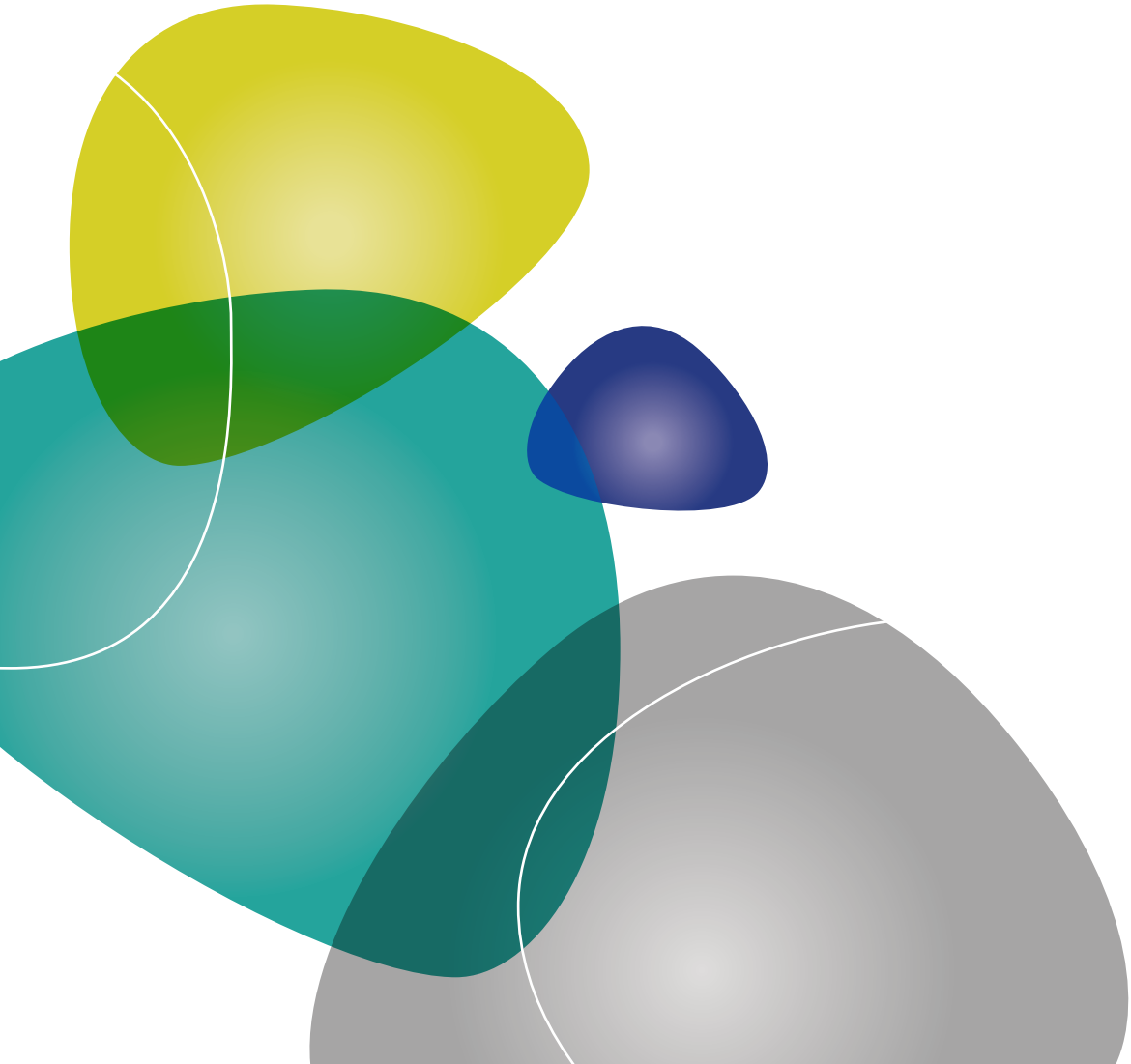
Energy Networks Australia

Network Innovation

2022 Report

This report details case studies that were submitted to Energy Networks Australia for the 2021 Industry Innovation Award.

Energy Networks Australia is the national industry body representing Australia's electricity transmission and distribution and gas distribution networks. Our members provide more than 16 million electricity and gas connections to almost every home and business across Australia.



Andrew Dillon
CEO, Energy Networks Australia

INTRODUCTION

Networks are evolving at a rapid pace to help deliver a net zero future that gives customers greater control over how they use and consume energy.

As Australia's electricity grid looks to double in size as it decarbonises, innovation is fundamental to future success. The future is already here, as we begin to see projects that were trials and pilot programs five years ago become business as usual.

These awards are a way to recognise ground-breaking initiatives, technology, services and solutions from energy networks that benefit customers and help us to share lessons across the sector.

Energy Networks Australia received 10 entries of an extremely high standard for the 2021 Industry Innovation Award. Nominating companies included Australian Gas Infrastructure Group (AGIG), AusNet Services, Endeavour Energy, EQL Ergon, Horizon Power, Powerlink, SA Power Networks and Western Power.

The independent judging panel, comprising of members from the Australian Energy Market Commission, Australian Energy Market Operator, Australian Renewable Energy Agency, Clean Energy Council, St Vincent de Paul Society and Energy Networks Australia, was unanimous in its decision.

