energy networks association

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THE GREAT ENERGY QUEST:
CASE STUDIES IN AUSTRALIAN ELECTRICITY STORAGE

CONTENTS

INTRODUCTION

As long as there has been an electrical grid, companies have sought ways to safely and efficiently store energy so that it can be consumed on demand, output can be meticulously controlled, and the exact frequency of the energy distributed can be tightly regulated.

Energy storage has been identified as a significant tool for the future of coordinated and reliable operation of utility grids. This is due to storage having the potential to offer a number of valuable benefits and services to the energy supply industry, broader industry, and the electricity customers

Energy storage is particularly important for the integration of distributed renewable generation technologies.

With an increasing demand for renewable energy sources, PV (photovoltaic) and wind turbines are taking on greater roles in the global energy mix. Their inherently variable nature brings additional technological challenges for managing the grid – that must match power generation with demand for optimal customer service at any time.

What's more, these RES (Renewable Energy System) installations are often in remote locations and subjected to harsh temperatures and punishing humidity. Therefore, energy storage that can help smooth the peaks and troughs of renewable energy output is a vital element in the design of electrical networks.

Storage can also protect against errors in forecasting, remove barriers to connecting renewable resources to a variety of grids, shifts demand peaks by storing off-peak energy, provides frequency regulation, and can delay expensive grid upgrades. Making sure the right amount of energy is being distributed to end-users is critical to our grid infrastructure - too much energy can wreak havoc on electronics, too little results in brownouts and disruptions to service.

Today, a wide array of storage technologies have been, or are in the process of being developed and deployed to ensure that the grid can meet our everyday energy needs.

ENA member companies are currently undertaking a number of projects into the practical application of energy storage on their networks and are investigating how to optimise services from storage and support for domestic generation with storage. This document highlights a number of case studies detailing some of the work currently being undertaken by Network businesses in integrating energy storage with the grid.

INTEGRATING NETWORK TARIFFS AND CUSTOMER OWNED DISTRIBUTED ENERGY RESOURCES

Project Name
Integrating Network Tariffs and Customer Owned Distributed Energy Resources

Member Company
Ergon

Funding
This project has to date been funded by the Qld Government Department of Energy and Water Supply. Ongoing funding will be through the Demand Management Innovation Allowance

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RATIONALE

As energy storage enters the residential customer market, the ability for customers to respond to different tariff signals no longer becomes a behavioural choice, but more a controlled ability to manage energy use and energy generation. This study looks to determine how customers interact with different tariffs when provided with home energy monitors, energy storage devices and in most cases, solar photovoltaic (PV) generation.

APPROACH

A series of steps are required to be undertaken to achieve the appropriate test space and learnings from this project. These include:

- Undertaking a market survey of available battery energy storage systems (BESS) at a residential scale – with the aim of selection of a range of systems;
- Lab testing to review how these systems may be programmed to operate under different tariff arrangements;
- Identification of a suitable location and suitable customers willing to participate (Townsville urban area);
- Developing a data management process to review energy meter data as well as data streams from storage, PV and load for analysis;
- Installation of the systems on site – Home Energy Management Systems (HEMS), BESS, PV (existing on all sites) and electronic metering (existing on most sites); and
- On-site testing of several tariff scenarios including time of use, critical peak pricing and capacity or demand tariffs at intervals.

RESULTS

There are a significant number of residential battery energy storage systems (BESS) available in Australia. Due to limited standards in this area, the quality of the systems was found to be very variable and there were issues identified with compliance with existing standards. A number of the suppliers did not have a good understanding of how the BESS operated and had only considered how they responded to the shifting of renewable energy to maximise PV energy.

The control systems for the BESS were also found to vary significantly, with little consistency in how they operated. Most systems offered little more than solar shifting and a basic time of use response function and only considered energy management to and from the batteries, and not the actual household energy use.

The field trials are still ongoing, and in the locations where time of use is currently being trialled, this has resulted in customers being able to respond more rapidly, reducing peak load. Energy interested customers in the trial have also used their Home Energy Management Systems (HEMS) to manage better their overall energy use.

AUSTRALIA'S BIGGEST BATTERY COMES TO BUNINYONG

Project Name
Battery in Buninyong

Member Company
Citipower/Powercor

Project Timeline
The system will be commissioned in Q4 2015 - Q1 2016, before commencing operation in 2016.

