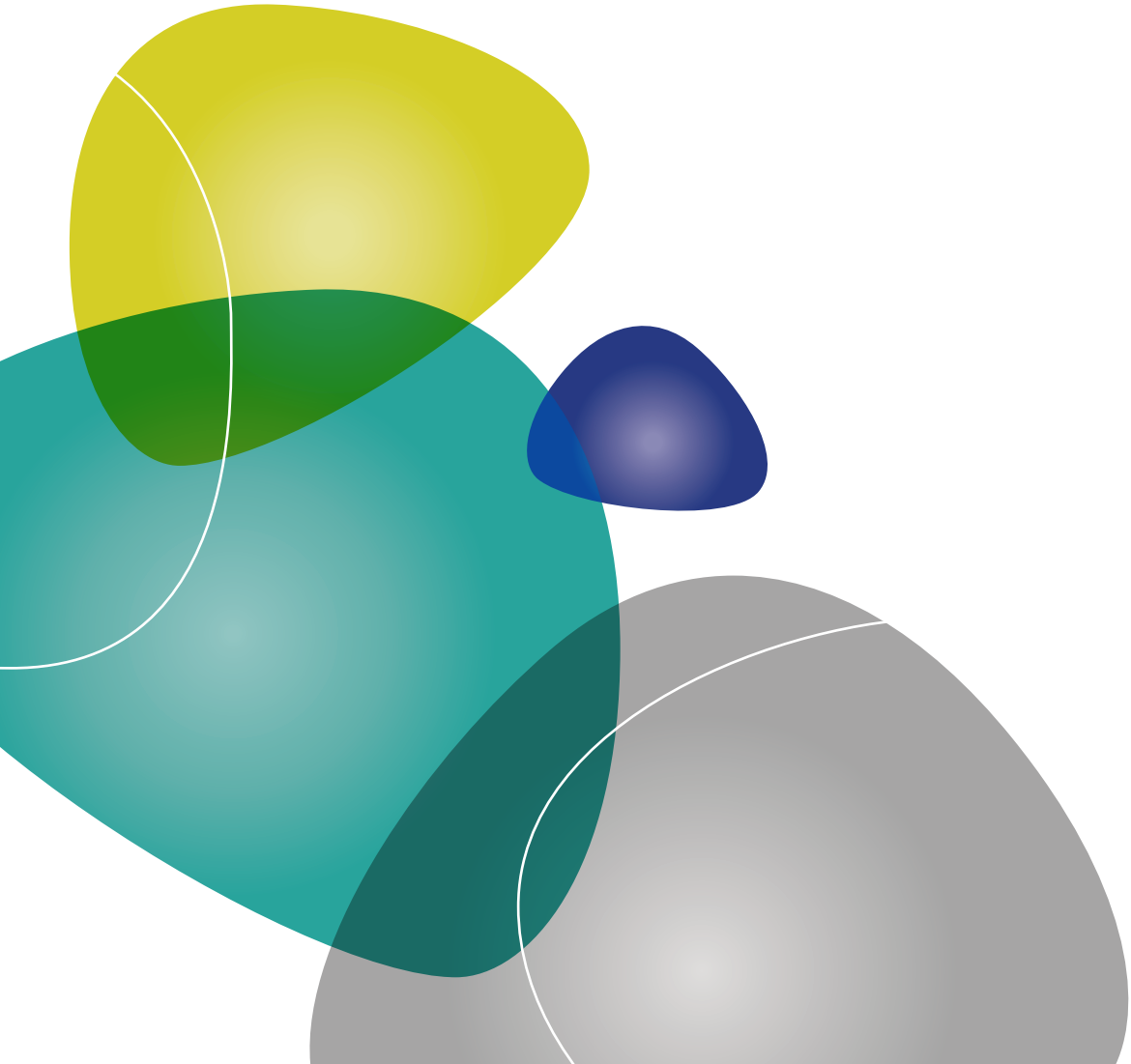
Energy Networks Australia

Network Innovation

2020 Report

This report summarises case studies that were submitted to Energy Networks Australia for the 2019 annual innovation awards.



Andrew Dillon
CEO, Energy Networks Australia

INTRODUCTION

Innovation in Australian energy networks is fundamental to ensure that our 20th century grid can support the 21st century energy revolution and our gas supplies can play their part in a low-emissions future.

The generation, delivery and consumption of electricity is undergoing extensive change. Developments in new types of generation, the emergence of the internet of things, consumer preferences, electrical storage and other drivers are encouraging innovation and adaptation of existing infrastructure to support new demands and directions in network transformation.

The transition to renewable gas such as biogas and hydrogen is also underway. It will provide zero emission energy for household heating and cooking as well as energy storage, utilising existing gas infrastructure.

