Renewable Energy Technology

Energy Storage – Large-scale Batteries

Background

In June 2016 the Victorian Government announced the Victorian Renewable Energy Target (VRET) of 25 percent by 2020 and 40 percent by 2025, and this commitment was passed into law in October 2017.

To achieve these targets, the Renewable Energy Action Plan (REAP) outlines decisive actions being taken to encourage investment in our energy sector and to ensure Victorians continue to benefit from a renewable, affordable and reliable energy system. The REAP invests $146 million into three focus areas:

1. Supporting sector growth
2. Empowering communities and consumers
3. Modernising our energy system

A range of new grants, projects and innovative solutions form the basis to achieve the ambitious targets, and to provide stability and reliability in the transitional energy generation and distribution network.

Increasing renewable energy capacity will also ensure that Victoria continues to reduce its greenhouse gas emissions. Victoria aims to achieve 15 to 20 per cent reduction in emissions by 2020 (from 2005 levels), and ultimately, net zero emissions by 2050.

Figure 1: the REAP is investing in three focus areas

Why large-scale battery storage?

A variety of technologies can be used to store electricity, including mechanical, pressurised and electrochemical systems. These include pumped hydroelectricity, compressed air, liquid air, rail potential energy, and large-scale battery storage.

One important REAP initiative is to deploy large-scale energy storage facilities in central and western Victoria. By storing energy generated from renewable sources, battery storage provides:

- contingency power during a temporary loss of supply (either unexpected or regulated)
- near-instantaneous stabilisation services to the grid during episodes of frequency imbalance
- an alternative interim electricity source to the more expensive emergency gas-fired and diesel generators

Storage, when combined with renewable energy, will help maintain our reliable and affordable energy supply, especially in times of peak demand. It may also reduce the frequency of blackouts and need for load shedding in instances where there is a supply imbalance.

However, battery storage cannot prevent blackouts in situations where the electricity network has been compromised, such as when a storm impacts poles and wires and electricity cannot be physically supplied.

Figure 2: Batteries don't just provide extra electricity at peak times, they also stabilise the grid during frequency disruptions.

The technology

A range of electrochemical technologies are being used around the world and being further developed to store energy in batteries. These include lithium ion, sodium ion, molten-state such as sodium sulphur batteries, flow batteries and others.

Each has its pros and cons. For example, abundance of key metals and elements, power density, manufacture requirements, scalability, megawatt hours of output, and supply duration can impact the suitability of a given technology. Battery storage continues to become more competitive at a commercial scale as technologies improve and production costs fall.

Large-scale batteries typically consist of several components – a battery unit or 'enclosure' (generally a large box like a shipping container), an inverter, and a transformer that can either be internally or externally mounted or connected. The number of enclosures will be determined by the technology and required output.

An Australian example

In 2017 the world's biggest lithium ion battery was built near Jamestown, South Australia.

The 100-megawatt (MW)/129-megawatt hour (MWh) Tesla battery, located next to the Hornsdale Wind Farm, can power the equivalent of 50,000 homes for over an hour or supplement supply at a lower output for up to four hours.

In operation since December 2017, it has already provided rapid response to several sudden frequency disruptions, and was able to keep supply and demand in balance at critical peak times in both South Australia and Victoria.

What does it mean for me?

Large-scale batteries improve grid reliability and lower prices in two main ways.

First, they can help lower prices by storing low-cost power for use during times of high-cost and high-demand.

Second, large-scale batteries can make stored electricity available for immediate dispatch when energy demands exceed generation. They are comparable to other peaking generation mechanisms (such as gas peaking plants) and can be deployed quickly, allowing for more efficient use of the network. This can help keep downward pressure on energy bills and reduce network costs.

Why now?

Energy systems around the world are transforming through rapid changes in energy technologies, consumer behaviour and choices, and global demands for cleaner energy. A clear and well-planned transition to a clean energy future now will help us avoid a much larger, more disruptive and costly transition in the future.

The review into the future security of the National Electricity Market (NEM) led by Dr Alan Finkel AO recognises that technical solutions to energy stability and reliability already exist, but need to be expedited. We can benefit from the experience of countries already using these methods to position Victoria as a national leader in transforming to a modern energy future. The challenge now is to better integrate new methods of generating and using energy while maintaining system reliability and affordability.