There were four shortlisted finalists:

- AGIG (SA) – Hydrogen Park SA
- EQL Ergon (QLD) – Maximising Distributed Energy Resources using State Estimation
- Horizon Power (WA)– Carnarvon DER trials
- Western Power (WA) – Flexibility Services Pilot

Energy networks delivering clever solutions to integrate renewables into the energy grid were at the top of the field in the 2021 Energy Networks Australia awards program. The contenders for the awards had a strong emphasis on integrating distributed energy resources and renewable gas into networks and delivering a smarter, cleaner energy grid.

Queensland electricity distributors Ergon Energy Network and Energex (part of Energy Queensland) were named the 2021 Energy Network Industry Innovation Award recipient. The winning project is an Australian-first implementation of a digital system to generate a complete and consistent picture of the operational state of the grid. This supports the integration of distributed energy resources (DER) like rooftop solar PV so more customers can export solar, voltage impacts on the grid can be mitigated and power quality can be improved.

This report highlights all 10 nominations and details some of the innovative work occuring across energy networks throughout Australia. I thank the judging panel for their time and consideration in evaluating the nominations and thank the entrants for their thoughtful and considered entries to the award.

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JUDGING PANEL

Jill Cainey

Dr Jill Cainey has extensive experience in Australia's energy system in particular the need for networks to transform to accommodate new and innovative approaches to delivering sustainable energy.

Jill represented the interests of electricity storage in the UK and Europe and was appointed MBE for services to Energy Technology in 2017 for work in electricity policy and regulation.

Jill also has more than 25 years of experience internationally in climate change and is very interested in the interaction of extreme weather and electricity systems and developing resilient network infrastructure for the future.

David Feeney

David Feeney has recently joined TransGrid as the head of policy and energy market reform. Previously he was the Executive General Manager of Transmission and Distribution Networks at the Australian Energy Market Commission.

Before that David was appointed as Executive General Manager of Retail and Wholesale Markets where he was responsible for reviews and rule changes relating to the competitive parts of Australia's electricity and gas sectors.

He has more than 20 years' experience across government and telecommunications sectors with previous roles including commercial development with Telstra and managing industry engagement and commercial access arrangements for NBN Co. He has a Bachelor of Commerce from the University of Newcastle and a Master of Public Affairs from the University of Sydney.

Violette Mouchaileh

Violette's current role of Executive General Manager of Reform Delivery, AEMO is responsible for strategies relating to the Wholesale, Gas and Retail Reform Delivery programs, Distributed Energy Resources program and data initiatives. Since joining AEMO in 2009, Violette has held various roles across gas and electricity in market design development, market change implementation and operational roles.

Violette has more than 17 years experience in the Australian energy industry holding various positions in Commonwealth Government departments and regulatory bodies. Her experience includes economic regulation, energy policy development, development of regulatory frameworks, market development and design, and market change implementation.

This includes the establishment of energy governance framework and national planning arrangements, network and retail pricing reforms, establishment of the gas Short Term Trading Market, implementation of Power of Choice and demand side initiatives, including the AEMO/ARENA DR trial, and the COAG Energy Council's Gas Market Reform Group. Violette has a Bachelor of Economics and Commerce with Honours.

Craig Chambers

Craig has over 27 years of experience in the energy and climate sector. His diverse background spans pioneering distributed and renewable energy innovation to founding a vertically integrated start-up, in addition to leading corporate strategy, regulation and pricing for Australia's largest utility group.

As a thought leader, Craig has supported the electricity sector to adapt to new technologies, adjust to changes in customer behaviour, and deployed innovative business models to achieve sustainable transformation. He is an industry advisor, chairs the DEIP Program and leads DER and EV transactions at ARENA.

Darren Gladman

Director, Distributed Energy
Clean Energy Council

Darren has extensive experience in policy, communications and stakeholder engagement in energy and climate change policy.

He leads the Clean Energy Council's policy and advocacy for distributed energy, which includes industry development and regulatory issues in areas such as distribution networks, solar and battery systems, product standards and consumer protection.

He has been with CEC since 2012. Prior to joining CEC he was a senior manager and policy adviser for the Victorian Government.

Gavin Dufty

Senior Executive / Policy and Research Manager, St Vincent de Paul Society Victoria

Gavin has been as a consumer representative in the energy sector for over 25 years. During this time, he has undertaken research electricity disconnections; documented changes in energy pricing and its impacts on households; and been involved in the development of state and federal energy consumer protection and concession frameworks.

Gavin is currently a representative of a number of industry and government committees including: gas and electricity distribution companies customer consultative committees; AGL's national customer council; the AER's customer consultative group; and an Energy Consumers Australia board member.

Australian Gas Infrastructure Group - Hydrogen Park South Australia (HyP SA)

2021 Finalist
Industry Innovation Award

Principal company:
Australian Gas Infrastructure Group

Project partners:
The $14.5 million HyP SA project is supported by a $4.9 million grant from the South Australian Government's Renewable Technology Fund.

AGIG is also supported by:

- The City of Marion
- Valmec, who led construction;
- GPA Engineering, who led design;
- Siemens, who supplied the electrolyser; and
- BOC Ltd, who supply to industry via tube trailer facilities.

Project timeline:
2018 – 2021 (ongoing)

Location:
Mitchell Park, South Australia

Funding:
The $14.5 million project is supported by a $4.9 million grant from the SA Government's Renewable Technology Fund (RTF).

