

Welcome to the Grid Edge

MicroGrids, Distributed
Energy Precincts and Grid
Edge innovation

May 2017



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INTRODUCTION

Australia's energy system is undergoing a transformation with customers at the centre.

Solar, battery storage and other distributed energy resources are becoming more efficient and affordable. These technologies are being installed by both customers and energy businesses across the country while other edge of grid technologies are also developing rapidly. These technologies allow customers to participate in the energy system like never before, making the most of their solar and batteries, selling services back to the grid and being rewarded for their energy use choices.

Communities are increasingly seeking to form MicroGrids or mini grids. These systems may at times be self-sufficient or exchange services with the grid for mutual benefit with the wider community.

In remote communities isolated MicroGrids, remote area power supplies and stand alone power systems often prove to be more reliable and cost effective than traditional service delivery. They provide the opportunity not only for some customers to enjoy more reliable electricity, but to reduce costs, by alleviating the need for costly investment in network augmentation while also reducing bushfire risks.

These edge of grid technologies can also support resilience and allow power to be restored to communities more efficiently after natural disasters.

Used effectively, edge of grid applications can ensure reliability of the grid, maintain power quality and help avoid costly network augmentations.

Energy network businesses are committed to working with customers to develop and build the energy system of the future. They are installing and trialling these new technologies and each project allows the network business to better understand potential applications and the needs of the community.

This publication highlights just a few examples of how network businesses from around Australia are working with customers and communities. A more innovative, agile approach can help provide Australian customers with affordable, secure and cleaner energy in an increasingly decentralised and dynamic energy system.

Cyclone Response using Community based MicroGrids

NETWORK BUSINESS

Ergon Energy

PROJECT LOCATION

North Queensland communities between Mackay and Ayr

PROJECT PARTNERS & SUPPLIERS

Ergon Energy, Energex, Essential Energy (NSW)

PROJECT TIMING

March 28 - April 14 2017

CONTACT

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In March 2017 Energy Queensland faced its first major challenge as a business when Tropical Cyclone Debbie wreaked havoc across more than half of Queensland's east coast and there was significant damage caused to its Ergon and Energex distribution networks.

At one point, almost a quarter-of-a-million Queensland customers across the more than 1300 sq kms were without power.

Ergon Energy and Energex, as part of the Energy Queensland group, implemented a restoration plan that was effective, inventive and innovative.

Ergon Energy and Energex teams began aerial damage assessments within 24 hours of Tropical Cyclone Debbie crossing the coast in the Whitsundays. Within 48 hours, Electricity Systems Designers and Lines Planners were mapping out MicroGrid solutions to restore power until communities could be connected by grid supply.

Energy Queensland's technical expertise and field experience enabled crews to resurrect a battered and broken network and support it with community-based MicroGrids while longer-term repairs were mapped out and undertaken in the worst hit areas. One area where this was particularly successful was the beachside community of Midge Point which as a result of installation of a Pegasus unit and micro-grid the community was able to start repairs and recovery well ahead of the planned grid supply repair schedule.

The first step was to restore Grid supply where possible. Where this wasn't possible, Ergon Energy deployed and installed generation to support critical community infrastructure in line with Local Disaster plans e.g. water/sewage pumps.

The next priority was to restore power to the largest number of customers as quickly as possible. This involved rebuilding assets such as powerlines in local streets and repairing distribution transformers, then reconnecting individual service wires to homes and businesses.

Cyclone Response using Community based MicroGrids



Ergon Energy's mobile generator fleet is approximately 13.5MVA in total capacity. The current fleet includes 35 low voltage generators ranging in size from 33kVA to 625kVA, with an additional six containerised low voltage mobile 1250kVA units and five Pegasus 1500kVA HV injection units. These HV injection units are capable of being directly connected to either the underground or overhead 11kV or 22kV networks.

The operational response included the deployment of Pegasus high Voltage mobile injection units and other generators to re-energise communities while our crews repaired the network and restored power to 65,000 north Queensland customers between Mackay and Ayr within two weeks of getting access to the impacted area.



Networks Renewed

NETWORK BUSINESS

Essential Energy

PROJECT LOCATION

Collombatti and Bellingen, NSW

PROJECT PARTNERS & SUPPLIERS

Essential Energy, ARENA, Reposit Power, UTS & SMA Australia

FUNDING

ARENA, partner organisation contributions and Essential Energy's Demand Management Innovation Allowance (DMIA)

PROJECT TIMING

September 2016 – September 2018

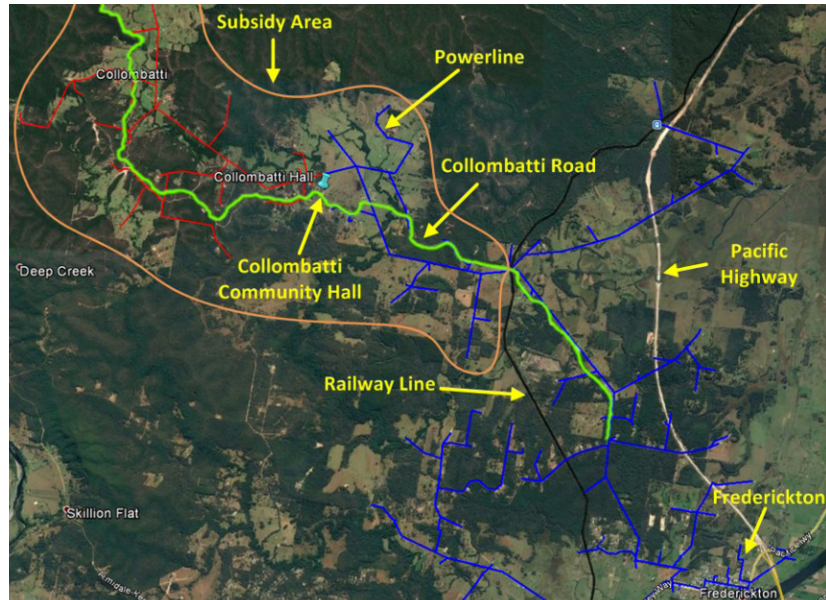
CONTACT

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FURTHER INFORMATION

Collombatti: www.essentialenergy.com.au/content/batterytrial

Bellingen: www.essentialenergy.com.au/content/invertertrial



Essential Energy partners in battery storage/solar inverter trial in regional NSW

Essential Energy is signing up regional NSW residents to participate in a trial to assess the potential for customer-owned battery storage systems and advanced solar inverters to help better manage demand for network capacity.