The benefits associated with the transformation of Australia's power system include:

- Direct participation by customers;
- Accommodating all generation and storage options;
- Enabling new products, services, and markets;
- Providing low-carbon fuel choice;
- Delivering energy storage, power quality and reliability;
- Optimised asset utilisation and operational efficiency;
- Anticipating and responding to system disturbances;
- Operating resiliently and managing environmental impacts.

Significant research, development and deployment is occurring in power networks as new techniques and technologies are investigated to manage changes in demand and generation in the most cost-effective manner.

Across Energy Networks Australia members, many innovative projects are underway to shape the networks of the future. Business investment in research and development is being integrated into the system while improving resilience at both a local and system wide scale.

Networks are also partnering with stakeholders such as universities, retailers and governments to ensure expertise is maintained during these projects.

The scale of the energy transformation underway in Australia is unprecedented. It requires new business and operational practices – working smarter and thinking outside the box.

This report, a compilation of entries to the 2019 Energy Networks Australia Industry Innovation Award, demonstrates just some of the projects our members are delivering to support the transition.

CONTENTS

ATCO's Clean Energy Innovation Hub

2019 Finalist
Industry Innovation Award

Principal Company
ATCO

Project Timeline
July 2018 - June 2021

Location
Jandakot, Western Australia

Funding
ATCO and ARENA

Themes
- Clean Energy Transition
- Safe Reliable and Secure
- Customer Choice and Control

Rationale
A team from across the organisation collaboratively worked towards solving customer concerns and developed the project which aims to:
- Investigate the role of hydrogen in the future energy mix; and
- Test micro-grids enabled by gas technology integrated with solar and batteries

Description
In June 2019, ATCO successfully produced the first 'green' hydrogen (zero emissions fuel) in Australia through its Clean Energy Innovation Hub (CEIH). The CEIH is an industry-leading research and development facility for testing different combinations of clean energy technology including photovoltaics, batteries, gas-fired turbines and the production, storage and end-use of 'green' hydrogen in a 'living lab' micro-grid setup. Pure 'green' hydrogen is stored in a high-pressure storage vessel and thereafter distributed within the micro-grid as a blended fuel for normal consumption, and direct fuel for testing and for back-up power to a residential hybrid energy home.

Approach
ATCO partnered with a stakeholder engagement firm to ensure it implemented a best practice approach to engage with key stakeholders including the local community, our employees, neighbouring businesses and energy companies, local, state and federal government representatives and academics from local universities.

ATCO adopted a multi-channelled approach including in-person, mail and digital communications, which saw the project team door-knocking to meet their neighbours, hosting briefings and workshops for the community and staff and having meetings with local businesses, energy companies and government representatives. There was widespread support for the project from stakeholders with high levels of interest in learning more as the project develops.

Results
ATCO successfully completed integration, testing and commissioning of 300kW of solar photovoltaics, 500kWh of lithium Ion batteries storage and an existing 200kVA natural gas-fired generator with a 23 tonne per annum state-of-art hydrogen production plant.

The fully integrated hydrogen production plant includes a proton exchange membrane electrolyser, high pressure hydrogen storage vessel, custom-built pressure reduction station, hydrogen/natural gas blending station and a suite of downstream consumers. The downstream consumers include a 1.2kW hydrogen fuel cell and existing natural gas appliances: gas powered air conditioning (GPAC), hot water boilers, gas barbeques, heaters and cooktops.

Ballarat Energy Storage System

Principal Company
AusNet Services

Project Timeline
2018 -2019

Location
Ballarat, Victoria

Funding
- ARENA
- Victoria Department of Environment, Land and Water Planning (DELWP)

Themes
- Power System Security
- Intelligent Networks & Markets

Stakeholders
- Energy Australia
- Fluence
- Spotless Downer
- ARENA
- DELWP

Rationale
The project provides capacity comparable to 6,000 residential battery storage systems at a single location.

It was designed to enhance network stability and reduce congestion on Victoria's transmission grid and add a peak power resource to help manage price volatility during high demand periods.

Description
A "supergroup" of Australia's leading electricity sector companies partnered to deliver the Ballarat Energy Storage System, a standalone 30 MW / 30 MWh battery-based energy storage project sited at a critical transmission junction west of Melbourne. The project was aimed at improving and enhancing system security, resilience and reliability, providing key grid stabilisation functions and meet growing demand for flexible, plentiful and low-cost power in Victoria ahead of summer 2018 / 2019.

The project represented several firsts: the first standalone battery-based energy storage system in Australia and the first grid-scale battery-based storage commissioned in Victoria.