Themes:
HyP SA is aligned with the themes identified in the Energy Network Transformation Roadmap by:

- enhancing relationships with customers
- engaging with customers and the community in new ways
- delivering a new and innovative product to customers

Description:
HyP SA is delivering a five per cent renewable hydrogen blend to more than 700 homes, and 100 per cent renewable hydrogen to industry throughout Australia via heavy haulage.

Rationale:
AGIG considers it a corporate responsibility to pursue projects such as HyP SA to deliver lowest cost decarbonisation while retaining safe and reliable energy supply. HyP SA paves the way for future hydrogen and renewable gas projects in Australia, with key technical, regulatory, commercial, and stakeholder and community engagement programs undertaken to remove market barriers.

Approach:
Being an Australian-first project and a leadership project for Gas Vision 2050, it was essential the approach was transparent, collaborative and genuine across all key stakeholders including the community. Underpinned by continued two-way-communication, AGIG captured the knowledge, strengths and expertise of each party to ensure best-practice delivery.

Benefit, results and outcomes:
Through HyP SA, Mitchell Park customers receive Australia's lowest carbon gas through the existing network. They pay no more than if they were receiving 100 per cent natural gas. Being an Australian-first project, innovation and leadership has occurred across the development. Key outcomes include:

- Environmental benefits through supply of five per cent renewable hydrogen to more than 700 homes saving almost 13 tonnes of carbon dioxide per annum.
- A major supplier to industry through an Australian-first application of trucks to transport renewable hydrogen.
- Establishing a new standard for engaging on the future of gas, reaching tens of thousands of South Australians through various face-to-face, mail and online mediums.
- Deploying Australia's first megawatt-scale Proton Exchange Membrane electrolyser and demonstrating how electrolysers can be integrated into electricity and gas networks to support grid stability and decarbonisation.
- Underpinning future projects by removing barriers to achieving key technical, regulatory, and commercial approvals.

All aspects of renewable hydrogen production and supply are now considered 'business-as-usual' for AGIG.

Innovation leadership:
HyP SA has provided critical learnings that will enable further projects to be delivered by:

- Achieving relevant approvals for an Australian-first
- Appliance compatibility testing
- Downstream network considerations
- Community engagement

Innovation impact:
HyP SA has upskilled professionals, technicians, tradespeople, engineers, and first responders throughout the energy industry as well as the public sector. Renewable hydrogen production and delivery is now business-as-usual for AGIG, as it seeks to deliver more projects and achieve AGIG's vision of 100 per cent renewable gas networks. HyP SA has established a new standard for engaging on the renewable gas transformation.

Knowledge sharing:
HyP SA has been purposefully located in Australia's leading innovation district in metropolitan Adelaide to host site tours for anyone seeking to learn more. The site has hosted hundreds of visitors to boost education and provide confidence in the industry's wider development.

Ausgrid - A Shared DSO Vision

Principal company:
Ausgrid

Project partners:
Energy Networks Australia and contributions from cross industry DSO Vision Working Group, with representatives from AusNet, CitiPower, Powercor, United Energy, Endeavour Energy, Essential Energy, Energy Queensland, EvoEnergy, Horizon Power, Western Power, TasNetworks and SA Power Networks.

Project timeline:
October 2020 – February 2021

Funding:
Business as usual funding

Themes:

- Customer oriented electricity
- Carbon abatement
- Incentives and network regulation
- Power system security
- Intelligent networks and markets

Description:
Ausgrid led the development of a shared Distribution System Operator (DSO) Vision that sets out what the role is of distributed networks service providers (DNSP) and, importantly, what it is not.

Rationale:
Energy policy development in Australia has continued at pace over 2020-2021. The interconnectedness of network businesses and the importance of Ausgrid's role in the end-to-end supply chain made a shared DSO Vision essential for networks and the wider industry.

Approach:
Ausgrid established a cross-business DSO working group and Executive DSO Steering Committee to improve the coordination and alignment across the organisation which culminated in an Ausgrid DSO Vision. Although DNSPs were largely aligned on the steps required to integrate DER, there lacked a common language to articulate them. Considerable confusion still existed over the role of DNSPs as DSOs. Ausgrid proposed the development of a DNSP wide DSO Vision to ENA's Policy and Strategy Committee. Energy Networks Australia established a DSO Vision working group, calling for regulatory and technical members from across networks.

Benefits:

- The shared vision has formed the basis for engagement with consumer groups and market bodies.
- The Vision has been referenced in several DNSPs' submissions to the ESB's paper and is being adopted by stakeholders outside of DNSPs.
- The Vision provides a basis for assessing capabilities and informing investments that DSOs use to dynamically manage network capacity, optimise value to customers and support the energy transition.

Outcomes for electricity customers:

- A shared vision on a single page that consumer representatives can engage with and comment on.
- The "what DSOs don't do" section has defined important boundaries in roles and responsibilities and increased collaboration between DNSPs, AEMO and new market entrants.
- The collaboration with other network businesses significantly improved the DSO Vision and external stakeholder acceptance of the DSO Vision.

Innovation leadership:
The DSO Vision is a cohesive framework that leverages existing concepts (tariff reform, flexible export limits, smart grids) to set out a vision for the role of the network and identifies what is out of scope for network businesses. The shared DSO Vision and the collaborative process that led to its development, has led to fortnightly meetings with ENA's DSO Vision Working Group.