In a joint project with the Australian Renewable Energy Agency (ARENA), University of Technology Sydney, Reposit Power and SMA Australia, Essential Energy will test battery storage systems and advanced solar inverters with eligible customers in a two-year partially subsidised trial.

The rural towns of Collombatti, north-west of Kempsey, and Bellingen, south-west of Coffs Harbour, have been selected for the trial due to the high concentration of solar customers in the area and the potential to address an emerging network constraint.

The project's two key objectives include:

- » Developing a set of guidelines for future uptake to ensure such technology is optimally integrated and does not result in costly network expenditure
- » Exploring the possible value such technology can provide on a least cost basis to address network constraints

System installations will be delivered in two separate stages, with the quantity of these installations dependant on achieving the required network benefit.

During the initial pilot stage, up to 40 customers will receive subsidised installation of the battery storage systems or advanced solar inverters and will retain ownership of the equipment as part of the trial. During the trial period, participants will receive payments based on the level of network support their system provides.

Networks Renewed

The trial has been designed around an open market approach, maximising customer choice, emerging market participants and the potential future energy market. Subsidies have been used to reduce system costs today comparable to that likely to be seen over the next few years.

Within the rapidly changing energy ecosystem, the key objectives of the project will help Essential Energy operate a best practice business in performance, efficiency, offering value to customers while maintaining downward pressure on network charges.



United Energy, Virtual Power Plant Pilot Project

NETWORK BUSINESS

United Energy

PROJECT LOCATION

United Energy Distribution Network in Melbourne

PROJECT PARTNERS & SUPPLIERS

Energy Makeovers, Sunverge, Tesla & Reposit Power

FUNDING

United Energy's Demand Management Innovation Allowance

PROJECT TIMING

October 2013- March 2018

CONTACT

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Since October 2013 United Energy in Victoria has been undertaking a trial of Commercial and Residential Solar Storage Installations on the Distribution Network.

As part of this project, United Energy has installed 50kW of solar photovoltaic (PV) and 150kWh of energy storage across a 10 residential customer premises and 1 commercial installation at their Burwood field depot

This project seeks to explore the viability of utilising solar PV and energy storage as an alternative to investment in traditional network infrastructure. It is designed to:

- » Better understand the current state of solar PV and energy storage technology and its ability to scale;
- » Develop an understanding of the economics of solar PV and energy storage;
- » Identify the risks and test the controls for the use of solar PV and energy storage technology in network support applications; and
- » Validate the use of solar PV and controlled energy storage technology for peak demand and voltage management applications on the distribution network

United Energy has selected customers with a different range of energy usage patterns to participate in this project. The selected constrained (overloaded) assets were identified, where the use of solar PV and energy storage technology was likely to be more economic than the traditional augmentation solution.

United Energy successfully programmed the energy storage systems to automatically forecast high-temperature days and prioritise operation of the systems for dispatch of energy during the evening peak, whilst managing internal temperatures of the energy storage units for optimal performance. United Energy has executed the peak demand control strategy across a range of energy storage units installed in the field and found that it is reliable to call upon solar PV and energy storage technology for network support and peak demand reduction applications when required. This trial project is still ongoing with United Energy utilising the installed solar storage systems to explore the suitability of the technology for voltage management applications.

As part of the next steps for this program, United Energy will seek to commence further installations of solar PV and energy storage systems within the selected constrained regions of the distribution network in order to prove that this technology can be controlled in concert to defer investments in actual planned augmentation projects.



CONSORT Bruny Island Battery Trial

NETWORK BUSINESS

TasNetworks

PROJECT LOCATION

Bruny Island, Tasmania

PROJECT PARTNERS & SUPPLIERS

TasNetworks, Reposit Power, Australian National University, University of Sydney, University of Tasmania

FUNDING

ARENA funding and partner organisation contributions

PROJECT TIMING

Commenced April 2016

Complete April 2019

CONTACT

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TasNetworks Part of Exciting Three-Year Battery Trial

For TasNetworks, customer owned batteries are an opportunity to resolve network problems without building additional network. This is particularly true at the edge of the grid, where building more network is expensive.

The CONSORT Bruny Island Battery Trial is a joint research and development project through TasNetworks, battery control software business Reposit Power, the Australian National University, University of Sydney and University of Tasmania. The project received \$2.9M funding from ARENA (Australian Renewable Energy Agency) as part of ARENA's Research and Development Programme.

Over three years, the trial will look at how battery-PV systems can be used by customers on Bruny Island to manage their energy and simultaneously help manage the network.

Bruny Island was chosen because of the nature of the electricity network on the island, and the demand peaks that occur there during holiday periods. Deployment of batteries of this size can make a real and measurable difference.