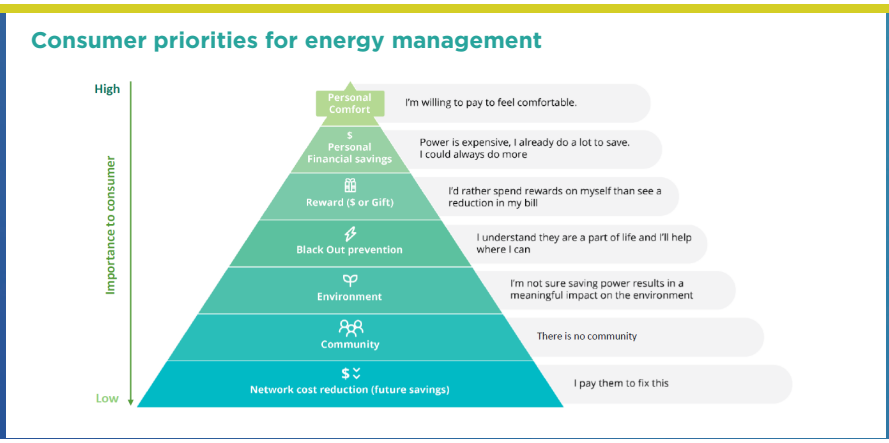
Approach
AusNet Services has been looking at ways to utilise battery storage technology to help with network congestion or other constraints (including stability) and, in turn, help reduce or delay network replacement or augmentation needs as well as resulting costs.

Energy Australia can utilise the technology to achieve several market and grid benefits. The system can be utilised to provide flexible peaking capacity, to provide frequency control ancillary services (FCAS), and the potential for other network services by agreement with a transmission/distribution network provider. The layering of these services enables the storage asset to deliver maximum value to benefit customers in the region.

Results
In its first four months of operation, the Ballarat project delivered more than 1,500 MWh of service to the Victorian grid – injecting power to meet peak needs and providing FCAS to ensure reliability, for which the system has been called on more than 1,400 times by the market operator. AEMO shared in its Q1 2019 Quarterly Energy Dynamics report that FCAS provided by Ballarat "displaced higher-priced supply from other technologies, largely coal."

Despite only representing a small fraction (~0.3%) of Victoria's installed electricity generating capacity, the Ballarat project has been providing about a quarter of Victoria's contingency FCAS services and four percent of its regulation FCAS services, participating in all eight FCAS markets.

Energy Partner



Principal Company

CitiPower Pty Ltd

Powercor Australia Ltd

Project Timeline

April 2018 - February 2019

Location

Network service areas for Powercor and United Energy – Victoria

Funding

Demand Management Innovation Allowance

Themes

- Customer Oriented Electricity
- Demand Response (DR)

Stakeholders

- United Energy Distribution Pty Ltd
- CitySmart
- Queensland University of Technology (QUT)
- Royal Automotive Club of Victoria Limited (RACV)

Rationale

The goal is to increase registration and participation in network-initiated DR programs. By understanding consumer household decision making and electricity use, CitiPower Powercor created insights to engage customers with messaging, solutions, and tactics to maximise participation in peak demand events.

Description

Non-network solutions are increasingly used to ensure reliability during peak demand events, requiring network distribution businesses to engage with customers to reduce load. Customer engagement strategies are considered immature in the electricity sector, with communication channels and messaging broadly targeted without tailored value propositions or segmentation to maximise event participation.

The project team engaged CitySmart to examine household personas within our service areas and overlay those personas with electricity load profiles. This analysis was then tested through focus groups and customer outreach to determine the most effective messaging and channels to drive DR event performance among different household types.

Approach

The networks engaged with RACV as a channel partner to help support the mixed methods research conducted by QUT.

Collaboration with RACV was sought to leverage the member organisation's brand reputation and awareness to drive customer outreach and engagement in the research.

QUT qualitatively surveyed customers to identify persona alignment subsequently overlaying these personas with O-power customer load profiles to apply load profile architypes.

QUT also administered quantitative surveys and undertook a statistical analysis of results – descriptive analysis of measures, reliability and validity testing of self-report scales, significance testing and segmentation analysis using two-step cluster analysis.

Results

The outcomes included:

- Detailed understanding of customer motivations, preferred communications channels, drivers and barriers to uptake for demand response/demand management programs.
- Segmentation of energy consumers by communication channel, energy use and messaging will drive registrations and event participation.
- A methodology for prioritising "high value" households for both controlled load and behavioural demand response programs to reduce the cost of customer acquisition.

