

ARENA INSIGHTS NEWSLETTER

Empowered Consumers:
Distributed Energy Resources
Portfolio Update



Australian Government
Australian Renewable
Energy Agency

ARENA

2018 is shaping up to be a huge year for consumer energy with record rooftop solar and battery installations, real-time demand response trials, and a number of reports predicting these 'distributed energy resources' (DER) will form the bulk of new supply in the energy sector by 2030 and beyond.

INCREASE IN THE UPTAKE OF SOLAR AND BATTERIES IN HOUSEHOLDS ACROSS AUSTRALIA

In the second quarter of 2018, over 57,000 rooftop solar systems were installed nationally, adding 310 MW of installed capacity. According to SunWiz, [the number of household batteries installed in Australia is tipped to jump to 33,000 in 2018, cracking 300 MWh of storage capacity](#). While the numbers may still be small compared to solar, [the rate of registered battery installation has tripled each year since 2015](#).

As battery installation rates increase, battery aggregators are scaling up and working with ARENA and AEMO to trial the provision of frequency control services under the Market Ancillary Services Specification, as well as distribution network support including on the TasNetworks, SA Power Networks, United Energy and Evoenergy networks.

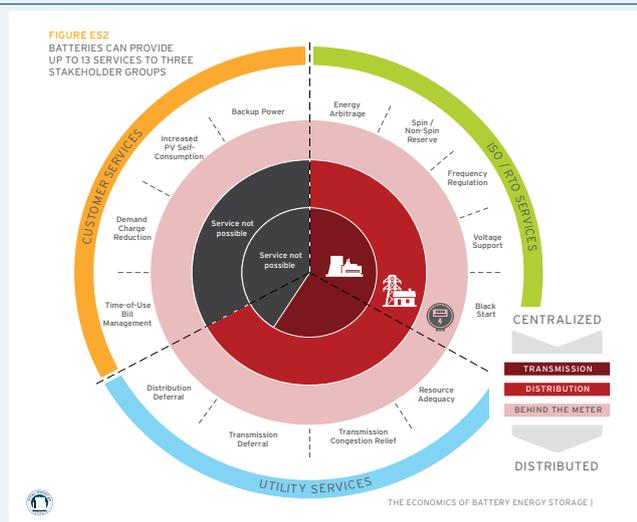


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DISTRIBUTED ENERGY RESOURCES (DER)

AEMO's inaugural Integrated System Plan (ISP) has predicted DER could provide up to 15% of underlying electricity demand (GWh) in 2030 and 22% in 2040. Bloomberg's New Energy Outlook is even more bullish about DER with the payback period for solar with battery storage falling to 10-years in the 2020s, and small-scale PV having the largest installed capacity of any single technology in Australia by 2025.¹ To better support consumers in the DER transition ARENA has funded projects like the ITP Renewables Battery Testing Centre (see highlight below), and the new [Battery Performance Standards Project led by DNV GL](#). The recently announced [Distributed Energy Integration Program \(DEIP\)](#) - a collaboration of energy peak bodies, market authorities, industry associations and consumers associations, will also aim to play a key role in maximising the value of customers' distributed resources for all energy users

ARENA'S DER INVESTMENT TO DATE

ARENA has funded a range of studies and pilot projects that look at optimising DER. Highlights from projects in ARENA's DER portfolio include:

United Energy Solar and Storage Program

- This project is a targeted deployment of solar PV and storage at customers' premises that are connected to constrained (or overloaded) distribution substations.
- United Energy's (UE) analysis indicated it was more cost effective to deploy solar/storage (at subsidised cost) at 14 substations on its network than undertake traditional augmentation projects to alleviate constraints. Across these 14 substations, a total of 42 customer sited solar storage systems needed to be installed to bring the substations to a design rating equivalent to a network augmentation. This

¹ Bloomberg NEF, New Energy Outlook 2018: Australia Seminar, 11 July 2018 (subscription required)

represents only a small fraction (3%) of total customers serviced by the constrained substations.

- The project is generating useful information on constrained substation load profiles with and without dispatch of multiple and single solar/storage on hot days.
- UE will continue to develop operating models for the systems including automated control algorithms and monitor dispatch for implications to non-network solution planning through to mid 2019.
- Read more in the [ARENA Knowledge Sharing Plan - Residential Solar and Storage Program Interim Report](#).

ITP Renewables Battery Testing Centre

- This project is analysing the performance of conventional and emerging battery technologies in typical Australian conditions. The aim is to verify battery performance (capacity fade and round trip efficiency) against the claims of manufacturers. The technologies include lithium ion, conventional lead acid, advanced lead acid, zinc bromide and saltwater battery bank.
- To date the test data shows:
 - › Lithium ion had higher round-trip efficiency over conventional lead-acid and zinc bromide.
 - › Phase 1 batteries (+1,000 cycles completed) had a capacity fade ranging from ~80-90%. Tesla 1 had the highest rate of capacity fade but discharged/charged at faster rate than other battery packs due to the rate being not able to be controlled.
 - › Phase 2 batteries had only achieved ~500 full cycles due to a later start date for testing, so no conclusions can be made as yet.
- Installation and commissioning experiences:
 - › Integration of battery pack with inverter continues to be a challenging aspect of installation. The communications interface is the most common issue highlighting a need for common communications protocols to be developed.
 - › Commissioning problems are not uncommon in systems where the battery manufacturer has only recently offered integration with the inverter.
 - › Some market instability with manufacturers exiting or changing their product offering.
- The project's website had 74,000 views with international reach (predominantly US, Germany and UK) and interested stakeholder contact.
- Read more on the testing in [Report 1](#), [Report 2](#), [Report 3](#) and [Report 4](#).