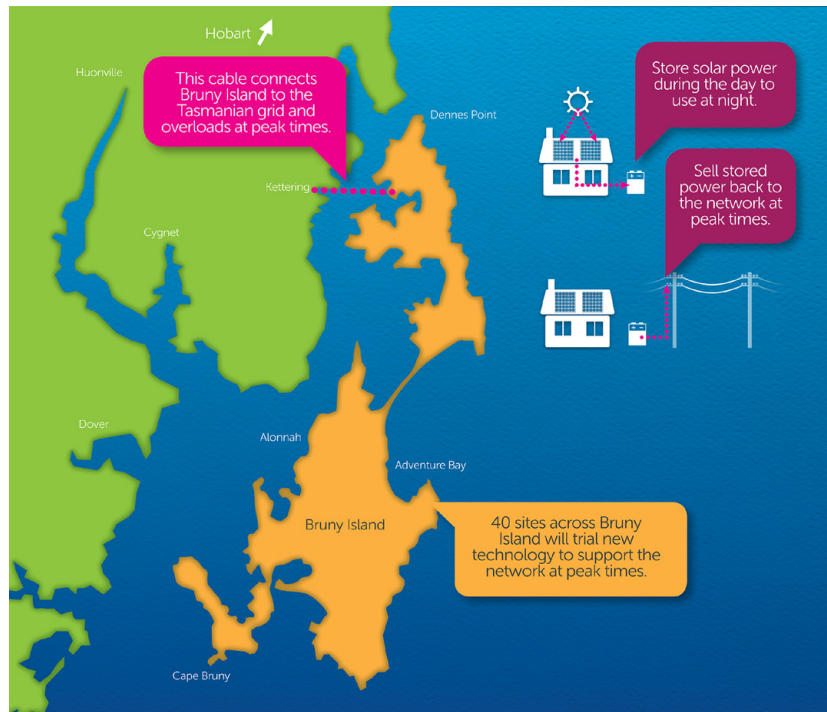
The key theme of this project has been customer choice. It is designed to replicate a future where customers have chosen to install a battery, without network involvement.

There are two key components of the trial:

- » a battery subsidy, to make a solar and battery system affordable to a Bruny Island resident;
- » ongoing payments to use the battery, when there is a network constraint. This is initially \$1/kWh.

Installation of the battery-PV systems on Bruny Island began in December 2016. Up to 40 customers will receive subsidised installation of the systems, with battery control software to enable them to sell electricity back to the grid.

CONSORT Bruny Island Battery Trial



The project includes world-leading research, investigating:

- » new ways to make the network and batteries co-operate to resolve network issues;
- » new ways to fairly distribute the benefit amongst the customers; and
- » what customers think and feel about their energy storage systems, and how that effects what we may do with them.

It is envisioned that these energy storage systems will assist in managing a network limitation in the cables supplying the island. They will alleviate congestion on the undersea power supply cable, and reduce the reliance on extra generation during peak seasons.

It is hoped the battery-PV systems will provide a long-term alternative to the expensive option of installing another undersea supply cable or augmenting the existing cable.

Onslow Distributed Energy Resources (DER) Project

NETWORK BUSINESS

Horizon Power

PROJECT LOCATION

Onslow, Western Australia

PROJECT PARTNERS & SUPPLIERS

Stage 1: Downer EDI Engineering – Power Station, Zone Substation and Transmission Line and Geographe Underground – Distribution Network extension

FUNDING

Internal

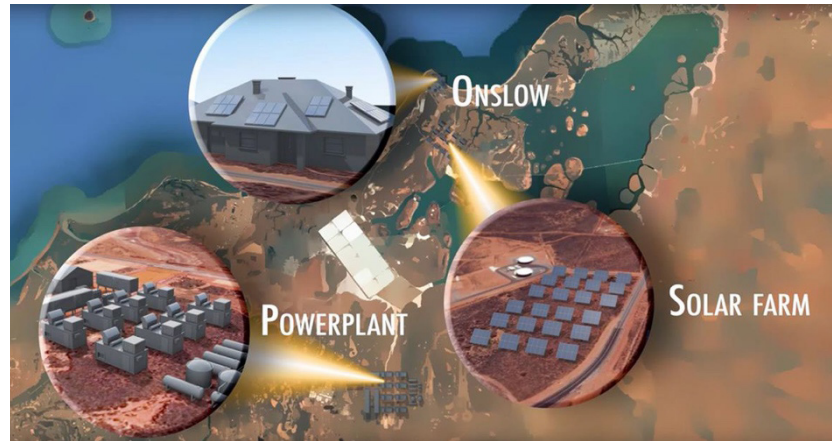
PROJECT TIMING

Stage 1: January 2017 – March 2018

Stage 2: January 2018 – March 2019

CONTACT

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The electricity industry is undergoing unprecedented levels of change placing the traditional utility business model at risk of rapid disruption.

With solar photovoltaic (PV) connections in Western Australia alone projected to exceed half a million by 2025, Horizon Power believes that distributed energy resources (DER) are the key to a more sustainable energy future; where individuals can service not only their own energy needs, but can also help service their community's needs through a dynamic energy trading platform.

The Onslow DER project will fully explore the options for developing a safe, reliable high penetration renewable DER energy solution for Onslow. Horizon Power will deliver new power infrastructure in Onslow in two stages.

Stage one will consist of four main components:

- » A power station with 8 MW of installed capacity;
- » A zone substation;
- » 33 kV dual circuit transmission line into the new zone substation;
- » Extensions of the existing 11 kV distribution network.

Stage two will consist of distributed energy resources away from the main power station in the form of:

- » Solar; and
- » Battery storage.

Underpinned by a modular efficient power station and state of the art solar farm the Onslow Microgrid will leverage off advances in digital communications infrastructure to integrate with intelligent devices and appliances as well as prepare for future technologies.