Innovation impact:
It is imperative that all network businesses work together. The customers, partners, and market bodies Ausgrid interacts with also interact with other networks and a shared policy position strengthens the case for change and stakeholder trust.

Endeavour Energy -Off Peak Plus

Principal company:
Endeavour Energy

Project partners:
Metering and data provider Intellihub and ten electricity retailers

Project timeline:
July 2019 to July 2021

Location:
Albion Park in the Illawarra

Funding:
This program was funded by the AER's demand management incentive scheme.

Themes:
Off Peak Plus embraces the five key domains of the ENTR including:

- Customer oriented electricity
- Power system security
- Carbon abatement
- Incentives and network regulation
- Intelligent networks and markets

Description:
Endeavour Energy and partners collaborated to install 2,500 smart meters in homes designed to link with hot water systems to help manage rapidly increasing solar PV systems across its network.

Smart meters dynamically control each hot water system installed by Endeavour Energy or any of the participating electricity retailers. This means hot water systems can be switched on to soak up solar energy on low demand days when large amounts are being exported to the electricity grid.

Rationale:
Endeavour Energy sought to identify a better way to replace last century, ripple control technology at Endeavour's Albion Park Zone substation to manage hot water load control, and to better regulate local grid voltage caused by record numbers of customers connecting to its network.

Approach:
Under the rules, metering swaps can only be made in NSW if the meter fails, and these swaps need to be retailer led. Endeavour Energy approached the AER for regulatory approval and worked with Intellihub to sign up ten retailers, agreeing to share data and to contact customers to secure replacement of the meters that enabled retailers to develop virtual power plant-style products.

Benefit, results and outcomes:
Off Peak Plus offers a world leading approach to controlling off peak hot water systems through smart metering instead of traditional network equipment. It has helped to future proof the grid, manage peak demand, improve network performance, save customers money and allow more solar to safely connect to the grid.

Innovation leadership:
This project demonstrates a significant improvement in total benefits to customers and the system by leveraging smart metering-based off peak control compared with traditional network control systems.

The increasing saturation of residential solar energy in many parts of Australia means excess energy flowing into the grid can cause problems with voltage regulation. Networks cannot always see or predict when and where this is happening.

The Off Peak Plus program offers a smarter alternative for industry, regulators and consumers. It can provide access to real time data about the state of the network at the street level and it will allow Endeavour Energy to manage the voltage on the network and to allow more and more solar to connect.

Innovation impact:
Off Peak Plus has fostered greater industry wide collaboration to deliver a solution that improves customer outcomes and demonstrated that this collaboration across the industry can be successful.

Ergon Energy Network and Energex - Maximising Distributed Energy Resources using State Estimation

2021 Winner
Industry Innovation Award

Principal company:
Ergon Energex EQ

Project partners:
Ergon Energy Network & Energex: Queensland's distribution network service providers and GridQube, Distribution System State Estimation & Optimisation Technology Partner.

Project timeline:
July 2020 – June 2021

Location:
Five Energex depots in south-east, QLD.

Funding:
Network Businesses – Ergon Energy Network and Energex

Themes:
Electricity Network Transformation Roadmap themes at the core of this innovative project are:

- Intelligent Networks & Markets
- Customer Oriented Electricity
- Carbon Abatement

Description:
This ground-breaking work uses distribution system state estimation (DSSE) driven dynamic operating envelopes (DOEs) running within a distribution network's operational platform. Energex can now understand how the network is performing in real-time and can maximise opportunities for distributed energy resources (DER), particularly exports from enabled PV systems, without risking network safety or performance. DSSE is an efficient way to generate a complete and consistent picture of the operational state of the network with limited input data.

Rationale:
A lack of network visibility coupled with an inability to manage export intelligently and dynamically from rooftop PV systems is a challenge which must be addressed if Australia is to meet its renewable energy targets. This innovative project has established a digital platform within the network's operational technology environment capable of generating an accurate picture of real-time medium and low voltage network operation cost-effectively.

Approach:
The successful implementation of DSSE within the network businesses required collaboration between our engineering, metering and digital teams and Queensland technology start-up GridQube.

Benefit, results and outcomes:
The Ergon Energex production-ready system performs a comprehensive near real-time assessment of the local network via state estimation, evaluating network voltages and available capacity, and computes an optimal operating envelope for DER which is then published to systems connected to that network. Establishing secure, scalable dataflows between operational systems and the cloud-based platform was paramount to Ergon Energex success and required strong technical collaboration between internal and external stakeholders. Improved outcomes for energy network customers include:

- Potential for additional revenue from solar exports and connection of larger systems.
- Reduced network expenditure required to manage DER impacts.
- Efficient network augmentation gained by understanding binding network constraints and quantifying benefits of standard mitigation actions through simulations.
- Increased network utilisation and renewable generation connection
- Improved power quality and equity.
- Displacement of higher cost fossil fuel generation by renewables.

Innovation leadership:
The interconnected energy system spanning from large scale generators down to prosumers is growing more complex. Advances in computing, communications and the increased availability of network monitoring has enabled state estimation techniques, widely applied in transmission networks, to enter the realm of distribution networks.

Innovation impact:
Ergon Energex is focused on increasing solar export opportunities for customers, particularly commercial and industrial customers with larger PV systems. This project exemplifies an innovative approach to developing engineering solutions to the complex challenges facing the industry. Ergon Energex has learned the architecture and management of cloud-based infrastructure, data streaming platforms and the associated cybersecurity considerations are an emerging skillset and are working to grow expertise.

