Battery **Storage**

Battery energy storage systems

A battery energy storage system (BESS) uses batteries that convert electrical energy into chemical energy so that it can be stored, collected, and distributed at a later time.

Utility-scale BESS installations enable variable and intermittent renewable energy sources like wind to provide a stable, steady supply of electricity to the grid. BESS systems are typically charged when generation supply is higher than demand and the excess energy is stored for release during lower production periods or when demand is high.

The process is managed by a monitoring system connected to the Australian Energy Market Operator (AEMO) and based on real-time data from the National Electricity Market (NEM).

By storing excess energy generated during peak production times, BESS can reduce waste, prevent curtailment and provide energy for use during periods of low production, demand spikes and backup power during network disruptions. By balancing the supply and demand for variable renewable energy sources, a BESS plays a critical role for grid stability and reliable energy supply.

Battery type

The batteries proposed for Bowmans Creek Wind Farm's grid-scale BESS would be Lithium Iron Phosphate (LFP) batteries, a type of lithium-ion battery.

Lithium-ion batteries are popular for utility-scale storage due to their high efficiency and safety, long lifespan and compact energy density.

Lithium-ion batteries are capable of storing large amounts of energy in solid state electrodes. LFP batteries are the same type of batteries that are commonly used in electric vehicles. They are typically made from lithium iron phosphate, graphite, aluminium and copper. They are cobalt free, use no rare earth metals, have a safe chemical and mechanical structure and are more resilient to extreme conditions.

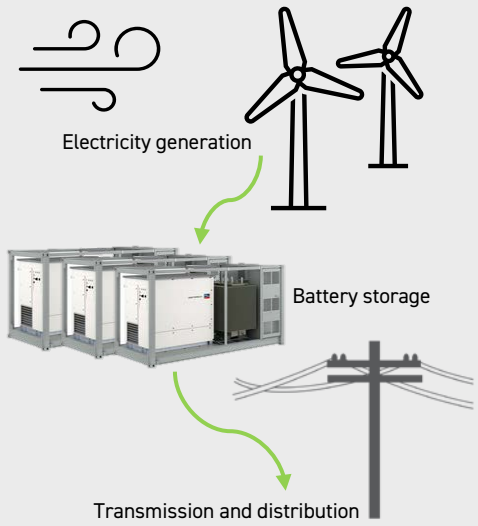
How a BESS works

Industrial-scale lithium-ion BESS are designed with modular units, which look a bit like shipping containers arranged in rows. Each modular unit contains interconnected battery cells as well as cooling, safety and firefighting systems. The modular units are connected to inverters that convert the electricity from the batteries from direct current (DC) to alternating current (AC) for the grid.

The smaller interconnected battery cells inside each modular unit operate like a typical battery, where chemical reactions across an anode and cathode create an electric flow. The components within lithium iron phosphate (LFP) battery cells include the cathode, anode, electrolyte, separators and current collectors.

An Energy Management System (EMS) monitors the energy stored and needed and manages charging and discharging of the batteries.

The Bowmans Creek Wind Farm BESS is proposed to have a power capacity of up to 250 megawatts (MW) and an energy storage capacity of up to 2,000 megawatt hours (MWh) over eight hours. It would charge when generation is higher and market prices are lower, and discharge when generation is lower and market prices are higher. This would optimise the wind farm's output, contribute to grid stability and reduce electricity costs.



Key functions of a BESS

Energy storage
Capture and store electricity during low-demand periods for use during peak hours.

Grid stabilisation
Provide rapid responses to fluctuations, ensuring steady power delivery.

Renewable integration
Stores excess energy to prevent waste and ensure availability during low-generation periods.

Backup power
Ensure critical facilities like hospitals, data centres, schools - remain operational in outages.

BESS proposed for Bowmans Creek Wind Farm Stage 1

Power capacity of up to 250 MW.

Energy storage capacity of up to 2,000 MWh over eight hours

BESS Safety

BESS in Australia are assembled and installed under a comprehensive standard focused on the installation and safety of their use with power conversion equipment *(AS/NZS 5139:2019).* They must also operate in compliance with strict project approval conditions.

The chemical reaction in lithium-ion batteries produces heat and must be controlled to manage safety and fire risks. BESS are equipped with Battery Management Systems (BMS) to monitor charge, cooling systems, temperature in real-time, and fire suppression systems to reduce fire risks. Each battery container includes a liquid cooling thermal management system designed to keep the batteries operating at the right temperature and its own comprehensive safety and fire suppression systems including detection, alarm, isolation, firewall and emergency cooling systems.

To mitigate the risk of runaway thermal events, non-combustible fire barriers are installed within BESS containers and there are separation distance requirements between each container. As BESS units are self-contained, this provides for staged protection through internal containment of any event by the BMS and minimises the risk of spread to other units. LFP battery chemistry, which is the type Ark Energy plans to use, is less likely to experience thermal runaway than other battery types.

All renewable energy facilities including BESS involve multiple plans to manage and minimise hazards and risks and these are developed in accordance with guidelines and in consultation with relevant authorities such as Fire and Rescue NSW, the local Fire Control Centre and the NSW RFS. They typically include:

- Emergency Management Plan outlining measures to prevent, prepare and respond to emergencies, such as fire, that may impact the site.
- Fire Management Plan approved by the fire authority which includes procedures for dealing with fire and materials kept on site for that purpose.
- Risk Management Plan that identifies hazards and the strategies to be applied to lower the risks such as Asset Protection Zones to ensure appropriate clearances to surrounding vegetation and other fuel sources.

Decommissioning and recycling

LFP batteries have a longer life cycle than other batteries and can last up to 20,000 cycles. Decommissioning a BESS is the responsibility of the operator and a Decommissioning Management Plan, clearly outlining processes for dismantling infrastructure, removing materials and rehabilitating the site, is typically a condition of project consent and must be approved by the regulator.

LFP batteries contain components that use lithium, phosphorus and graphite, and there are recycling technologies for these valuable materials. When LFP batteries reach end-of-life most components and raw materials can be recovered and recycled through specialised processes by certified operators. If recycled, potentially 95 per cent of battery components can be recovered for alternative use or turned into new batteries (CEC 2025). Other BESS facility infrastructure and plant materials such as concrete and steel are also typically recycled. Ark Energy is committed to recycling batteries from its facilities when they reach end-of-life. Resource recycling is a focus business area for Ark Energy's parent company Korea Zinc, which has a battery recycling business that utilises its existing non-ferrous metals refining capability. End-of-life batteries from Ark Energy's projects will likely be recycled within the Korea Zinc Group.

Scan QR codes below for more information

Australian Renewable Energy Agency – Battery storage (web page)

Battery Energy Storage System Fact Sheet – Queensland Renewable Energy Council

Example Battery Energy Storage System container

Artist illustration of a Battery Energy Storage System

95%

of a lithium-ion battery is recyclable

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