Dalrymple Battery Energy Storage

2019 Winner
Industry Innovation Award

Principal Company
ElectraNet

Project Timeline
November 2017 – April 2019

Location
Yorke Peninsula, South Australia

Funding
ARENA

Themes

- Customer Oriented Electricity
- Power System Security
- Intelligent Networks and Markets

Stakeholders

- AGL, AEMO, ABB and
- Consolidated Power Projects (CPP)

Rationale

The objectives of the project were to demonstrate that utility scale battery storage can effectively provide:

- network reliability and security services alongside competitive market services in a network with a high penetration of renewable non-synchronous generation;
- "seamless" islanded operation with 100% renewable generation following transmission outages;
- demonstrate a commercial model for the provision of regulated services and competitive energy market services;
- build delivery capability for such assets.

Description

The Dalrymple 30 MW, 8 MWh BESS is the first transmission grid-connected battery in the National Electricity Market (NEM) providing both regulated and competitive market services. The success of the project, which is now in full commercial operation, required significant innovation leadership including:

- development of a first-of-its-kind commercial model to support the provision of regulated reliability and security services alongside competitive market services;
- navigating the NEM registration, licencing and connection processes for the first time paving the way for others to follow; and
- largest autonomous regional micro-grid development to date co-optimised for both grid-connected and islanded operation with 100 per cent renewables.

Approach

The project targeted a wide range of battery services, including the unprecedented islanding of an 8 MW distribution area with the 90 MW Wattle Point Wind Farm. A collaborative approach was required to achieve these objectives, including regulatory approvals, registration and technical delivery.

ElectraNet conducted a competitive tender process to select CPP as its Engineer Procure and Construct (EPC) contractor who engaged ABB as power system integration partner.

A key challenge was to optimise the BESS control parameters to be suitable for both grid-connected as well as islanded operation. This proved more difficult than expected and required dedication and patience by everybody involved to achieve.

Results

ElectraNet designed, built and owns the BESS and leases commercial operation to AGL. The Dalrymple BESS is the first in the NEM to provide both regulated network reliability and security services alongside competitive market services. In addition, the project also had the ambitious goal to integrate the 90 MW Wattle Point Wind Farm as part of an islanding scheme with the local 8 MW distribution area.

The BESS is successfully achieving all its objectives in operation. Customers are benefiting from the BESS operation through improved reliability and security and the provision of competitive market services.

The Evolution of State Estimation

Principal Companies
- Energex
- United Energy
- TasNetworks

Project Timeline
Dec 2017 – Dec 2019

Location
- Queensland, Victoria and Tasmania

Funding
ARENA

Themes
- Customer Oriented Electricity
- Power System Security
- Intelligent Networks & Markets

Stakeholders
- University of Queensland
- Springfield City Group
- Aurecon
- Australian Power Institute
- Energy Networks Australia
- Queensland University of Technology

Rationale
Distribution Network Service Providers (DNSPs) are facing the issue of accommodating connection of intermittent generation assets into networks over which they have historically had only a limited visibility. With huge numbers of distributed energy resources (DER) now connected further down in the networks, knowledge of what is happening in those networks is becoming paramount. Solar Enablement Initiative (SEI) was established to implement state estimation at a distribution level for historical and near real-time applications and provide complete visibility of distribution network operation.

Description
SEI refined and applied a novel state estimation algorithm (SEA) to operate on medium voltage distribution networks. We then successfully implemented the SEA as a proof of concept across three Australian network distributors. This integration allows the SEA to calculate the most probable system state (point in time snapshot of voltages, currents, power flows) from available data, overcoming the measurement deficiency common to distribution networks. Detailed network visibility is essential and enables increased capability for integrating customer solar and storage. It effectively unlocks the value of energy resources embedded in distribution network.

Approach
The project has been driven through strong relationships between technical and strategic leads from each partner organisation working collaboratively with the project team. While the algorithm existed before the project, the real innovation delivered has been the work done by the project team to successfully integrate it into the network systems. All DNSP participants recognise the immense value of this work and the opportunity it presents to their organisations.

Results
The outcome of this project is the successful implementation of a novel SEA on distribution networks. SEI has overcome the challenges of measurement scarcity, unbalanced loading conditions and sheer scale, common on distribution networks, and which have prevented the adoption of these network analysis techniques in the past. The SEA has enabled the generation of a complete snapshot of voltages, currents and power flows on an entire feeder from only a limited set of network monitoring inputs, resulting in substantial potential cost savings - due to a reduced need for high penetration of monitoring devices.

Customers will also benefit from the comprehensive information generated by the SEA being used to better promote network areas that are DER connection compatible. In time, we hope to migrate to web-based tools where customers can perform their own automated connection assessments.

The near-real time implementation feature paves the way for Distribution System Operator functions. Increased oversight of the near real-time state of the network allows identification of operating envelopes which could be communicated to DER owners, aggregators or other market participants to harness existing network capability to maximise the value of customer DER and increase carbon abatement.