Ergon Energy Network and Energex - Microgrid and Isolated Systems Test (MIST) Facility

Principal company:
Ergon Energex EQ

Project partners:
Ergon Energy Network; Clarke & Prince Architects; Babinda Electric – Electrical contractor; Osborne Constructions – Building contractor; Aurecon – Electrical designer; ICON Technologies – Monitoring system integrator; RTDS Technologies – Manufacturer of real-time digital simulator.

Project timeline:
Construction started Jan 2020 and finished in Dec 2020; Facility Operations – Ongoing

Location:
Cairns, QLD

Funding:
Funded by the Energy Queensland Group

Themes:
Electricity Network Transformation Roadmap themes at the core of this innovative project are:

- Customer Oriented Electricity
- Carbon Abatement
- Intelligent Networks & Markets

Description:
The Microgrid and Isolated Systems Test (MIST) facility is a state-of-art research and development facility that integrates advanced real-time network simulation, high power live testing capabilities and high-speed accurate monitoring. MIST enables stress-testing of equipment under realistic network conditions in a controlled laboratory environment.

Rationale:
MIST is purposefully located in Cairns as the hub and transition point between the weakest parts of the northern NEM and Ergon Energex remote power stations. It provides infrastructure that allows new equipment and technologies to be prototyped and functionally tested prior to installation on Queensland's distribution network and isolated power systems.

Approach:
The facility is designed to cater for both the standard operational testing required by the business, and the capability to test new products and systems to fast-track deployment. The project was a significant collaborative process bringing together multiple disciplines including electrical, structural/civil, mechanical, building design, control systems, data acquisition systems and specialist simulation equipment. MIST is intended to be accessible for academic research purposes through EQL's existing ties to most Queensland universities.

Benefit, results and outcomes:
MIST infrastructure consists of the following:

- A high-power switchboard which is rated to handle live testing of multiple electrical devices up to 1MVA each.
- Dedicated 1MVA grid connection with synchrophasor technology and full export capability.
- Real time digital simulator (RTDS) with linear power amplifier for Hardware in the Loop (HIL) and Power Hardware in the Loop (PHIL) testing.
- Fully integrated and end-to-end high-speed monitoring system which handles data acquisition, processing and reporting.
- 60kW solar array and 40kW solar simulator.
- 83kVA/200kWh battery system with microgrid functionality.
- Classroom training and knowledge sharing room adjacent to the test laboratory.

Although MIST is only recently operational, already we have some key outcomes, including:

- Testing of the draft AS4777.2:2020 procedures.
- Implementation of EQL's new future power station control systems and demonstrated integration of solar PV.
- Performance testing of over 10 diesel generation sets for EQL's isolated power stations.
- Ongoing work in development of detailed RTDS models for EQL's distribution networks, and integration into EQL's operational communications network.

Innovation leadership:
The infrastructure scale and capability of MIST is an Australian DNSP first, able to simulate network events in real-time, using Power Hardware in the Loop (PHIL) testing, while simultaneously able to test multiple large, distributed energy resources together. The new MIST facility provides a strong and significant technological platform, encapsulating all the tools needed to drive innovation and future-proof the energy sector.

Innovation impact:
MIST has led to a significant shift within the distribution business and highlighted the importance of technical development, research and innovation. Change is not always easy, particularly for regulated network businesses. One challenge the business faces is when bringing in new and different equipment or processes, it takes time for individuals to adjust and to recognise the potential benefits to their day-to-day activities.

Horizon Power - Carnarvon Distributed Energy Resource Trials

2021 Finalist
Industry Innovation Award

Principal company:
Horizon Power

Project partners:
Murdoch University, Australian Renewable Energy Agency (ARENA)

Project timeline:
January 2017 to July 2021

Location:
Carnarvon, Western Australia

Funding:
ARENA, Advancing Renewables Program

Themes:
Customer-oriented electricity; Power system security; Intelligent networks and markets

Description:
Horizon Power has conducted a series of distributed energy resource (DER) technology trials to test the technical and economic viability of a high penetration DER future for towns across regional Australia. The project installed a variety of DER technologies, meteorological data gathering systems and internet of things (IoT) devices in houses and businesses in the town of Carnarvon.

Rationale:
The project sought to understand the impact of the energy transition on Horizon Power's business model, system planning, technology choices, operational practices, and the development of innovative customer-facing products.

Approach:
Horizon Power recruited 116 customers with rooftop solar to participate and recruited additional participants who received a DER system consisting of solar panels, a solar inverter, battery and battery inverter, DER control technology, and a Wattwatchers device.

Benefit, results and outcomes:
The project has examined solar variability, its impact on DER, and the subsequent effect on network operation and improved DER hosting capacity calculation methodologies.

- built a DER monitor and control (DMCS) software stack that combines business intelligence and publishes dynamic operating envelopes to a third-party DER aggregator.
- aggregated DER into virtual power plants within a microgrid setting.
- developed equitable feed-in-management techniques for DER.
- used price signals to optimise behind-the-meter battery operation and quantify customer and network value.
- concentrated investment in customer-side DER onto a feeder with an existing high penetration of DER, creating a very-high penetration DER environment to test DER management and potential impact on future operational practices.
- used a microgrid controller and VPP to island a specific feeder from the broader network to create a 100 per cent renewable energy inverter-only operational environment.
- tested scenarios where customer DER provides network support services such as Q-control, frequency and voltage support.
- used analysis of AMI data to identify single phase solar inverters contributing to network voltage excursions, which can be reassigned to less congested phases bringing the network closer to balance during times of peak solar.
- used AMI data to audit customer inverter settings and improve performance.

