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The future of energy storage in Australia

Electricity is the most volatile commodity in the world. Supply attempts to match demand each millisecond; in the Australian NEM its price can change by factors of more than 10,000 each day. Vital yet ephemeral, electricity in a modern, large-scale grid cannot be economically stored. However, advances in battery technology will change that. With network battery trials underway, and technological and cost barriers falling, the demand for battery storage will increase exponentially.

Demand for electricity will continue to grow as population increases, consumers indulge in higher standards of living, electric vehicle penetration expands and the need to adapt to extreme temperatures increases. While average demand grows, peak demand grows even faster. Although demand may only peak for a few hours each year, meeting this peak has traditionally required expensive infrastructure-centric approaches such as:

- Expanding generation capacity by building peaking plants (diesel or gas), or operating responsive hydro-powered sites
- Increasing transmission and distribution capacity through augmenting the electricity network
- Reducing the peak by taking customers off supply, or by shifting their demand across time

At the same time, the electricity industry is being challenged to incorporate ambitious amounts of renewable energy into the generation mix. Australia's RET scheme commits to achieving 20% renewable penetration by 2020. This poses problems beyond simply finding enough renewable reserves to meet the target. Solar and wind are intermittent sources of energy, and therefore cannot meet demand at all times. Today, readily available reserve generation "fills the gaps" when renewable energy is not being produced. However, as the proportion of renewable energy in the generation mix increases, non-intermittent generation becomes relatively less capable of filling this role, and unexpected changes in renewable output degrade the quality of the energy supply.

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Providers of energy storage technology, as well as those whose businesses have the potential to profitably deploy such technology, are eager to evaluate the energy storage market. This is evidenced in a series of evaluation studies commissioned by MHC‟s clients.

MHC perspective

In one such study, MHC investigated the Australian and New Zealand energy industries" experiences with, and plans for the future use of, energy storage over the next 10 years. Our interviews and analysis covered a range of distribution businesses, market operators, land developers, significant energy users and government-funded bodies. We identified three main opportunities for energy storage:

- Placing batteries in stressed power systems where peak demand is outstripping generation and/or network capacity, in order to avoid the cost of upgrading generation and network infrastructure.
- Supporting renewable energy by allowing intermittent solar (and in some circumstances, wind) generators to store energy as it is generated and discharge it later to meet demand.
- Replacing entire transmission infrastructure with battery storage as part of a self-contained local power system.

We modelled the likely market for 5kW energy storage units which could be deployed to benefit communities around Australia and New Zealand. In developing our model, we estimated the current and forecast electricity demand profile in several regional cluster types over the next 10 years, and compared battery storage to the alternatives available to meet that demand profile.

Given the nascent state of this market, the model relied on publically available data and Marchment Hill's qualitative research and findings. The following key assumptions were made:

Local Cluster Characteristics	Isolated	Rural	Regional	Urban
Current Average Demand (MW total)	120	120	2,093	5,774
Current Peak Demand (MW total)	180	180	3,489	11,547
Current Peak Demand (MW average per cluster)	1.5	1.5	7.0	461.9
Average Growth in Demand p.a.	4.1%	4.1%	4.1%	4.1%
Current Supply Capacity (MW total)	202	283	4,841	12,817
Current Renewable Share of Generation (%)	24%	17%	14%	1%
2020 Renewable Share of Generation (%)	48%	38%	34%	3%

Figure 1: Key inputs used in MHC"s model (Local Cluster Characteristics)

Competing supply options (2020)	Cost per unit	Capacity per unit (kW)
Small scale local generation	$12,000	12
Large scale local generation	$5.40m	5,000
Transmission to remote generation	$45.0m	10,000
Battery storage	$3,500	5

Figure 2: Key inputs used in MHC"s model (Competing Supply Options)

We estimate that the current opportunity for commercially viable battery units from these segments represents about 3,000 kW of capacity, centred in isolated rural areas. Over the next 10 years, we expect this demand to grow to around 653 MW of capacity (1.3 GWh of storage), assuming that:

- The cost of manufacturing batteries continues to decline and battery lifetime improves, as it has done over the past decade
- The proportion of renewable energy serving the Australian system increases ¬ Fossil fuel generation costs (including carbon) double from their current levels
- Technology trials continue to show positive results
- There are no constraints on the manufacture of batteries

The results of our market model, based on these findings and other available data, are shown below:

		Capacity Needed per Location (kW)				
Year	Battery Cost per kW	Isolated	Rural	Regional	Urban	Total
2010	$2,800	3,000	-	-	-	3,000
2015	$1,400	14,500	-	-	-	14,500
2020	$700	70,400	26,100	530,200	26,400	653,100
Critical battery cost per kW threshold		$2,800+	$1,100	$900	-	-

Figure 3: Projected demand for battery storage (kW) by physical location in Australia and New Zealand.

The table above also estimates the cost-per-kW tipping points which storage must achieve in order to accelerate widespread rollout. At approximately $900 per kW of stored energy, widespread deployment into regional communities becomes commercially viable. This is reflected in a sharp projected demand increase in regional areas outside urban centres between 2015 and 2020. Our results depict a smooth decline in costs and consequent increase in uptake, but this is somewhat idealised; in reality, these figures will tend to change in irregular steps, and be influenced by many factors outside the scope of our modelling. We do expect a fledgling battery storage market to emerge in urban areas by 2020.

To date, energy businesses have purchased batteries almost entirely for technology trials. Their interest in full-scale deployment of these batteries is only embryonic due to the economic and technical hurdles which exist today. However, in moving from technology trials to commercial rollout, we see no significant regulatory hurdles associated with incorporating energy storage into the electricity network. Storage will become increasingly attractive to less-isolated rural and regional communities as the price of batteries and the associated equipment required to support them declines over time – and as the technical capability of batteries improves to enable more efficient storage and discharge. As in other fields, advances in technology and manufacturing efficiency are coming fast, and we can expect to see considerable cost reductions per kW year on year over the next decade and beyond.

As grid-connected storage becomes more cost competitive with traditional alternatives, it will be a „game changer". Distribution businesses that plan a role for storage in their network today will find themselves best prepared for tomorrow – but with dischargeable electric vehicles and consumer-grade storage solutions on the horizon, they will not be the exclusive holders of this option for long.