

USING RENEWABLES TO KEEP THE GRID SECURE



To be secure, Australia's electricity grid needs to be able to cope when a part of the network or a power plant breaks down. A number of tools are used by the Australian Energy Market Operator (AEMO) to keep the grid secure, including a toolkit known as Frequency Control Ancillary Services or FCAS. (See "What is FCAS?" to learn how FCAS works).

AEMO buys FCAS from providers, which can include power generators, big electricity users, and other organisations. Providers that generate or store electricity help to make the grid secure by rapidly injecting more power into the system when it is needed. Others FCAS providers such as energy-intensive businesses can achieve the same effect by shutting down some or all of their operations for an agreed period.

In Australia FCAS has traditionally been provided by mostly coal and gas electricity generators; however overseas experience has shown that renewable energy providers can also supply FCAS to help keep the grid secure and stable.

ARENA has been working with AEMO and the renewable energy industry to explore how to make renewables-based FCAS not only technically possible but also commercially attractive in Australia. ARENA has also invested in a range of projects to develop renewables-based FCAS.

During 2017-18 ARENA supported additional projects to explore the potential of renewables to provide FCAS and grid security in the future. These include utility-scale renewables such as wind farms and big batteries as well as distributed energy resources such as household solar with battery storage, which was a recommendation of the Finkel Review.

MUSSELROE WIND FARM FCAS TRIAL

Lead organisation: Musselroe Wind Farm Pty Ltd, a subsidiary of Shenhua Clean Energy and Hydro Tasmania

ARENA funding: \$499,000

Total project cost: \$1.0 million

Location: Woolnorth, TAS

ARENA's most recent FCAS project is a ground-breaking grid stability trial at the Musselroe wind farm located in windswept north-east Tasmania. With 56 turbines capable of generating 168 megawatts, the Musselroe facility provides five per cent of Tasmania's yearly electricity needs.

The \$1 million trial, to which ARENA is contributing \$499,000, is investigating the technical capability as well as the economic and commercial potential of wind farms in Australia to provide FCAS to stabilise the national grid.

Wind power is playing a big part in Australia's transition to renewable energy, so it makes good sense to explore how it could provide essential grid stability services. If the project finds that wind farms would commercially benefit from selling frequency control services in Australia, this could lead to more wind farms providing FCAS, which would bring down the cost of FCAS and in turn lower electricity bills.

HORNSDALE STAGE 2 WIND FARM FCAS TRIAL

Lead organisation: HWF2 Pty Ltd,
a subsidiary of Neoen

ARENA funding: \$300,000

Total project cost: \$600,000

Location: Hornsdale, SA

The Musselroe project builds on the findings of an earlier project at South Australia's Hornsdale stage 2 wind farm, where ARENA partnered with AEMO to test the technical feasibility of wind farms providing a type of FCAS called inertia.

The project involved AEMO having remote control over the facility's wind turbines so that the market operator could adjust the amount of electricity being generated to maintain the grid's stability.

By confirming that wind generation has the potential to help with system stability, the project was another important step towards demonstrating renewable energy's potential role in the NEM. It also provided proof of concept to the energy market and investors on the ability of wind farms to provide FCAS.

ELECTRANET BATTERY STORAGE PROJECT

Lead organisation: ElectraNet

ARENA funding: \$12.0 million

Total project cost: \$30.0 million

Location: Yorke Peninsula, SA

The speed with which a battery can be switched on or off makes this form of energy storage an ideal way to help keep the grid secure by providing renewables-based FCAS.

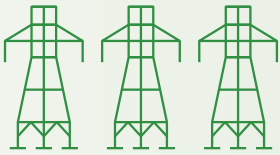
ARENA is helping to demonstrate that potential by supporting ElectraNet's construction of a large-scale battery near the Dalrymple substation on South Australia's Yorke Peninsula.

This is the second stage of the Energy Storage for Commercial Renewable Integration (ESCRI) project, following a study into the potential for such storage to benefit the state's electricity network. The 30 megawatt, eight megawatt hour facility will store energy generated by AGL's Wattle Point wind farm to demonstrate how energy storage can strengthen the grid and improve local reliability.

When completed in mid-2018, it will be the first large-scale, grid-connected battery to be designed, built and commercially operated in Australia largely with private investment from energy providers. It will also be one of the largest batteries in the world, in terms of megawatt capacity, behind the Tesla/Neoen battery located in the same state.

ESCRI BATTERY PROJECT

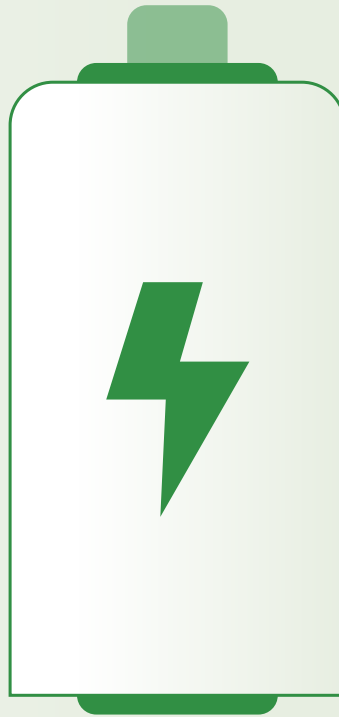
The first large-scale, grid-connected battery to be designed, built and operated in Australia largely with private investment from energy providers. The Energy Storage for Commercial Renewable Integration (ESCRI) project will provide grid stability in multiple ways.



