries perform more quickly and can be a sink as well as a source) batteries perform variability-management tasks such as frequency regulation significantly more efficiently and effectively than fossil generators.

- Since 2012 Ecoult has had a 3 MW UltraBattery system successfully providing fast frequency regulation services to PNM in a Pennsylvania plant.
- In 2016 we installed a MW-scale dual-purpose installation within a public utility in Pennsylvania to provide frequency regulation services 24/7 to the grid while providing the public utility with the emergency stand-by power it requires.
    - The public utility would have otherwise installed a traditional “passive” stand-by system, but the performance-based pricing for frequency regulation allowed it to install a dual-purpose UltraBattery system that provides, in a single installation, a) a revenue stream to the battery owner, b) much needed services to the grid *and* c) the guaranteed backup required.

Our experience with fast response markets in the USA is that MW-scale batteries can be an effective way to offset fossil fuel generation and provide variability-management services to the grid.

There is also significant research to suggest that increasing grid-scale variability-management through energy storage technologies will make the grid more tolerant to increased renewable penetration.[2] Having installed MW-scale smoothing batteries at Hampton Wind Farm in NSW and at a 500 kW PV farm in New Mexico, USA, it has certainly been Ecoult’s experience that renewable variability can be very successfully managed by batteries

4. Current market conditions in Australia

Market conditions on the Australian grid today are not particularly favourable for large-scale battery deployment for purposes other than stand-by applications.

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[2] An internet search provides many examples. See for instance: Crabtree, George, et al. "Integrating renewable electricity on the grid. *“PHYSICS OF SUSTAINABLE ENERGY II: USING ENERGY EFFICIENTLY AND PRODUCING IT RENEWABLY*. Vol. 1401. No. 1. AIP Publishing, 2011.

Variability-management activities in Australia are generally reimbursed by kW and not by performance. A kW produced by a fossil generator is likely to remain cheaper than a kW stored in a battery for some time to come. (In fact the 40% saving of overall frequency regulation, mentioned in the CESA publication referenced above, would make batteries more cost-effective and environmentally sustainable in the long run. However, there is no economic incentive in Australia to be an early adopter of such an application.)

Furthermore, the current a 30-minute average for settlement on the NEM makes it risky for a large battery owner to provide a few minutes of peak-power during a price spike since the 30-minute average could be lower than the cost of storage.

The net effect of this is that:

- Energy to cover these spikes is very likely to be most cheaply provided by fossil plants under current market conditions, despite the fact that:
    - fossil fuels are not necessarily the most efficient or environmentally sustainable way of providing short bursts of power; and
    - if energy storage was widely distributed, the grid would be less exposed to unexpected spikes in demand, and short-term price fluctuations may rarely take place.
- Owners of the very significant installed resource of MW-scale, steady-state (i.e. stand-by) batteries in Australia are not incentivized to upgrade their technology to batteries deigned for variability-management.
    - It is worth noting that turning existing stand-by battery banks into variability-management batteries would be perhaps the most efficient way of giving the grid operator access to the significant quantity of distributed variability-management capability that is required for fast frequency regulation, renewable storage and smoothing, demand management, peak load management and even transmission infrastructure offsets in weak grid areas.

5. View on proposed rule change

It is Ecoult's view that the introduction of 5-minute pricing as proposed by Sun Metals Corporation Pty Ltd could be a positive step towards creating similar market conditions in Australia that the performance-based frequency regulation payments have created in the USA.

While probably not enough on its own to make large-scale variability-management battery deployment a cost-effective alternative to fossil fuels during peak loads, 5-minute pricing may go some way toward allowing large battery owners to offer "generation" services to cover short peaks using energy stored from PV or during low-price periods.

This is an important step because if there was a viable market for such services, the vast quantity of existing installed energy storage could be quickly adapted to create a large grid-connected variability-management storage resource.

This resource could be utilised to reduce instances of variability on the grid, which would improve grid efficiency and potentially reduce peak pricing to customers. It could also offset fossil fuel generation, foster increased renewable penetration and help develop a more robust MW-scale solar-and-storage market on the NEM.