Innovation leadership:
The project team worked tirelessly to bring the whole company on the transformative journey, challenging traditional assumptions, painting a visionary picture of a distributed energy future, exploring options for customer value creation, and building coalitions of support through sophisticated data visualisation and communication tools.

Innovation impact:
The project collected about 390 million data points a day, providing valuable first-hand experience using IoT networks to build energy and weather-specific situational awareness by merging customer, network and meteorological data. There is a solid drive to harness data and leverage its ability to contribute to operational efficiency, affordability, reliability and sustainability of the energy system and network services. Lessons learned in the energy data analysis realm have provided substantial value in creating new system planning and long-term forecasting tools.

Accelerating the renewable gas transition: Western Sydney Green Gas Project

Principal company:
Jemena

Project partners:
Jemena Gas Networks and the Australian Renewable Energy Agency (ARENA).

Project timeline:
July 2017 to August 2021

Location:
Horsley Park, New South Wales

Funding:
The $15 million project was co-funded by Jemena and ARENA through ARENA's Advancing Renewables Program.

Themes:
The goals and objectives of the Western Sydney Green Gas project align strongly with Energy Networks Australia's Gas Vision 2050.

Description:
Jemena designed and constructed Australia's most comprehensive Power-to-Gas ("P2G") project, which sources renewable electricity and converts it into hydrogen via electrolysis. This living laboratory showcases bi-directional interconnectivity between electricity and gas systems and is Australia's first renewable gas pipeline. Jemena will blend green hydrogen into the network making renewable gas available to customers. It will also test how to develop affordable energy storage to complement renewable energy.

Rationale:
The project was considered an important steppingstone to support the decarbonisation of Australia's energy market by demonstrating a long-term storage solution for intermittent renewable energy, both within the gas distribution networks as well as conversion to a clean fuel for hydrogen vehicles.

Approach:
There were three key streams of engagement to bring the project from conception to completion:

- Legislative and commercial regulatory frameworks
- Safety and technical regulatory frameworks
- Plant safety and development approvals

Benefit, results and outcomes:
The successful completion of NSW's first electrolyser and Australia's most comprehensive hydrogen demonstration is a significant milestone for the energy industry. The application and integration of novel technologies presented ongoing challenges across procurement, engineering and design, through to construction and integration. One of the key project outcomes was to establish frameworks to facilitate the development of future hydrogen projects across Australia. The absence of technical and commercial regulatory frameworks for the injection and distribution of hydrogen required an extensive stakeholder engagement program to obtain the appropriate approvals and social licence. A key lesson was to engage stakeholders early, given the innovative nature of the project.

Innovation leadership:
Hydrogen can revolutionise the energy industry, creating opportunities for new technologies and jobs. This project, a living hydrogen laboratory, provides a platform for ongoing industry leadership. The project, and its sector coupling opportunities has attracted interest from a range of stakeholders involved in Australia's decarbonisation goals. A highlight of the project was the constant evolution, with the team leveraging emerging applications of hydrogen to maximise innovation opportunities. The project has set the precedent for the successful trial of future energy systems for the gas and also electrical networks.

Innovation impact:
It is important to highlight the significance of the integration of a novel asset, which requires completely new processes and procedures. Given Jemena's involvement across both the electricity and gas sectors, it was seen as an opportunity to expand capabilities and upskill its workforce. During integration with operations, the team undertook a comprehensive integration process, ensuring all existing artefacts and processes were amended to reflect the nuances of hydrogen. Hydrogen must be managed differently to natural gas, given it is unodourised, the flame is invisible and can leak more readily. The new safety system ensures Jemena will have hydrogen trained personnel ready for operation and maintenance activities involving hydrogen across the network – a critical capability for the rapidly changing energy landscape.

SA Power Networks - Enhanced Voltage Management Project

Principal company:
SA Power Networks (SAPN)

Project partners:
AEMO, SA Government

Project timeline:
June 2020 to March 2021

Location:
South Australia

Themes:
Power System Security, Grid Transformation, Network Optimisation & Platforms

Description:
The Enhanced Voltage Management Project (EVM) enables fine-grained management of substation voltage to increase state demand by lifting the system voltage above the high-voltage trip point of solar inverters. No retrofits were required to customers' solar systems, there was negligible impact on customer amenity, and the same capabilities are being used to better manage voltages on a day-to-day basis.

Rationale:
A significant imminent threat to SA power system security has emerged - the need to "keep the lights on", combined with the desire to facilitate more solar on the network, means an urgent solution is required. SA Power Networks developed, tested and urgently deployed an innovative voltage management solution that could provide a solar 'feed-in-management' capability to assist in managing system security emergencies, while significantly improving hosting capacity at all other times.

Benefit, results and outcomes:

- Provided AEMO with up to 300MW of PV curtailment during minimum demand events;
- Improved voltage for 80 per cent of SA customers ;
- More than doubled the amount of rooftop solar that can be accommodated on the network;
- Improved power quality during high solar export periods;
- Maintained power quality at peak demand times; and
- Delivered at a highly efficient cost.