Networks Renewed

Principal Companies
- AusNet Services
- Essential Energy

Project Timeline
September 2016 – April 2019

Location
Collombatti, NSW
Yackandandah, VIC

Funding
ARENA

Themes
- Customer-oriented electricity
- Intelligent networks and markets

Stakeholders
- Reposit Power
- Mondo
- Australian PV Institute
- University Technology Sydney

Rationale
The widespread uptake of rooftop solar is leading to emerging challenges managing voltages and power quality across the distribution networks who are required to maintain customer voltage within 216-253V.

The objective was to prove customer-owned solar and battery storage systems can provide voltage regulation services on the distribution network.

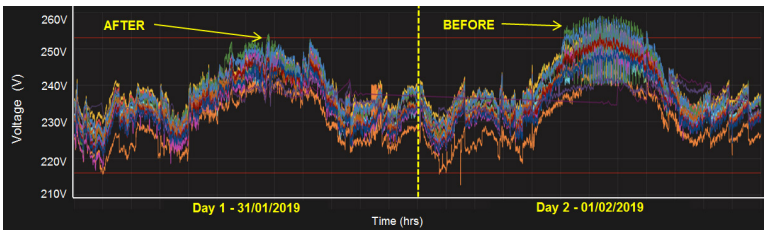
Description
The project has provided real world evidence of customer inverters overlayed with smart control providing voltage management services to distribution networks through dynamic control of real and reactive power. This has enabled a higher uptake of solar PV with minimal customer impact and enabled customer battery storage systems to be centred as a solution to address networks constraints at potentially lower cost compared with traditional network options.

Approach
The project was delivered in two separate stages:
- **Pilot stage:** a limited number of customers to assess the effectiveness of the project plan with an overarching objective of achieving a measurable network benefit from customer systems.
- **Market Stage:** Lessons learnt from the pilot stage guided the design of the Market stage, the number of eligible customers during the Market stage was significantly increased with the aim of addressing an emerging network constraint (Essential Energy)

Results
In Victoria, voltage was reduced by 3-5V (6-8V when combined with a battery) through reactive power control during peak solar production, while in NSW HV feeder level voltage was improved by more than three per cent during peak load.

The project learnings have helped identify and prioritise some of the foundation work required before networks can operate in an environment with a high uptake of DER that supports effective and efficient integration of renewables while maintaining downward pressure on network charges.

The project will improve outcomes for energy network customers including:
- Increased solar hosting capacity on the grid
- Lower electricity charges derived from:
  - Access to distribution market revenue streams
  - Voltage support services from customer DER at a potential lower cost compared to traditional network solutions. A business model detailing the value framework has been developed.
  - Supporting the uptake of lower cost renewables.
- Improved power quality through dynamic voltage management at the premise level



Smart Sun Pilot

Principal Company
Horizon Power

Project Timeline
2017 – 2020 (ongoing)

Location
Broome, Western Australia

Funding

- State Government of Western Australia, through LandCorp and Horizon Power
- Customers

Themes

- Customer oriented electricity
- Incentives & network regulation
- Intelligent networks & markets

Stakeholders

- LandCorp
- CSIRO
- SwitchDin

Rationale

Customers are investing in Distributed Energy Resources (DER), including solar panels. Due to the intermittent nature and reverse power flow inherent in solar generation, there are physical limits to the amount of solar that can be connected to the network.

Through Smart Sun, Horizon Power is piloting a way that DER can be managed in order to overcome these challenges that benefits customers, including land developers, and the wider network.

Description

With the Smart Sun Pilot, Horizon Power and SwitchDin have jointly developed and implemented a first-of-kind virtual power plant with real-time visibility and control of rooftop- solar generation, battery energy storage and customer loads (hot water system, pool pump and air-conditioning) in LandCorp's Warranyjarri estate in Broome.

The Pilot has demonstrated that numerous distributed devices may be coordinated as a fleet to achieve benefits for all parties by:

- reducing lot development cost, through reducing local peak electricity demand and associated infrastructure costs; and
- reducing cost and barriers to the uptake of solar PV installation, by managing PV generation and customer loads.

Approach

The Pilot provides customers with heavily discounted rooftop solar together with battery energy storage to soak up excess solar generation and prevent too much feeding back into the network, while also managing the battery energy storage and customer air-conditioning to reduce peak demand.