Further development of Horizon Power's leading MicroGrid Operating Platform aims to support the development of local communities through increased competition and greater participation which will lower electricity bills, as well as the subsidies that Government pays to support the provision of reliable energy across regional areas.

Endeavour Energy SolarSaver Residential Battery Energy Storage Trial

NETWORK BUSINESS

Endeavour Energy

PROJECT LOCATION

Western Sydney

PROJECT PARTNERS & SUPPLIERS

ITP Renewables

LG Chem

SMA

Reposit

FUNDING

Endeavour Energy's Demand Management Innovation Allowance

PROJECT TIMING

April 2017 – March 2019

CONTACT

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Western Sydney is leading the way with renewables with more than 100,000 homes now with solar systems. With the market for residential battery storage also rapidly evolving, there are now both opportunities and barriers associated with this technology that will be important to understand to ensure the effective and efficient deployment on electricity networks.

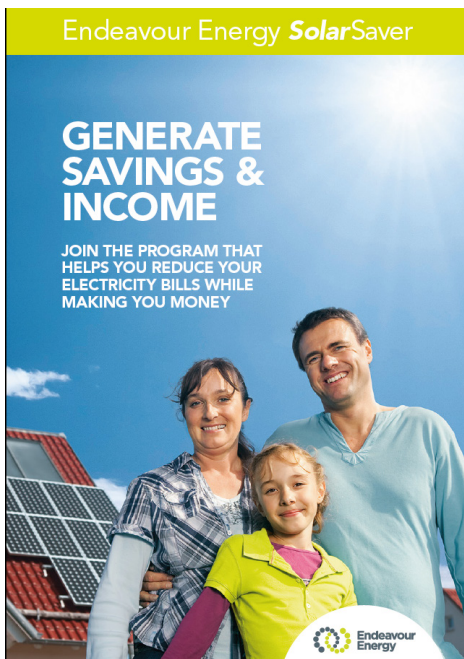
As a socially responsible business, Endeavour Energy is working with local communities to develop programs that use electricity more effectively and efficiently while still meeting the energy demands of our customers.

The Endeavour Energy *SolarSaver* program aims to use the energy stored in a battery installed in selected homes with solar panels, to reduce the electricity delivered from the network during peak demand times. Rather than building and maintaining additional electricity network to be used only a few days a year, *SolarSaver* is one of a number of new programs using a more sustainable way to reduce peak demand and help residential customers use electricity more efficiently.

Under *SolarSaver*, customers with a suitable existing solar power system invited to participate will be able to purchase a battery system from a selected supplier for 25% of the total cost. In return, Endeavour Energy will use the energy stored in the battery to reduce the electricity delivered from the network during peak demand times. The battery system comprises of a LG Chem 9.8kWh HV battery, SMA Sunny Boy Storage 2.5kW battery inverter, and Reposit smart monitoring and control kit.

In addition to the generous subsidy for purchase of the battery system, participating customers save money on their electricity bills by storing excess energy from their solar panels and using it during peak hours or selling it to selected retailers when the spot market price is high.

Endeavour Energy will be collecting energy data from the installed systems until the program ends on 31 March 2019. The energy stored in the batteries will be used to reduce the electricity delivered from the network during peak demand times. Reduced investment in the electricity network needed to cope with peak demand will help keep the cost of electricity down in the future, so that everyone will benefit.



Endeavour Energy SolarSaver Residential Battery Energy Storage Trial

Endeavour Energy will remotely control the charging and discharging of the batteries up to 12 times per summer (1 November to 31 March) and winter (1 May to 31 August) period. The main objectives of the trial include:

- » quantifying the network demand reduction potential from installing battery energy storage systems in residential premises;
- » understanding the customer benefits; and
- » building on the demand management control capabilities of the network.

A secondary aim of the trial is to test the power quality improvement capabilities of battery energy storage systems.

Endeavour Energy targeted customers with existing solar panels of different sizes that are supplied by the Parklea Zone Substation which has the highest penetration of PV systems within Endeavour Energy's distribution area. Parklea Zone Substation is also forecast to exceed its firm capacity due to the increased growth from the re-zoning and developments along the North West Rail corridor.

The *SolarSaver* recruitment campaign commenced in April 2017 with direct mail packs sent to targeted customers directing them to register their interest online. Customers that met the registration criteria progressed to the next stage of having a site inspection to confirm their eligibility before the battery system is installed, with the first installation expected in late May 2017.

Mooroolbark Community Mini Grid

NETWORK BUSINESS

AusNet Services

PROJECT LOCATION

Mooroolbark, Melbourne

PROJECT PARTNERS & SUPPLIERS

GreenSync: Main contractor for residential energy systems and minigrig control system

Power Technology Engineered

Solutions: Design and delivery of mini grid stabiliser

EIV: Design and delivery of LV switching cabinet

SUPPLIERS

Residential Solar: Energy Matters, JA Solar and Fronius

Residential Batteries: LG Chem, Selectronic and Ecopower

Stabiliser system: Toshiba, Vacon and Freestyle Technologies

FUNDING

Regulated funding under the Demand Management Innovation Allowance

PROJECT TIMING

Commencement date: January 2016

EXPECTED COMPLETION DATE

December 2018

CONTACT

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Australia is in the midst of an energy revolution.

The growth in solar power, energy storage and smart control technology has the potential to change the way society produces, uses and sells energy.

To help prepare for this future, AusNet Services is trialling Australia's first mini grid in an established community. The project envisages a future where Distributed Energy Resources (DER) play a major role in the electricity supply system, and the distribution network becomes a dynamic platform that facilitates trade of energy and energy services.