Insights from this project for future work include:

- voltage management is an efficient way to provide system wide feed-in-management to existing solar PV systems in emergency conditions.
- dynamic substation voltage control can significantly increase the amount of solar that can be accommodated on distribution networks.
- joint voltage control planning across distribution and transmission networks has the potential to further increase solar hosting capacity.
- customer voltage data can provide a powerful source of information and feedback to improve voltage management in networks.

Innovation leadership:
The innovative solutions employed in South Australia will act as a test bed and incubator for the design of Australia's high DER power system. Using the substation voltage to wind up state demand when required by switching off existing solar systems, all without any retrofits and without perceivably impacting on customer amenity, is ground-breaking.

Innovation impact:
The innovative collaboration models developed by AEMO, SA Power Networks and the SA Government enabled solutions to be rapidly co-designed, approved and implemented. This has enabled the successful implementation of remote disconnect/reconnect requirements, improvements in system restart procedures and improving the effectiveness of the Under Frequency Load Shedding scheme in SA.

Using voltage management to curtail PV en masse had never been done before, and a rapid research and development activity was required to build the confidence to take the concept from a novel idea to full-scale deployment.

United Energy - Pole-top battery expansion program

Principal company:
United Energy

Project partners:
United Energy, ARENA, retail partner

Project timeline:
June 2019 – March 2022

Location:
South - eastern Melbourne, Victoria

Funding:
The $11 million project includes $7 million from United Energy and $4 million from ARENA.

The two trial units were funded by United Energy and using Demand Management Innovation Allowance (DMIA) research and development funding.

Themes:
This project addresses many of the themes identified in ENA's Electricity Network Transformation Roadmap.

- Customer oriented electricity
- Power System Security
- Carbon Abatement
- Incentives and Network Regulation
- Intelligent Networks and Regulation

Description:
This innovative project is installing 30kW (or 66kWh) community batteries on power poles across 40 residential areas. By installing these batteries on the network, United Energy will help sustain 99.99 per cent power reliability for customers, support those with rooftop solar to get the most out of their investment and enable all customers to support a cleaner energy future.

Rationale:
Each pole-mounted battery on the low voltage network has been proven to support between 50 and 75 homes in the immediate vicinity with reliable, stored energy for up to 2.2 hours at a time. On peak demand days there is a risk of outages because the network cannot physically move enough electricity to meet customer needs. Installing batteries to provide an alternative source of electricity helps defer traditional network investment and offers additional benefits to all customers.

Approach:
Network constraints are just one of the factors taken into consideration in planning for the location of our pole-top batteries. Other criteria considered included:

- the density of housing around the area:
- the potential for visual amenity impacts:
- whether the low-level noise that comes from the battery could impact anyone around it.

The batteries will charge at times of the day when there is low electricity demand or when local rooftop solar systems are exporting into the network. Power from the batteries can then be used later in the day when demand is high and solar systems are no longer generating. United Energy partnered with an energy retailer partner on this project.

Benefit, results and outcomes:
The batteries offer benefits for local customers whether they have solar on the roof or not. They can:

- provide everyone in the community with access to renewable energy:
- help customers get the benefits of having a battery to draw down on for extra power without having to buy one for their home:
- improve the reliability of electricity supplied in the community, particularly during peak demand times:
- increase the network capacity to allow more homes to connect and export from rooftop solar systems:
- improve the quality of electricity supplied by our distribution network:
- help reduce network charges for customers by avoiding traditional network upgrades.

Innovation leadership:
The project is highlighting the role low-voltage (LV) connected batteries can play to manage constraints and increase the hosting capacity of the network for rooftop solar, thereby facilitating greater deployment of rooftop solar across the network.

Specific innovation targeted incudes:

- improved technology readiness for LV Batteries through improved understanding of the design, manufacture and installation requirements:
- improved commercial readiness for LV Batteries by capturing value for network and market services and demonstrating the merit of the LV Battery business model; and
- reduction in barriers for installing residential solar by demonstrating the technical and commercial feasibility of using LV Batteries to increase network hosting capacity on low voltage network.

Western Power - Flexibility Services Pilot

2021 Finalist
Industry Innovation Award

Principal company:
Western Power

Project partners:
Western Power, Schneider Electric and Western Power's commercial and industrial customers

Project timeline:
April 2020 to September 2020

Location:
Perth, Western Australia

Funding:
NA

Themes:
Energy Network Transformation Roadmap: 'networks will play a key role in the delivery and connection of an expanding range of innovative products and services to customers.'

Description:
Western Power has seen the widespread adoption of rooftop solar PV generation in its service area, creating low loads on weekends and holidays and during spring and autumn periods, challenging grid stability. Western Power created a pilot to learn how customer owned assets could help support network constraints. By addressing these occasional low loads, Western Power has improved grid stability and encourage greater renewable penetration.

Rationale:
Western Power needed to build capability to enable two-way flow of energy on its network. During system low events, this required flexibility in managing customer assets to create a net load increase through managing solar generation and shifting load behaviour to the middle of the day. This innovative program is one way Western Power is smoothing the 'duck curve' into a 'platypus' and enabling a future where more renewables can be connected to the grid through an agile, flexible network operation.

Approach:
The Flexibility Services Pilot was the first project of its kind in WA, arguably in the world, and a key component of Western Power's drive to create a more sustainable, reliable and innovative network for the future by enabling customer assets.