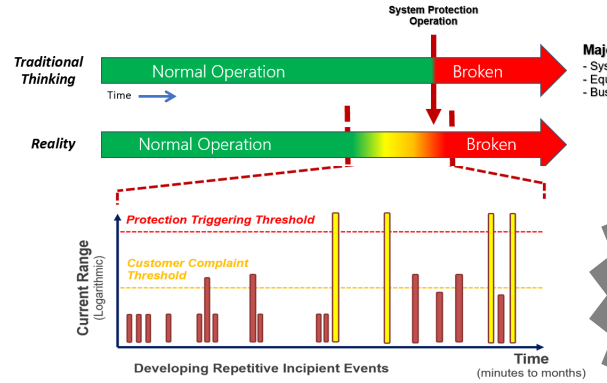
Results

Sun Smart Pilot enabled more customers to connect solar to the network, thus reducing their electricity bills. It also enables a more even spread of electricity demand across the day, thus potentially reducing costly generation or network support and augmentation.

Interim results indicate:

- Savings per household ranged between 40 per cent to 80 per cent
- Average customer satisfaction rating of 95 per cent
- Replacing electric hot water systems with heat pumps resulted in about 70 per cent reduction in hot water energy use
- Air-conditioners contributed significantly to a site's peak electricity usage and were successfully controlled to limit maximum power as a fleet to reduce the local transformer electricity peak
- Controlling rooftop solar PV inverters to reduce output can be effective in avoiding reverse power flow on the distribution transformer
- Peak transformer demand was reduced by about 20 per cent with a 33 per cent customer participation rate
- The barriers of integrating solar PV into microgrids can be managed by battery energy storage systems being controlled to charge during times of excess PV generation, to stop reverse power flow and to reduce the transformer peak by discharging
- 78kW of PV has been installed, with no negative impact to customers or the network, generating over 110MWh of clean energy between January 2018 and the end of February 2019.

Darwin's Distribution Fault Anticipation Trial



2019 Finalist
Industry Innovation Award

Principal Company
Power and Water Corporation

Project Timeline
June 2018 – July 2019 (ongoing)

Location
» Dundee Beach, Darwin, NT

Funding
» Internally Funded – New Technology Trial Implementation Investment

Themes
» Network Operation, Monitoring, and Stability

Stakeholders
» Lord Consulting Ltd

Rationale
Dundee feeder is one of Power and Water's worst performing with more than 200 km of overhead line across native bush, mangrove swamps and farmland. Extended travel results in long outages, many of which are of 'unknown' cause.

The project was to identify the root cause of unknown outages, to develop initiatives to prevent outages from re-occurring and to monitor if these initiatives have been successful. Innovation was needed to identify the parameters of common faults, then the creation of a new fault location model interface/software.

Description
Commencing November 2017, Power and Water commissioned six trial Distribution Fault Anticipation (DFA) devices on their worst performing feeders within Strangways Substation, covering among others, the area of Dundee Beach, Darwin.

DFA is a highly sensitive online monitoring system that analyses the discrete changes in system parameters, alerting the operator to indications of developing faults. DFA algorithmic analysis can also be used to identify system performance trends which otherwise would be invisible through existing system monitoring. The outputs from DFA provide better information for the management of system faults and OPEX investment for performance improvement.

Approach
Between January and July 2018, Dundee Feeder exhibited 82 fault events. Many of these events recorded by the DFA were identified as possible animal origin. Differing phases led to the assumption that these were sporadic Fruit Bat, lightning or vegetation events.

Analysis was carried out to see whether the event parameters held a pattern. It was identified that many exhibited similar fault lengths (10 to 20 cycles). Ongoing, the circuit was then monitored to identify if a pattern to the behaviour of the bats could be established.

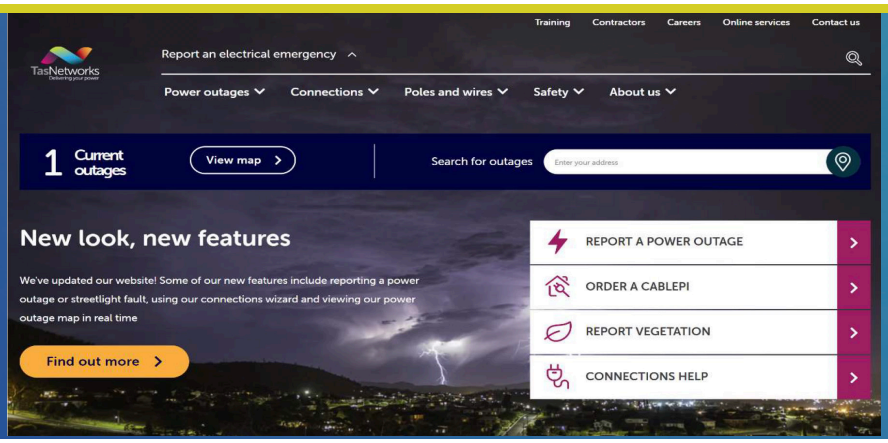
Due to the randomness of the events, Power and Water were not able to determine that almost all of these events were within a small isolated section of the feeder. To enable a more accurate location, an interface was constructed which allowed for the export of DFA waveform files into an aspen fault locator modelling tool. This approach had not been carried out anywhere else before Power and Water's system.