Funding
The project is majority funded by the AER's Demand Management Incentive Scheme with the remainder of funds provided by Powercor Australia Limited

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Manufacturing of battery pouches at Kokam's factory in South Korea. There will be approximately 7,900 of these individual battery cells in our 2MW battery.

RATIONALE

Energy storage both on a large scale and consumer level is attracting much attention, driven by a growing range of potential applications of the technology. Like many other distribution businesses, Powercor have identified energy storage as a technology that is increasingly becoming an important part of the evolving grid. Storage technology offers the capability to reduce energy at risk, defer traditional network capex, provide voltage and frequency support and improve reliability.

DESCRIPTION

Powercor have installed a 2 megawatt battery storage system on a property in Buninyong, along one of the main powerlines that services 6,400 customers in the area. Equivalent to 20 percent of the current powerline's capacity, the battery will increase the bandwidth of the network on peak demand days.

Measuring 12.2 metres by 2.4 metres and 2.9 metres (a standard 40 foot shipping container), the battery is capable of providing back-up power to approximately 3,000 customers for an hour during a power outage.

APPROACH

An initial review by the project team looked at a range of storage technologies. Lithium-ion was chosen as the preferred medium as it offers a good range of power to energy ratios, and it is an established technology with ongoing R&D focus and possesses a growing track record. A range of reputable providers are available, including some with multiple generations of containerised experience. Lithium-ion can also respond quickly to, as well as endure long duration dispatch.

LOCATION SELECTION:

The project team assessed the entire Powercor network and scoped out the business case for integrating a large-scale battery into the Powercor network both at a zone substation as well as distribution feeder level. The resulting analysis presented the team with several scenarios that could be implemented to maximise the value of energy storage and potential opportunities that could be realised. Buninyong was chosen as the site that would provide us with maximum benefits for Powercor, its customers and network.

VENDOR SELECTION:

A project team was assembled to identify characteristics that were important to the various divisions within the business. These were fed provided to vendors via an RFI and RFP. S&C Electric was selected as system integrator with the battery supplied by Kokam.

DECISION:

After considering all factors that were identified in the selection process, Powercor have commenced works to install a 2 megawatt / 2 megawatt hour energy storage system in Buninyong, south of Ballarat, along one of the main power lines that services 6,400 customers in the area.

The system will have islanding capability, thus providing the ability to keep customers on supply in the event of a network outage.

RESULTS

Once operational the system will be scheduled in various modes of operation to assess the capability to achieve the range of services and test the real world capability to benefit the network and customers.

FIGURE 2 **THREE BATTERY CONTAINERS, ONE OF WHICH IS BEING FIT OUT FOR POWERCOR'S 2MW BATTERY.**

FIGURE 3 **KOKAM'S MANUFACTURING FACILITY. THE POWERCOR BATTERY WILL BE USING POLYMER POUCHES AND NOT THE STANDARD ALUMINIUM POUCHES, WHICH WILL ALLOW FOR HIGHER ENERGY DENSITY.**

iDEMAND

TransGrid

Project Name
iDemand

Member Company
TransGrid

Project Timeline
Commencement: 2013
Completion: November 2014

Funding
This project was funded from a demand management allowance under the approved 2009-14 Revenue Determination by the Australian Energy Regulator.