To establish a model of the future electricity network, a typical suburban community was approached to take part in the Community Mini Grid project, with the offer of solar power and battery storage to be installed at customer premises. The project encompasses the design, build and operation of a 16 household mini grid within a single street in Mooroolbark, a typical suburban community in Melbourne's East. All customers are connected to a common distribution transformer via typical 3-phase overhead low voltage reticulation. The project involves:

- » Rooftop solar photovoltaic (3+kW) and battery storage systems (5kVA/10kWh) at 14 of 16 houses;
- » Central network devices including a switching cabinet, power meter, and mini grid stabiliser system (15kVA/10kWh) at the low voltage grid connection point to allow the mini grid to temporarily separate and operate in islanded mode;
- » A monitoring and control system that can optimise power flows within the mini grid, perform aggregated control functions, and which feeds into a network level "Distribution System Operator" platform;
- » A customer web portal to allow customers to monitor and configure their energy systems; and
- » The potential to add an air conditioner load-control test.

Mooroolbark Community Mini Grid

The mini grid project seeks to investigate the value to the network that concentrated DER can provide when coordinated by a network optimisation scheme, the impacts on the network that may arise from customer driven control of DER, as well as customer preferences regarding local energy supplies.

The project will test scenarios such as peak demand management, solar export management, virtual power plant operation, response to wholesale markets and local energy sharing. The performance of DER systems in providing temporary backup supply will also be tested, both as individual customers and as an interconnected mini grid while islanded from the main network.

All the residential and central hardware systems have been deployed and are operational following a detailed protection and safety review and commissioning process. The remote monitoring system is in place and is supplemented by a 24/7 incident response plan through the issue and response to SMS alerts. System integration has proven to be a challenge throughout the project, however the mini grid control system is now being implemented with a suite of component and system controls scheduled to be deployed. Testing is underway using available controls such as solar export limitation and individual backup power provision. A full mini grid island operation test has been undertaken where the mini grid was separated from the main grid, temporarily powered by 100% inverter-based supplies, and then re-integrated to the main grid.

Establishing and nurturing customer goodwill throughout the trial process continues to be a key activity and an essential ingredient for success. Given the time and resource commitment required to manage the installation of the residential energy systems, an important learning experience for future initiatives is to preference an engagement structure where customers take some responsibility for product selection and installation, subject to any interoperability requirements.

Stand-Alone Power System (SPS) Pilot

NETWORK BUSINESS

Western Power

PROJECT LOCATION

Ravensthorpe, West River, Lake King and Ongerup, Western Australia

PROJECT PARTNERS & SUPPLIERS

Horizon Power and Synergy

FUNDING

This project was funded from internal Western Power budgets

PROJECT TIMING

July 2016 – July 2017

CONTACT

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In Western Australia, significant sections (about 40,000 km) of the fringe-of-grid assets were constructed under rural electrification policies of the State Electricity Commission of Western Australia between the late 1950s and the 1980s. Today, the age of network in these regions typically exceed 30 years of age and will be scheduled for replacement or refurbishment over the coming years.

The historical challenge of relatively low population density over a large area remains essentially unchanged in the 21st century leading to high costs to serve customers.

Local generation supply options, for example, stand-alone power systems (SPS) have evolved in recent years and, in some circumstances present a safer, more reliable and more economically efficient alternative to network rebuild for some customers at the edge of the distribution network, where there is low customer density and customers have low electricity consumption.

In July 2016 Western Power installed 6 hybrid photovoltaic/diesel/battery Stand-alone power systems in Ravensthorpe, Lake King and Ongerup areas at the edge of the South West Interconnected Network (SWIN) as part of a 12 month trial to test the suitability of this technology as an alternative to a traditional network solution as well as gauge customer response to the technology.

Installed systems consist of solar photovoltaics (PV) ranging in size from 9-19 KW and lithium battery storage ranging in size from 40 – 80 kWh. Systems also incorporate a diesel generator to support the system during periods of high cloud cover. System sizes between participants vary as units have been designed to meet the typical electrical load experienced at each site.

Suitable potential sites for deployment of SPS were selected via analysis of network data. Edge of grid lines were filtered to locate areas of the network with ageing assets, low customer density and relatively low energy use. Candidates were refined further by filtering for medium to high bushfire risk areas where a safety benefit could also be realised.

Stand-Alone Power System (SPS) Pilot

It was determined at early stages of the project that a hybrid PV/diesel/battery system was the most suitable system to consider as a network replacement option. Costs to procure and deploy an SPS solution was estimated from tender bids received through an earlier Request-For-Information process. Lifecycle costs for this solution were compared to a traditional “poles and wires” network rebuild; where lifecycle costs of the SPS solution were less than or equal to 50% of the network replacement cost it was considered to be a candidate for SPS deployment.

A detailed functional specification was developed in collaboration with Horizon Power and was subsequently put to market to find a suitable technical partner to design and install as well as operate and maintain the SPS units.

Simultaneously to project activities, Western Power has submitted a rule change request to the Australian Energy Market Commission (AEMC) requesting that emerging technology solutions (such as stand-alone power) be reclassified as forming part of a distribution service as current definitions prevent wider implementation of these technologies. Similar discussions have taken place with Western Australian regulatory bodies.

Learnings to date from the trial have been positive. Key outcomes from Phase 1 of the trial are:

- » Customer felt reliability has improved; trial participants have experienced significantly less power interruptions than known network interruptions on the same feeders;
- » Feedback from customers has indicated a very high level of satisfaction with the performance of the SPS unit over a traditional network solution;
- » The systems have been robust enough to survive extreme weather events and exhibited only minor technical issues under normal operations; and
- » The need for detailed customer equipment audits and energy usage was seen as a necessary step to identify any non-standard loads within the customer’s facility which have the potential to negatively impact the operation of the SPS unit.