Results
Technical & Operational – Ongoing identification of key parameters of fault activity, enabling the targeted monitoring of similar clustered activity.

Software Development - Development of a conversion tool which translated Power and Water's ArcGIS data into a working geoschematic system impedance model. A conversion tool to import the DFA event waveform files directly into the Fault Location Tool for modelling.

Asset Management - Understanding environmental impacts that affect system behaviour and how design can be used to cost effectively mitigate these risks. In this case, the Bat behaviour was isolated to flat construction poles.

Voice of the Customer



Principal Company
TasNetworks

Project Timeline
Aug 2017 – October 2019

Location
Hobart, Tasmania

Funding
Internally Funded

Themes
Customer oriented electricity

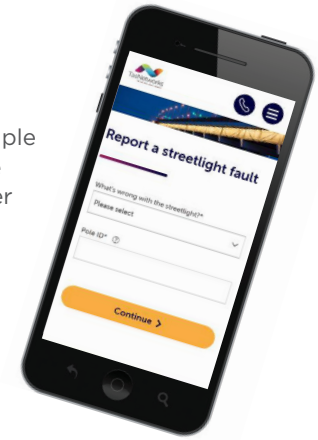
Stakeholders

- 2PM Services – Project Management
- Revium – Public website implementation (design, site structure)
- RXP Services – UX design, Developers
- GMC – Business and Data analysts

Rationale

Customers expected TasNetworks to be more proactive in resolving their enquiries, they wanted consistent, simple information and timely resolution to issues. Customers also wanted choice in how they interact with TasNetworks, with a growing expectation for businesses to offer a variety of communication channels enabling customers to communicate how and when it suits them to fit with their lifestyle.

Description



The program is a step change in how TasNetworks responds to enquiries and increased choice in how and when customers engage with us. We consolidated multiple legacy systems and manual processes into a single case management tool, The Podium, supporting the customer journey from enquiry to resolution. The website has also undergone a significant redevelopment, with the introduction of web chat, integrated online forms and an SMS subscription portal providing customers with alternative communication channels enabling us to communicate time critical information to customers on a range of customer touch points where and when they need them.

Approach

To determine the scope of the program, several workshops were held internally across the organisation. These workshops focussed on identifying pain points that impeded our ability to deliver a high-quality customer experience. TasNetworks also analysed complaint data and monthly survey results to identify key areas of concern to customers and to validate key objectives and scope items.

Throughout the program, TasNetworks provided regular updates to the broader TasNetworks business via interactive roadshows. In later phases of the project, TasNetworks Facebook page was used to encourage people to explore the new website and provide feedback on its usability. Social media users were also encouraged to submit imagery of our electrical assets with a customer submitted image chosen for the welcome page to launch the new TasNetworks website.

Results

One of the most significant benefits is increased employee engagement. The new public website was redesigned to improve outage information, allowing customers to easily view outages across the state and to validate outages impacting them through “check my address” functionality.

Through this new proactive channel of communication customers receive relevant and timely information about issues impacting them, without the need to call, further freeing up the Customer Service Centre to focus on customers and value-added services.

Digital Aspirations Roadmap

Principal Company

Western Power

Project Timeline

July 2018 to June 2020

Location

South West Interconnected System

Funding

Internally Funded

Themes

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

Rationale

The scale and complexity of finding a framework to align and manage Western Power's innovations demonstrated that they had no existing fit-for-purpose processes appropriate for a whole-of-enterprise challenge. Drivers included:

- A forecast change in the value pool for Western Power as the cost of off-grid solutions reaches parity,
- Innovations being developed in a piecemeal manner; and
- A desire to frame innovation investments by which business problem they solved.

The objective was to develop a Roadmap to align innovations with business priorities, encourage a technology-agnostic approach, and support the transformation of Western Power to meet the changing energy needs of customers.

Description

The agile strategy approach was a way to manage a whole-of-enterprise challenge using co-design and collaboration with internal and external ecosystems. It has revolutionised the way Western Power collaborates and develops innovations. The roadmap provides a clear route to align current and future innovations with overarching themes which support a forecast shift in our business model that:

- Promotes an agnostic approach to technology;
- Provides razor-sharp focus on customers; and
- Encourages innovations that contribute to the entire business.

Approach

Using an agile development methodology is not typical in strategy development but presented an opportunity in this instance. Western Power started by engaging its business senior leaders to set a scope for developing the Digital Aspirations Roadmap project. That team then founded a cross-functional team to undertake a collaborative two-day lock-in facilitated by start-up Skills of the Modern Age.