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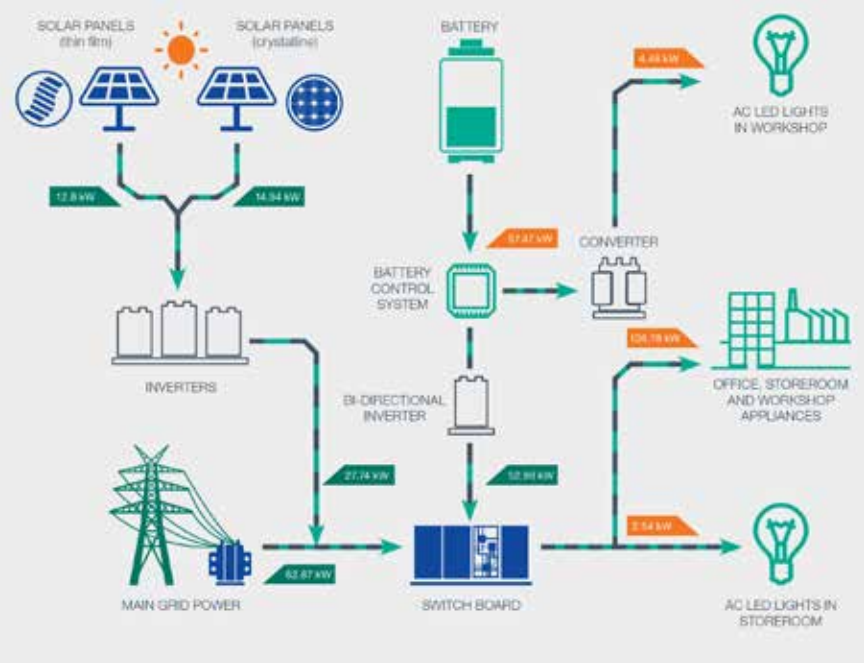
Website
The website has five tabs, with the "Live Monitor" (below) providing key power output/consumption data, "Downloads" providing downloadable spreadsheets, with other site related information and pictures also available. http://idemand.transgrid.com.au/LiveMonitor



RATIONALE

iDemand is a pilot project aimed at facilitating demand management related research in Australia and to engage consumers on demand management.

APPROACH

TransGrid planned and implemented a hybrid demand management system incorporating both embedded generation and storage at its western Sydney site. The iDemand system consists of a 400kWh Lithium polymer battery, 53 kW of polycrystalline silicon and 45kW of thin film cadmium telluride solar panels, energy efficient lighting, with a web portal that updates key system output data every 5 seconds. The TransGrid site chosen is a good representation of a medium scale commercial customer, having annual site load of around 900MWh, and highest recorded peak demand of 280kW. The system was designed with a target peak demand reduction on site of up to 50%.

RESULTS

Since the projects launch in November 2014, TransGrid has received six research proposals on topics such as real time battery dispatch algorithm to minimise peak demand, and battery degradation modelling. It is expected that some of the research conducted will result in better understanding of how to integrate batteries as part of a demand management solution. The iDemand website has been a drawcard for researchers as the website allows free access to data since November 2014 for solar generation battery dispatch, site load, weather and lighting load at one minute intervals. The peak demand on site has been reduced by more than two-thirds when batteries are dispatched simultaneously with the solar panels generating at capacity.

Ten site visits have been conducted since launch, with interested stakeholders including retailers, utilities and an ambassador to a South-East Asian country. Most of the stakeholders were looking to learn from the experiences of a battery or hybrid renewable site in action, with some no doubt considering implementation of battery storage.

TransGrid itself is developing an understanding on how to maintain large scale batteries, with ongoing learnings being fed into a recently proposed battery project, which is currently being scoped. It is expected that battery storage will play a role in successful implementation of demand management in near future, aided by widespread uptake of battery technology as their price per kWh of capacity continues to decline. The project was a finalist in the Innovation Award category for the Australian Clean Energy Summit 2015 run by the Clean Energy Council.

FIGURE 2 **WALLGROVE SITE WITH THE 98.4 KW OF SOLAR PANELS**

FIGURE 3 **400KWH, 100KW LITHIUM POLYMER IDEMAND BATTERIES**

CENTRALISED ENERGY STORAGE SYSTEM (CESS)

Project Name
Centralised Energy Storage System (CESS)

Member Company
Ergon

Project Timeline
Commencement: late 2014
Estimated Completion: 2016

Funding
This project was funded from Ergon Energy budgets and DMIA. Energex is a partner in this project and has provided materials to the project

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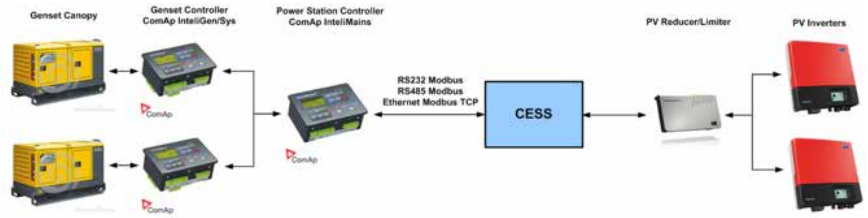

RATIONALE

The establishment of larger energy storage systems offer opportunities across various parts of the Ergon Energy network. Generally these opportunities are variable, based on the network topology and the customer loads. Centralised Energy Storage System (CESS) will develop a platform for the development of a variety of control methodologies to respond to various needs from the Ergon Energy network – this includes energy storage opportunities both for the network and for our isolated power system networks.