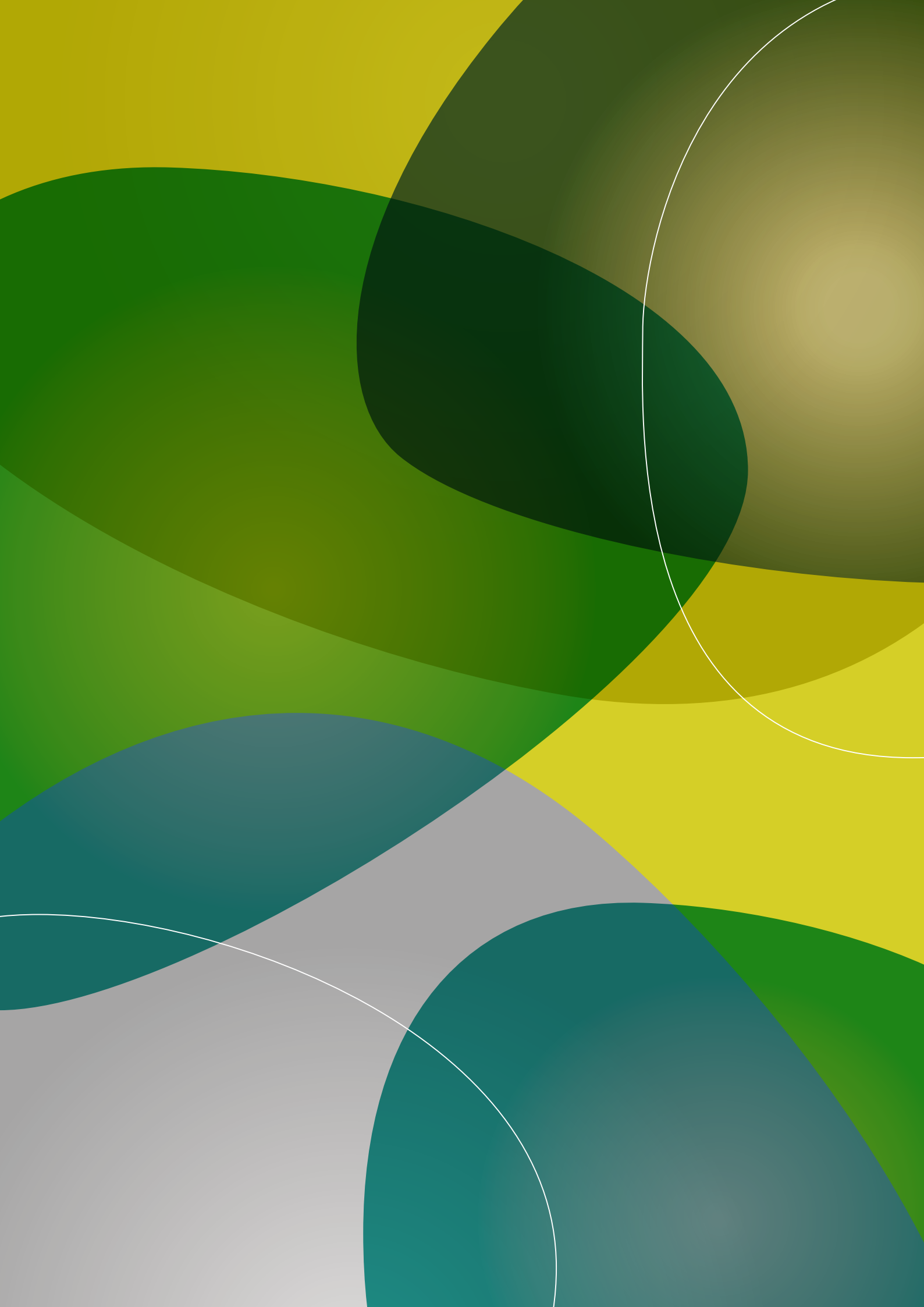
Western Power collaborated with Schneider Electric to develop a custom platform to manage participting businesses and understand how their flexibility could be measured and verified for the service they were providing the network. Western Power recruited businesses to participate in the Pilot both directly, and via partners/aggregators. The sector's engagement from beginning to end was critical to the success of the Pilot. Western Power held a prototype workshop which comprised 60 representatives form the value chain including suppliers, vendors, WA Government, other national utilities and energy retailers in WA.

Benefit, results and outcomes:
Western Power and their partners recruited more than 250 customers to participate in the program.

Key learnings included:

- Onboarding businesses and partners into a new program quickly and efficiently required a great deal of collaboration
- Flexible commercial arrangements that are co-designed as much as possible are a key to long term efficiency and value
- Understanding the technical challenges and methods for communicating
- Understanding how reliable a flexibility service can be, and what is required to make flexibility services reliable to dynamically balance power flows
- Baseline methodologies used to measure and validate flexibility.

Innovation leadership:
The Flexibility Services Pilot is a significant project that demonstrates how distribution network operators can setup, enrol and dispatch businesses directly and via aggregators to manage grid stability issues. Western Power's pioneering work forms an important test-case for networks who are seeking to contract flexibility to support grid stability and ultimately enable even greater rates of solar and DER adoption, such as electric vehicles. As part of Western Power's commitment to knowledge sharing across the sector, they are coordinating with other networks and industry bodies to share the outcomes of the Pilot.



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