AGL Virtual Power Plant

- This project aims to deploy a 5 MW virtual power plant (VPP) consisting of 1,000 distributed energy storage systems in South Australia to dispatch more than 9 MWh of stored energy.
- Trials showed the VPP can respond to both planned and unplanned dispatch events and may be able to participate in the six second contingency FCAS market.
- As part of Stage 2, more than 300 energy storage systems have been installed in customer premises, doubling what was achieved in Stage 1.
- More than 700 batteries have been sold to date, with AGL choosing to expand the range of technology available in the trial to include Tesla, LG, and Solar Edge. Sales continue for the final tranche of customers with more than 800 leads generated. This has been assisted by news coverage and energy storage media coverage, and the growing public understanding of VPP's and their value to the broader energy system.
- AGL continues to add local installer resources to the program to accelerate the roll out of batteries.
- The project has conducted orchestrated fleet dispatch events during 2017 and 2018 and has monitored the impact of the VPP on network load and site exports as well as the impact of local grid conditions on individual energy storage systems and fleet performance.
- Lessons learned:

- › Stage 1: majority of customers are highly engaged, tech-savvy early adopters. Approximately 50% of customers opted to pay the additional fee for their system to provide backup power, pointing to the importance of backup power functionality for South Australian energy storage consumers. Through the sales process, around 35% of customers ultimately did not qualify for the program as they did not want to lose the premium feed-in tariff. Battery inverter disconnections due to high grid voltages were a significant issue during Stage 1.
- › Stage 2: there were several interesting lessons from these trials, including the complexity of maintaining a consistent power export target over the course of extended dispatches. Reasons for this complexity include the impact of high grid voltage, battery state of charge variations, and the variability of solar production and household load on each of the individual sites. Battery inverter disconnections continued to have a significant impact during this Stage of the project.

Read the stage 1 report [here](#) and stage 2 report [here](#).

CSIRO Virtual Power Station 2

- Completed in January 2018, this project has generated technical information about the design and testing of reference controllers for both single site and multi-site coordination of distributed controllable loads, including air-conditioning, rooftop solar PV generation, and battery storage systems connected to a low voltage electricity distribution network.
- The project experiences / learnings were:
 - › A single communication channel was used on hardware for receiving the demand response signal from the network to enable remote control of air-conditioning units. This provided simple control for a group of air-conditioners, but disabled control of individual air-conditioning loads.
 - › Continued development of the communications infrastructure for the core control technology is required to provide more granular control of all devices at homes - solar, batteries, and loads.
 - › Further demonstration of the VPS2 in distribution operations in the field are required as to date, the project is limited to individual connection points and modelled impacts on distribution operations.
 - › Incentive schemes and approaches are required to ensure sufficient uptake of the fully compliant inverters, storage, and controls.
- Read the Project results and lessons learnt report [here](#).

Ergon Energy - Residential solar PV and battery pilot

- In July 2015, Ergon Energy Retail started a pilot to test an innovative residential solar PV and battery storage product as a turnkey Hybrid Energy Service (HE Service).
- The pilot scope included the design, installation, commissioning and operational testing of 33 grid-connected, centrally controllable, solar PV plus Battery Energy Storage Systems (BESS) installed at residential customer premises in Toowoomba (13), Cannonvale (7) and Townsville (13) over a one year period.
- The recently published [public report](#) outlines the results of the pilot:
 - › The primary reason customers registered for the pilot was the opportunity to save money.
 - › The HE System successfully provided backup power during outages (giving the customer reliability)
 - › The HE Systems could be successfully monitored and operated remotely as individual units and as an aggregated fleet in real time.
 - › Further revision of the HE Service business model is required to improve financial outcomes for all parties involved.

DEMAND RESPONSE RERT INITIATIVE

In October 2017, ARENA and AEMO jointly announced 10 pilot projects awarded funding under the demand response Reliability and Emergency Reserve Trader (RERT) trial initiative, designed to manage electricity supply during extreme peaks. Initial results are promising but key challenges have been identified in relation to recruiting and maintaining small customers and establishing efficient, permissioned access to meter data. ARENA expects to publish a summary of outcomes from year 1 of the trial later in 2018.

This work is informing the AEMC's consideration of a new rule change request that proposes the design of a wholesale demand response mechanism which could allow homes and business to access greater value when responding to spot market price signals, underpinning a more affordable, reliable and secure electricity grid.

WHAT COMES NEXT?

The rise of DER poses challenges for the grid with voltage, thermal rating and minimum demand issues already threatening to stall the march of DER in some areas. To avoid this, energy market authorities, industry and ARENA are exploring how these resources can be best orchestrated, and potentially, scheduled, to ensure maximum participation of DER in the electricity system. In addition, questions regarding when and where it is efficient to invest in increasing the network hosting capacity of DER are also front of mind.

To help address these challenges, ARENA announced in March 2018 that it is allocating \$12.5 million in funding under its Advancing Renewables Program to demonstration projects and studies contributing to various elements of DER.

One portion of the funding will be invested in network hosting capacity technology and demonstration projects to develop new ways to understand and manage the impacts of high DER penetration in different parts of the distribution network. This will allow networks to connect more DER (such as rooftop solar PV panels) cheaper and faster while reducing costs and operating within the technical limits of the power system.

The other portion of funding will be allocated to new studies or models that contribute to increasing the value, capacity or efficiency of DER, or reducing costs or risks associated with its development and application. These studies will help networks, retailers, government and system operators understand more about the technical and commercial challenges of managing a grid with a high penetration of DER.

Ultimately, the funding round will aim to optimise investment, improve system performance and reduce technical, market, and regulatory barriers to increase uptake of DER in Australia. ARENA will announce the outcomes of these initiatives later this year.

For any questions relating to this update, please contact knowledge@arena.gov.au