APPROACH

Energex provided Ergon Energy with 200kWh of energy storage to enable the development of a CESS platform.

The first stage of this project, which is currently underway, is to build a system platform that is capable of being configured for a variety of applications. Upon completion of the platform, various control and interconnection concepts will be trialled on the system, interlinking with the network for grid support, or renewable energy management, or with diesel generation systems for renewable energy management and reduced diesel run.

RESULTS

There are many containerised systems that already exist and come with a list of functionalities. Based on Ergon's experiences with many of the smaller systems, the way in which they are controlled and managed is by propriatry systems. These systems run as master controllers and are not easy to integrate into the various systems that exist across Ergon's network.

The outcomes of this project are still to be determined as it is still in the development and implantation phase.

GRID ENERGY STORAGE SYSTEM TRIAL

Project Name
Grid Energy Storage System Trial

Member Company
AusNet Services

Location
Thomastown, VIC

Project Timeline
Commenced 2012
Completion - ongoing

Funding
AusNet Services, part under DMIA

Application
Network peak demand management, power quality and islanded supply

Suppliers
ABB, Samsung, Cummins

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Grid Energy Storage System Installation

RATIONALE

AusNet Services initiated a project to trial the Grid Energy Storage System (GESS) in 2012 to explore the potential of using a large battery storage system embedded within the network to manage network peak demand, improve power quality, provide islanded supply to local network customers, and defer network upgrades. The GESS is an innovative non-network solution that is designed so that it can be readily relocated in order to maximise the flexibility of its deployment.

PROJECT DESCRIPTION

The GESS system is a large (1 MW / 1MWh) battery system plus smart inverter that is connected to an urban 22kV distribution feeder in Thomastown, Melbourne. The battery system provides network support by supplying power locally at peak demand times and recharging during low demand periods. The system also includes a 1MW diesel generator set that extends the rating of the battery system to provide full coverage during the peak demand period. This has been undertaken in order to keep the costs of the entire storage solution down. The generator also acts to supply sufficient fault current to maintain protection system coverage during operation in islanded mode. The facility has been fully integrated into AusNet Services' SCADA system, thereby allowing network operator's day to day control of the system.

APPROACH

The main aims of the project include:

- To improve customer service, by ensuring fewer and shorter interruptions and voltage sags will be experienced by customers;
- To mitigate value of customer reliability (VCR) risks;
- To manage peak demand so as to defer capital expenditure for augmentation of the 22 kV distribution network; and,
- To gain knowledge in the use of inverter-based supply systems for an islanded network.

RESULTS

During the summer of 2014-15, the GESS was put through a number of performance trials including local peak lopping, power factor correction and voltage droop functions while in grid connected mode. These trials successfully proved the performance of the system in real-world conditions, whilst also building the understanding of these systems with the grid network operators and planners. A further trial plan has been planned for the 2015-16 summer period around power quality support, feeder demand management and working in island mode.

USING HOT WATER STORAGE TO ABSORB PV OUTPUT

Project Name
Controlled Load Electric Storage Hot Water Systems Can Absorb PV Output

Member Company
Energex

Project Timeline
Completed: April 2015

Project Application
Network Utilisation

Funding
This project was funded from internal Energex budgets

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RATIONALE

The large penetration of residential solar (over 283,500 photovoltaic (PV) systems) on the Energex network has created a new 'off peak' time in the middle of the day. In some cases distribution feeders are acting as generators over this period. This is causing problems in the static LV network. These fluctuations have created power quality issues and in some cases inverters of small scale solar systems have been forced to shut down when voltage levels have become unacceptably high.

DESCRIPTION

A dynamic switching program of control load electric storage hot water systems was implemented to determine the ability of these systems to absorb some of the output from solar PV. This was undertaken to:

- make it easier for static LV networks to operate within agreed supply standards; and
- harness the full potential of customers' solar energy.

APPROACH

A Demand Control Event was held on 22nd April 2015 to 24th April 2015 for the Arana Hills zone substation. Arana Hills zone substation has one of the highest penetrations (6,000 customers) of residential control load of electric storage hot water systems within the Energex network. It also has 3,284 customers with 11,018 kW (total) of solar PV installed.