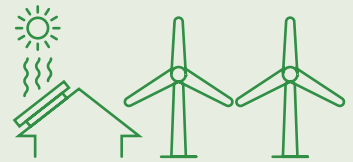
- > Provides fast-acting power response, keeping grid in balance when generators or transmission lines fail



- > Reduces constraints on Heywood interconnector with Victoria (should place downward pressure on SA wholesale power prices)



30 MW / 8 MWh utility-scale lithium-ion battery



- > Improves supply reliability by operating as microgrid with Wattle Point wind farm and rooftop solar when main grid supply is lost



- > Retailer operates battery under agreement with ElectraNet, providing additional market services without compromising security and reliability services

GANNAWARRA ENERGY STORAGE SYSTEM

Lead organisation: Edify Energy
Size: 25 MW / 50 MWh
ARENA funding: \$25.0 million (with Victorian Government)
Total project cost: \$34.3 million
Location: Gannawarra, VIC

With ARENA's support, the Gannawarra Energy Storage System project is helping to demonstrate how battery storage can be fitted to an existing solar farm. It will help to pave the way for similar battery extensions to be made to the dozens of solar farms already built or underway in Australia.

The project is co-located with Edify Energy's 60 megawatt (DC) Gannawarra Solar Farm. As it involves the first solar farm of its size in Australia's electricity market to include a battery, the project will demonstrate how the combined technologies can provide flexible dispatchable energy and improve grid stability.

With very few projects of this nature in Australia, successful completion of the project will create investment confidence for similar projects in the future. It will also be the first retrofit of a battery to an existing or under-construction solar farm in Australia, the first battery integrated with renewables in Victoria, and among the first of its kind in Australia. It will also be among the largest integrated battery with renewables systems in the world.



SIMPLY ENERGY VIRTUAL POWER PLANT

Lead organisation: Simply Energy
Size: 6 MW storage + 2 MW demand response
ARENA funding: \$7.7 million
Total project cost: \$23.5 million
Location: Adelaide, SA

A virtual power plant (VPP) is created by linking households with rooftop solar and battery storage to a central control system so that the benefits of renewable energy can be shared within that network or with the broader national grid.

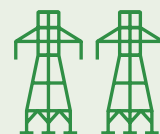
ARENA has supported Simply Energy's VPP project to deliver up to 1200 Tesla Powerwall batteries to Adelaide households. The project will also install batteries in ten commercial businesses to give them the ability to participate in demand response activities.

This is the second VPP to be created in South Australia following the AGL VPP, which was also supported by ARENA. Households participating in the project will be able to use more of their solar energy, reducing their power costs and have backup power in the event of an outage.

They will also be able to participate in Greensync's innovative distributed energy exchange (deX), which was initially developed with ARENA's support. The deX online platform will provide an energy marketplace where electricity can be bought and sold by businesses, households, communities and power utilities.

By integrating the VPP with deX and linking it to the national grid, there will be lower demand for electricity at peak times, which can ease pressure on the grid and reduce network costs. Power companies will also have more electricity sources to draw on, which will improve grid security and power reliability.

WHAT IS FREQUENCY CONTROL ANCILLARY SERVICES (FCAS)?



To be secure, an electricity network needs two things.

Firstly it needs enough power, supplied by electricity generators, to meet the needs of electricity users. That need, or 'demand', changes over the course of the day from the time we make our first coffee or toast in the morning, until we switch off the lights at bedtime.

Why balance keeps the grid secure

The second thing needed for a secure grid is not as obvious or well known. That secret ingredient is balance - at all times the amount of electricity being sent into the grid by generators must match the amount needed by electricity consumers. When the balance is right, electricity flows through the grid at a 'frequency' of 50 hertz or cycles per second. When the frequency moves away from 50 hertz because there is too much power being generated, or a sudden change in demand, the grid becomes unstable and will start to shut down to protect its equipment, leading to blackouts.

The Australian Energy Market Operator (AEMO) is responsible for adjusting the amount of power being generated or being used to make sure the grid always stays in balance. It is also AEMO's job to restore the balance when a blackout does occur.

Role of FCAS in achieving balance

AEMO uses Frequency Control Ancillary Services, or FCAS, to maintain or restore the balance in our electricity network's frequency. The market operator buys these services when it needs them from power generators, big electricity users, and other organisations.

FCAS providers that generate or store electricity help to rebalance the grid by rapidly injecting more power into the system, while others are energy-intensive businesses that can achieve the same effect by shutting down some or all of their operations for an agreed period.

Renewables can provide FCAS

While FCAS is already a critical part of our current electricity network, the importance of FCAS is growing with the rapid development of Australia's renewable energy sector. As increasing amounts of wind, solar and other variable forms of clean energy are fed into the grid, additional FCAS will be needed to stabilise it.

In Australia FCAS has traditionally been provided by mostly coal and gas electricity generators; however, overseas experience has shown that renewable energy providers can also supply FCAS to help keep the grid secure and stable. This is being done in Quebec, Ontario and some parts of Europe.