Given the success of the trial to date, Western Power is in the process of determining the next steps for the six installed trial SPS sites, and pending the resolution of statutory and regulatory barriers, Western Power is investigating the potential for a wider rollout of SPS as a network replacement tool.

United Energy, Dynamic Voltage Management System Trial

NETWORK BUSINESS

United Energy

PROJECT LOCATION

United Energy Distribution Network in Melbourne, Victoria

PROJECT PARTNERS & SUPPLIERS

Dynamic Ratings & CGI

FUNDING

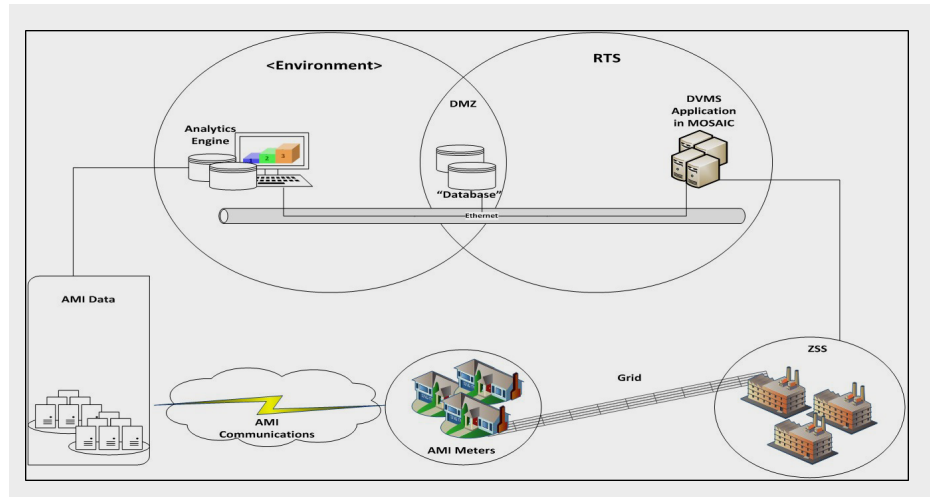
United Energy Regulatory Allowance
Capex Funding

PROJECT TIMING

July 2017 to August 2017

CONTACT

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Conservation voltage reduction is a proven method for reducing energy and peak demand on distribution networks.

United Energy has historically only used this under emergency situations to avoid load-shedding in the absence of AMI voltage measurements.

With advanced metering infrastructure (AMI) now rolled out throughout Victoria, there is an opportunity to apply conservation voltage reduction (CVR) without the risk of violating Victorian Distribution Electricity Code limits by using the real-time voltage measurements from AMI to inform the magnitude of the voltage reduction.

A preliminary analysis on voltage data provided by AMI has shown there is opportunity to use this voltage data to dynamically manage voltages on the network and improve steady-state voltage regulatory compliance. This is expected to deliver potentially large step changes in steady-state voltage compliance. This project aims to test the technical feasibility of conservation voltage reduction to regulate voltages and improve the steady-state voltage compliance to the Code.

CVR is implemented by controlling the voltage within the regulatory limits defined by the Code using on-load tap changes at zone substations. This project is required to test the technical feasibility of CVR to regulate voltages and improve the steady-state voltage compliance to the Code.

This project aims to trial the CVR technique on two zone substations. To implement CVR, voltage data provided by the sampled meters supplied from a zone substation is gathered and sent to the Network Analytics Engine to make decisions on optimising the voltages according to the dynamic load pattern. The control to activate the appropriate pre-defined voltage set-point will then be sent to the relevant voltage regulating relay (VRR) at the zone substation. The SCADA application will provide United Energy with the advanced capability to manage voltage conservations within the network. It has been proposed to apply pre-defined voltage set-points to the VRRs at the nominated zone substations.

Initial analysis on the AMI data has shown that the proposed scheme within the nominated zone substations can result in step-change improvements in the quality of supply compliance, in particular during periods of light load.

Crotty Dam Remote Area Power Supply

NETWORK BUSINESS

TasNetworks

PROJECT LOCATION

Crotty Dam, West Coast Tasmania

PROJECT PARTNERS & SUPPLIERS

Theiss Services

FUNDING

TasNetworks regulated funding

PROJECT TIMING

RAPS commissioned in April 2014, line removed in 2015.

CONTACT

TasNetworks



Crotty Dam is a remote site owned and operated by Hydro Tasmania, and is located along Lake Burbury approximately 25km southeast of Queenstown on the western coast of Tasmania.

There are two hydroelectric sites on the western shore of the dam; a water intake shaft for the underground tunnel to John Butters Power Station, and a dewatering shaft located next to Crotty Dam.

The Crotty Dam sites were built in a time when it was not economically viable to supply power to remote customers with off-grid technologies. At that time in order to provide power to Crotty Dam, a 12.7km three phase 22kV feeder was installed. Ongoing asset replacements and heavy vegetation cuts were necessary to maintain the feeder; and this maintenance was no longer considered to be the most cost effective solution.

Through advancements in technology a new proposal was put forth by TasNetworks to build an off-grid solution to supply Crotty Dam.

Remote Area Power Supply (RAPS) are a cost effective alternative to supplying electricity to customers “on the fringe” of the TasNetworks transmission and distribution system. The project is self-funded by TasNetworks as a regulated capital investment. Equipment supply, design and installation were provided by Thiess Services (previously Silcar Personnel). The project was completed in April 2014.

The RAPS systems were considered a technology trial. There are many other remote sites that are supplied by ageing long spur distribution lines which are costly to maintain. RAPS may also be a more cost effective option to supply the local customers currently supplied by these lines.

In 2014/15 two RAPS systems were installed and commissioned at Crotty Dam, with the design and technical support conducted by Thiess Services (previously Silcar Personnel). The sites are now powered by a mixture of diesel generation and battery storage.