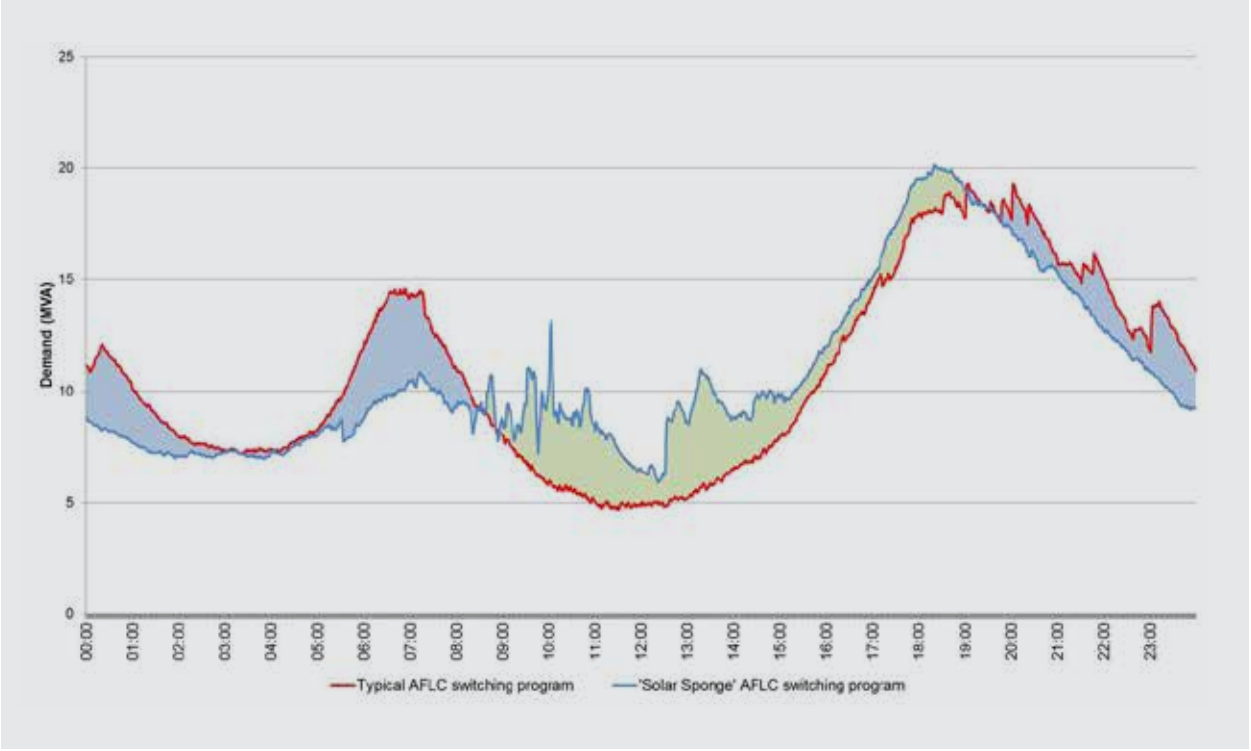
During this event, an alternative switching program for control load electric hot water systems was undertaken. For each of the two control event days, the electric hot water systems were turned off in the morning and load gradually returned during the day (through the residential peak). Power Quality Monitoring was fitted at the Power Transformer and selected Distribution Transformers and was programmed to remotely collect one minute interval data. The interval data collected was housed in a SQL Database, which was queried to provide the dataset for the data analysis.

The load profile from the Demand Control Event 24th April 2015 was day matched to the 22nd April 2015 (both with similar weather conditions) to determine the effect of the alternative switching program.

RESULTS

The results of this project demonstrate the benefits of using controlled loads such as electric storage hot water systems to absorb the output from solar PV. The alternative switching program enabled electric storage hot water controlled load, to clip the morning peak and fill the 'trough' during the middle of the day. Network utilisation was improved and customer inverters were able to continue to feed into the network maintaining customer feed-in-tariff earnings. There was no impact on availability of hot water for customers.