Energy storage technologies can unlock growth in areas experiencing network constraints. They can also support on-demand energy needs as the network transitions following retirement of Hazelwood brown coal generator and other ageing coal infrastructure.

Energy storage is an important enabling technology for improving the competitiveness and increasing the supply of renewable energy, especially as the industry continues to grow. It can allow renewable energy to be delivered at peak times when it is most needed, unlocking more value and increasing flexibility and reliability.

Victorian Government's Energy Storage Initiative

On 22 March 2018 the Minister for Energy, Environment and Climate Change announced that as part of the Victorian Government's $25 million Energy Storage Initiative, two large-scale batteries will be built in Victoria. These will be a part of the most sophisticated energy storage initiative in Australia. The batteries, strategically located at known stress-points in the electricity network, will provide much-needed backup power and grid-stabilisation functions which are vital to maintaining a reliable and affordable energy supply for Victoria.

The two projects are a 30MW/30MWh system connected directly to a vital grid intersection at a substation at Warrenheip, near Ballarat, and a 25MW/50MWh Tesla battery behind-the-meter at the Gannawarra Solar Farm, south-west of Kerang. This second battery will be the largest integrated solar farm and battery in Australia and among the largest in the world.

Construction will take from six to eight months with the batteries to be ready by the summer of 2018.

Where does it fit in to the energy system?

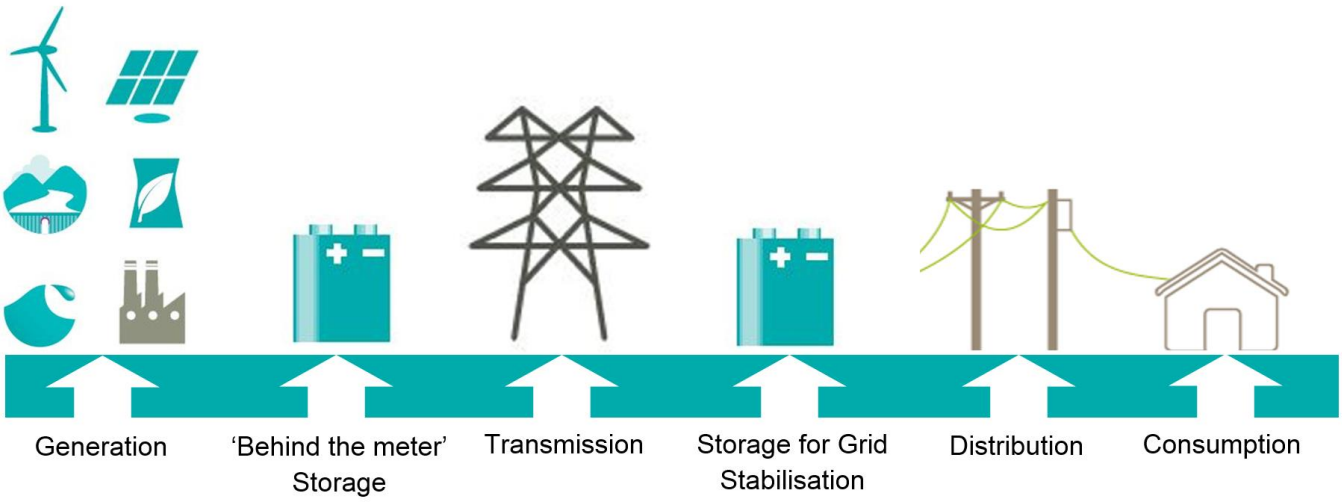

Figure 3: The Energy Distribution System

Large-scale batteries can both store electricity from renewable generation 'behind the meter' (pre-transmission) and provide grid stabilisation services between transmission and distribution.

Local impacts

Modern large-scale batteries use purpose-built containers that can be painted, positioned and screened effectively for minimal visual impact.

Lithium ion technologies favoured in Australia have no noticeable vibration, no emissions, and negligible close-proximity sound.

Each container is individually environmentally controlled with its own monitoring and fire suppression systems.

Each facility has industry emergency management plans that have procedures for potential disturbances and hazards, including approaching bushfires.

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