The 22kV line was decommissioned in 2015, avoiding the ongoing line maintenance and replacement costs.

As a trial, the Crotty Dam RAPS has provided valuable learnings for the business, these include process improvements to cover new technologies, but also technical knowledge for the RAPS design and construction.

TasNetworks will working to standardise RAPS assets so that the technology can be similarly deployed at future similar sites.



Endeavour Energy Grid Battery Energy Storage System (BESS) trial

NETWORK BUSINESS

Endeavour Energy

PROJECT LOCATION

Dapto, NSW

PROJECT PARTNERS & SUPPLIERS

In procurement

FUNDING

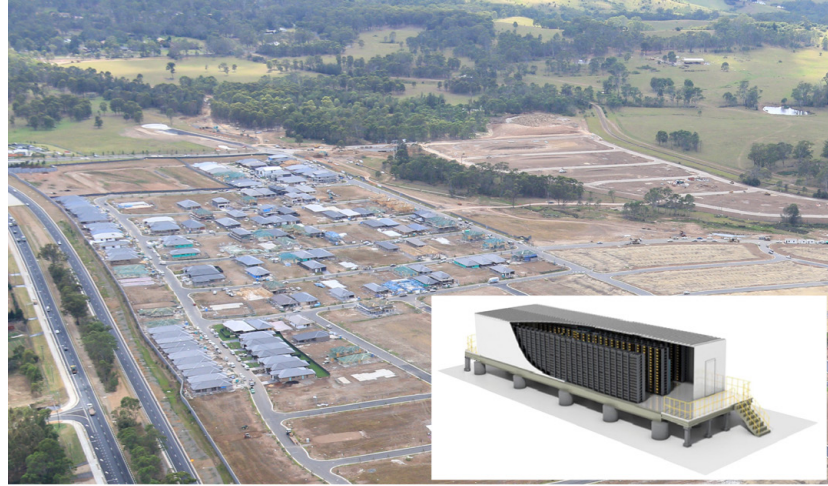
Pilot project funded from internal Endeavour Energy budgets

PROJECT TIMING

For the summer 2018-19

CONTACT

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Energy storage is a potential solution to the critical challenges facing the power grid today by providing customers a safe and reliable power supply without having to build more expensive network upgrades.

Battery storage systems also have significant potential to help manage load growth, peak demand, power quality and supply interruptions. With more home solar systems being installed, energy storage is also important in enabling renewable energy to be saved for use when customers need it the most.

In what will be a first in its network, Endeavour Energy is undertaking a trial to quantify the efficiency and network support benefits of a grid-scale Battery Energy Storage System (BESS). The trial involves the installation of a one megawatt hour battery storage system at the future site of Endeavour Energy's West Dapto Zone Substation in the Illawarra region. Once installed, the BESS could defer construction of the proposed West Dapto Zone Substation for several years.

The location was selected for the pilot due to the scale of future residential development, the peak load characteristics of the area over summer and the age of the existing network. When fully developed, the West Lake Illawarra Release areas will contain 27,000 new dwellings.

The pilot BESS will be containerised and modular for ease of relocation, and will consist of:

- » 1MWhr Battery
- » AC/DC Power Conversion System
- » 11kV Step-up Transformer
- » HV Protection and Control.

The trial will test the potential of battery storage in a real, grid-scale setting and provide Endeavour Energy with the expertise to utilise this technology as future needs arise. Similar battery systems could

Endeavour Energy Grid Battery Energy Storage System (BESS) trial

be deployed in other growth areas of Endeavour Energy's network to defer the construction of up to four new zone substations by 2024 and reduce network investment by up to \$1 million per year, keeping downward pressure on network charges.

This is significant as Endeavour Energy services the high growth regions of NSW, with the population of Greater Western Sydney forecast to grow approximately 46% by 2031. While the overall NSW population growth is forecast to be strong at 1.2% p.a. over 20 years, overwhelmingly the growth is concentrated in Greater Western Sydney, with the region's population forecast to grow by almost one million people (46%) over the two decades from 2011 to 2031.

Endeavour Energy's network includes the North West and South West Priority Growth Areas of Sydney, established in 2005 to accommodate 500,000 new residents over 30 years. These priority growth areas are the result of the biggest coordinated land release in NSW's history.

Generally the existing network in these areas is set up for the supply of rural type loads and is not suitable to supply the future urban development. Traditional network solutions to meet demand in these instances have been to augment the existing distribution feeders, and when this is inadequate, construct a greenfield zone substation.

Alternatively a BESS can meet short term demand with supplementary supply to defer both the augmentation of the existing network and the establishment of the final supply infrastructure. It has the potential to improve the quality of electricity supply in constrained parts of the network and provide backup power during network outages.

The BESS pilot project is currently in the procurement phase and is expected to be installed and commissioned at West Dapto before summer 2018.

Esperance Standalone Power System Project

NETWORK BUSINESS

Horizon Power

PROJECT LOCATION

Esperance, WA

PROJECT PARTNERS & SUPPLIERS

EMC, GHD

FUNDING

Internal

PROJECT TIMING

December 2015 – October 2016 (now in permanent operation)

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Devastating fires in November 2015 caused widespread damage to the Esperance power system including the loss of 324 poles.

Rather than replace all of the damaged overhead equipment, Horizon Power elected to restore power supply to a number of customers using Standalone Power Systems (SPSs).

This was enabled by the work Horizon Power had previously undertaken with Western Power on the SPS Pilot for Ravensthorpe, where Horizon Power (as Western Power's "Technical Partner" in that project) had sufficient knowledge of SPSs to be able to step into a real-world application of the equipment. The project was designed to replace the damaged network with a viable SPS alternative and enable Horizon Power to undertake its own SPS roll out. Temporary diesel generators were installed to provide power while waiting for delivery of the permanent SPS solution.