FIGURE 1 **COMPARISON OF TRADITIONAL SWITCHING DAY TO DYNAMIC SWITCHING ON DEMAND CONTROL EVENT DAY**



MODELING POTENTIAL UPTAKE OF BATTERY STORAGE UNDER DIFFERENT TARIFF SCENARIOS

Project Name
Effective Market Reform CSIRO Tariff and DER Uptake Modelling

Member Company
Ergon

Project Timeline
Commencement: 2013
Completion: May 2014

Funding
This project was funded from Ergon Energy budgets and the work provided by CSIRO.

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Project Manager
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RATIONALE

During 2014, the first commercially available packaged residential battery energy storage systems (BESS) started to appear on the market. This study was to determine the potential uptake of further increases in photovoltaic (PV) systems and BESS given various possible future tariff scenarios for Ergon Energy residential customers.

APPROACH

This project was the third phase of a series of modelling studies done by CSIRO, based on census data from Townsville and other sophisticated models CSIRO have developed. Five different tariff structures were tested and eight different PV and battery options were considered as part of this project. High resolution spatial and temporal data were used to project electric vehicle (EV), PV and then BESS uptake across the Townsville local government area.

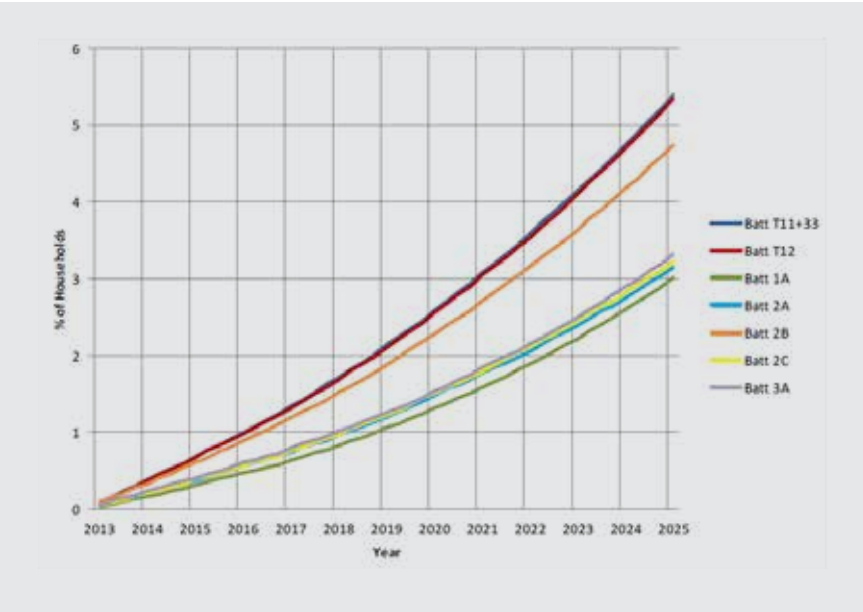
RESULTS

The outcomes of this project suggested that of the various tariff scenarios considered, the existing tariff structures were the most likely to spur the uptake of BESS. Therefore based on that scenario, the maximum uptake would result in approximately 5.4% of customers in Townsville investing in a BESS by 2025.

The lowest uptake of BESS was identified under the flat rate tariff with a seasonal peak demand price. Under this scenario, in 2025 the uptake of solar and BESS will result in a net electricity consumption reduction of 16% compared to 2013 electricity use.

PV generation in 2025 is expected to be between 170% and 210% of the levels in 2013 dependent on the tariff scenarios.

FIGURE 1 POTENTIAL UPTAKE OF FURTHER PV SYSTEMS AND BESS GIVEN VARIOUS TARIFF SCENARIOS



ENERGY STORAGE FOR COMMERCIAL RENEWABLE INTEGRATION (ESCRI)

ElectraNet

Project Name
Energy Storage for Commercial Renewable Integration (ESCRI)

Member Company
ElectraNet

Project Timeline
TBD

Project Application
Time Shifting of renewable energy generated, reduction of expected unserved energy to consumers and technology demonstration

Funding
ARENA, AGL, ElectraNet and WorsleyParsons

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RATIONALE

South Australia has one of the highest penetrations of renewable energy on an interconnected system in the world, with the majority of this generation from wind and solar, which is intermittent. Such high penetration of renewables requires careful integration within the network to ensure stable and reliable power is delivered to consumers under all conditions.