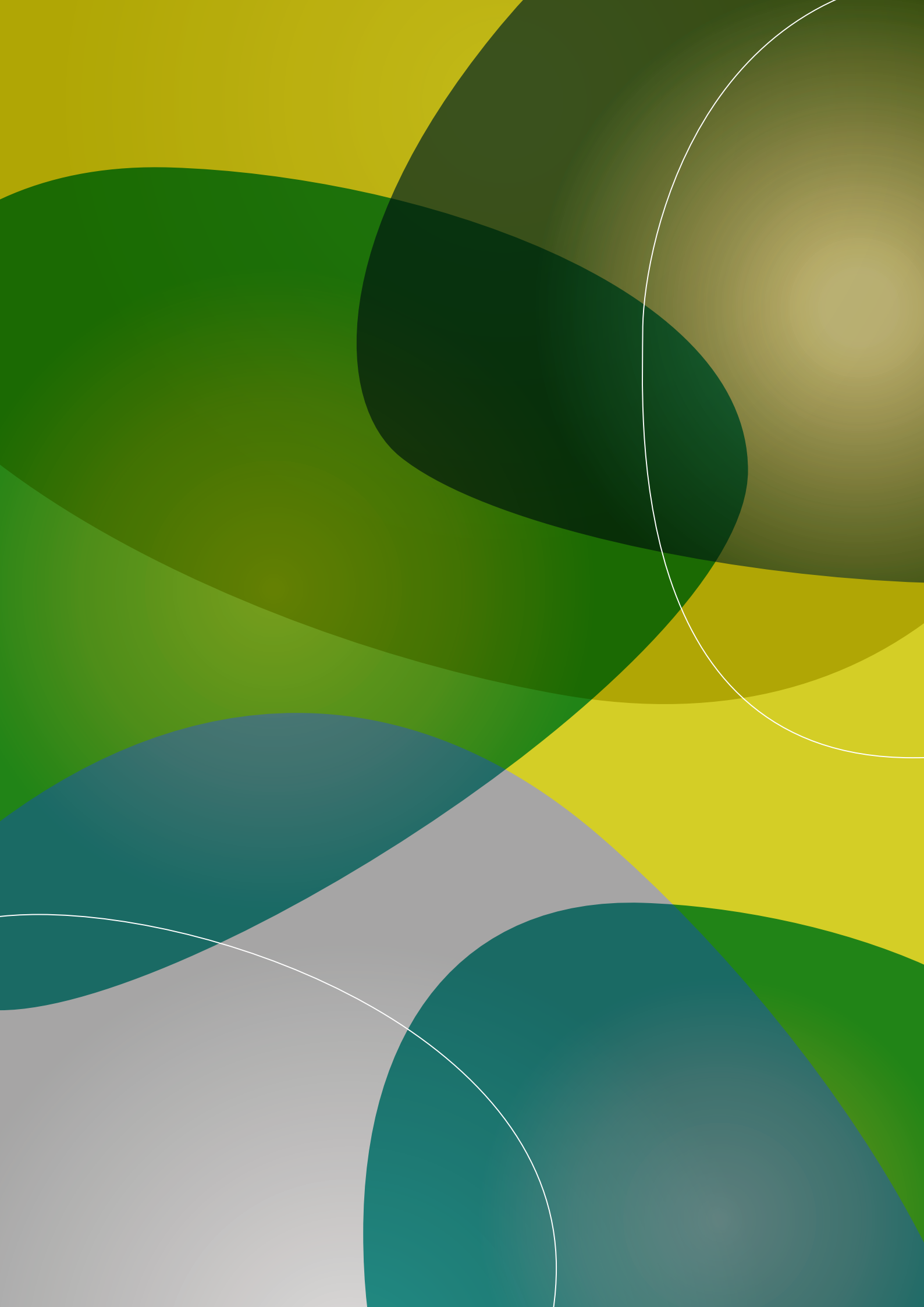
Outcomes included a detailed scope for the roadmap, identification of time horizons for innovations and a detailed pipeline of upcoming projects.

Results

Development of the agile strategy approach for solving enterprise-wide challenges that would result in Western Power transforming to the energy utility of the future has resulted in a new process that best suits the new time horizons utilities across the world must tackle. Like other energy utilities, Western Power has worked on time horizons often counted in decades, particularly in relation to asset management and investment.

The outcomes of this are two-fold:

- The team had the opportunity to ideate innovations that fill the gaps in our roadmap to best address our business needs. This will result in progress and focus on innovations that benefit the employee and customer experience.
- Putting in place data-driven sequencing means the capital profile of Western Power will change as innovations are planned in a strategic and coordinated manner across the enterprise. This also frees capacity, so innovations are prioritised based on best fit basis, rather than first-come, first served.



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