The project delivered Standalone Power Systems (SPSs) to five customers in the Esperance region, with each system comprising:

- » Ground mounted solar photovoltaic PV of 8-12 kW
- » Central battery inverter of 6 kW, between 1 and 3 per site
- » Battery storage using rackable 1.2 kWh batteries with sizing optimised for the particular customer
- » A diesel generator of 15-20 kVA

Horizon Power did not have good metering information for these customers as non-interval meters were in place prior to the November 2015 fires, with only annual meter reads. Therefore the decision was taken to install a similar system at all sites that could be augmented later to suit the specific customer energy requirements. Macro issues were dealt with, such as single phase vs three phase, the number of battery inverters sufficient to meet the expected peak loads, and a layout to suit the available land. Following the initial installation and commissioning, additional battery storage was later added to minimise the systems' dependence on the diesel generator.

Horizon Power implemented a tailored Customer Agreement, which was a modification of the Standard Form Customer Contract to enable the specific considerations of SPS to be catered for.

The systems were delivered between March and May 2016. Following commissioning all systems have proven to be reliable. The battery augmentation was completed in October 2016, and this is on track to limit the generator run time to less than 250 hours per year.

SPS is now an additional tool to be used in Horizon Power's network planning.

Summer Saver Program

NETWORK BUSINESS

United Energy

PROJECT LOCATION

United Energy Distribution Network in Melbourne, Victoria

PROJECT PARTNERS & SUPPLIERS

Bidgely

FUNDING

United Energy Demand Management Innovation Allowance and Regulatory Allowance Opex Funding

PROJECT TIMING

December 2016- March 2017

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The United Energy distribution network has observed growth in maximum demand exceeding growth in average demand for many years.

This results in an increasing percentage of network capacity being underutilised except during hot weather. Currently the top 20% of system capacity is used for approximately 1% of the year. To address this issue, United Energy introduced the Summer Saver Program to provide an alternative to the traditional solution of building new infrastructure. The Program incentivises customers to reduce demand during times of maximum demand, thus achieving network augmentation deferral.

Summer Saver Program is a voluntary residential demand response program that is run from December to March every year. Customers connected to capacity constrained sites are recruited to participate in the program and called to provide demand reductions during times of network constraint which usually occur where the maximum temperature is above 35°C. Customers are provided with a smart-phone app that allows real-time monitoring of energy usage during events. The customers' smart meters are utilised to provide the real-time usage information

First, suitability of capacity constrained sites on the distribution network for the Summer Saver Program is evaluated. Customers eligible at the capacity constrained sites are then recruited via direct marketing to participate in the program. Registered customer will be notified in advance through email and the smart-phone application of an event occurring. Customers are also informed on the timing and their previous consumption on like days.

The program has been a tremendous success with on average 77% of participants out of 552 successful across all the events. Successful customers on average reduced 1kW in demand during the events. This has allowed United Energy to defer augmentation at 92 sites. Results of an event on 7 January 2017 are demonstrated in Figure 1.

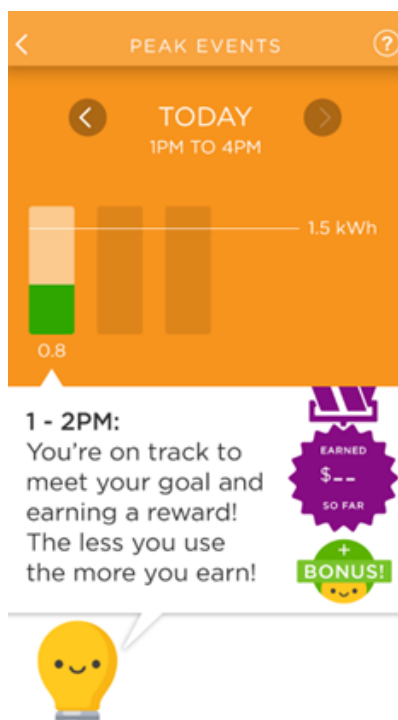
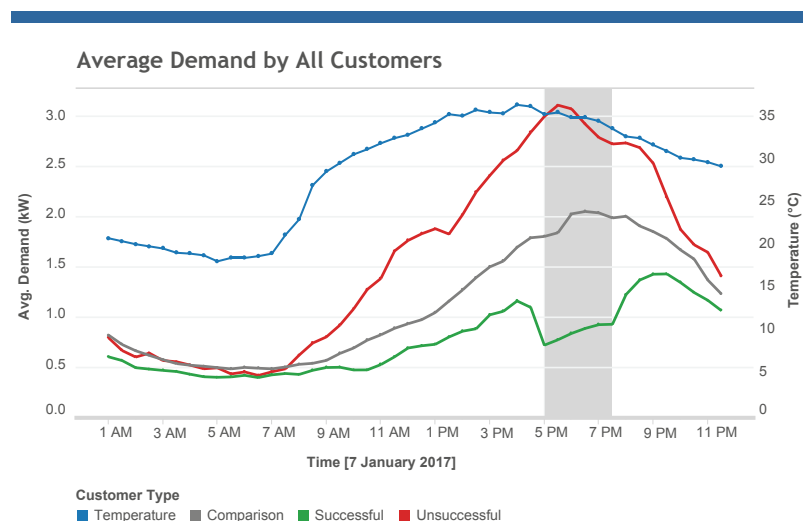
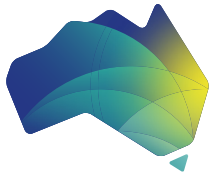


Figure 1: 7 January event results





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