The Energy Storage for Commercial Renewable Integration (ESCRI) project is currently exploring the role of utility scale non-hydro storage in South Australia's transmission network in the 5-30MW range, particularly to assist in this renewable integration area.

The project, which is in two Phases, is partly funded by the Australian Renewable Energy Agency (ARENA) and is being performed by a consortium consisting of AGL, ElectraNet and WorleyParsons (the Consortium). In Phase 1 of the project, the Consortium has concentrated on the business case of developing such a storage asset, and the associated issues that surround such assets. In Phase 2, which will depend on the outcomes of Phase 1, it is hoped to build, test and trial such an asset at utility scale.

DESCRIPTION

The ESCRI project is the first project of this type to examine the value of energy storage across three broad areas: the time-shifting of renewable energy generated, the network value to the transmission system as well as the ancillary service value that could be provided to the South Australian electricity system. The project is also considering the technical, commercial and regulatory issues involved with energy storage system deployment within the NEM.

APPROACH

This project is evaluating the potential of an energy storage asset to take advantage of energy from the significant overnight generation at AGL's South Australian wind farms. ElectraNet is addressing how the proposed storage system would interact with the electricity network while WorleyParsons are leading the technology selection and asset modelling components of this project, along with developing functional and technical specifications, timeline and costs estimates.

Due to the variety of potential benefits, novelty of the approach and maturity of the technology, the Consortium had to work iteratively addressing the following aspects:

- Site Selection;
- Regulatory Framework;
- Commercial Framework;
- Technology and Functional Specification; and
- Procurement and Costs

RESULTS

The Consortium issued a Request for Information to 42 proponents to gather information on the technical capability and estimated cost of utility scale storage. 16 responses were received from local and international companies/consortia and 8 proponents have been shortlisted for consideration.

The ESCRI project is in the process of concluding the Phase 1 results into a final report, which will consolidate all of the outcomes to date and detail the business case for the potential commencement of Phase 2. At this stage the exact location, size and business case metrics for that Phase 2 are still being developed. The Phase 1 project will be concluded by the end of 2015, with industry knowledge sharing being a key deliverable. It is currently anticipated that if approved, Phase 2 would likely commence in early to mid 2016.

RESIDENTIAL UTILITY SUPPORT SYSTEM (RUSS)

Project Name
Residential Utility Support System (RUSS)

Member Company
Ergon

Project Timeline
Commencement: 2011
Completion: December 2013

Funding
This project was funded from Ergon Energy's budgets as part of the Energy Sense Communities program of work.

Contact
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Project Manager
Mike Wishart –Principal Engineer - Technology

RATIONALE

This project trialled 10 advanced "smart-network enabled" lithium-ion battery storage systems within an urban network in Townsville. These trials were designed to demonstrate the effectiveness of VAR-controlled energy storage systems in reducing peak demand, improving supply reliability and quality and maintain network voltage regulation, particularly in locations with high concentrations of Distributed Energy Resources (DERs).

APPROACH

Ten 6kVA, 20kWh Residential Utility Support System (RUSS) units were designed and fabricated to Ergon Energy's requirements for installation at homes with existing solar photovoltaic (PV) systems, all within one distribution area. The units were operated in time scheduled control, injecting and absorbing fixed levels of real power; charging during off-peak periods and discharging at peak times. Reactive power was controlled via a four quadrant control algorithm.

RESULTS

The product of this project was specifically developed at a time when there were very few residential battery energy storage systems (BESS) available on the market. The control system was designed to meet Ergon Energy's specific requirements. The four quadrant VAR control worked well to manage customer PV voltage rise and peak load voltage drop, improving customer voltages by up to 12V.

The trial also demonstrated that battery failures provided significant insight into the challenges of new lithium-ion battery technologies. Time scheduled peak management were shown to have limited success at the distribution level, with smaller customer numbers, the diversity at a distribution level resulted in the distribution level peak being far more variable than the overall network peak. Despite continuous monitoring of distribution loads and significant storage, time scheduling of peaks for battery discharge resulted in relatively poor coincidence.

The coverage of the peak was 38% at the LV level, despite best efforts to tune the schedules. It was recommended that more sophisticated controls should be investigated and deployed to provide full coverage of the peaks and ensure the greatest benefit of the battery systems could be obtained.

GRID ENERGY STORAGE FEASIBILITY AND CONCEPT DESIGN STUDY

Project Name
Grid Energy Storage Feasibility and Concept Design Study

Member Company
Jemena

Project Timeline
Commenced June 2015
Expected completion October 2015

Project Application
Network Utilisation

Funding
Jemena

Contact
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RATIONALE

Jemena Electricity Networks (JEN) is currently developing its capabilities in the area of utility-scale energy storage, with particular focus on its application to mitigating peak demand network constraints and improving the quality of electricity supply. Jemena have undertaken a feasibility and concept design study to evaluate the technical characteristics of grid storage, its impact on the distribution network, protection and control issues as well as its cost / financial considerations.

There are two important outcomes of this effort – (i) the preparation of a preliminary scope of work and concept design for a future field trial of a grid energy storage system, and (ii) development of a framework for the planning assessment of grid energy storage as a demand management alternative to manage network constraints.

DESCRIPTION

This project has been jointly undertaken by Jemena and a consulting company and is being funded under the AER's Demand Management Innovation Allowance.

The project commenced in June 2015 and is expected to be completed by October 2015. JEN is also planning to undertake a field trial of energy storage systems within its distribution network. However, this field trial is only likely to happen after 2015, pending regulatory approval of proposed innovation funding, so the present feasibility study is not directly connected to the next stage field trial.

The feasibility and concept design study will determine the applications, technologies, sizes, types and locations of possible energy storage systems to overcome capacity constraints in a selected section of Jemena's network. All solutions must be compliant with power quality and protection requirements, while maximizing customer benefits.

The aim of the study is to assess grid energy storage as a possible means to defer or avoid larger capital expenditure in the three constraint network areas: sub-transmission, zone-substation and HV feeders. While renewable penetration is one of the parameters to be considered in the scenarios, it is not the primary focus of this study.

APPROACH

Jemena has taken a collaborative approach on this project with the Consultant, where Jemena's knowledge on grid side issues and network considerations is combined with the Consultant's expertise on delivering energy storage design and engineering solutions.

The project team want to investigate the conditions under which they can optimize the delivery of energy storage to maximize network value and minimize cost. As an example, if there is a capacity constraint at a zone sub-station and accompanying HV feeder(s) are experiencing power quality issues, the team want to identify the optimal solution that is able to mitigate both problems for the near and long term. This could mean installing distributed energy storage systems at multiple locations with coordinated control, as opposed to a large installation at one location.

RESULTS

Once operational, the results of the project will assist in determining the applications, technologies, sizes, types and locations of possible energy storage systems to overcome capacity constraints in a selected grid section.

RESIDENTIAL BATTERY STORAGE TRIAL

Project Name
Residential Battery Storage Trial

Member Company
AusNet Services

Location
Melbourne, VIC

Project Timeline
Commenced 2012
Completion - September 2015 for first phase.

Funding
AusNet Services, part under DMIA

Application
Network and customer peak demand management, solar PV uptake

Suppliers
MPower

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RATIONALE

In 2012, AusNet Services' initiated a project to investigate and trial the capability of battery and inverter systems connected to consumer homes, to reduce residential peak demand and reduce the technical network impacts of high penetrations of solar PV. The project also tested the battery systems capability of shifting customer demand from peak to off-peak times by discharging whenever the customer's instantaneous demand is high, and by re-charging overnight when the customer's demand is low, or recharging using excess solar generation. The Residential Storage project was identified as having potential benefits to both AusNet Services and the end customer.

Residential battery storage cubicle with solar inverter in the foreground

PROJECT DESCRIPTION

The project delivered an integrated residential storage solution to ten customers comprising of:

- batteries (6.6kWh lithium-ion);
- an inverter/charger (3kW peak);
- programmable energy management systems; and
- a communication system.

The storage systems were installed in combination with solar PV (either 1.2kWp or 3kWp). All of the battery systems had internet connectivity to enable remote changes to system settings, retrieval of data and manual control of system operation.

APPROACH

The main aims of the trial were to:

- Ascertain whether local residential storage can be used to flatten the network demand profile;
- Ascertain whether Solar PV / Storage combinations can be used to manage peak demand;
- Provide information on the potential effect of controlled/uncontrolled charging of electric vehicles;
- Provide information on the economic viability view of distributed storage as a means to manage peak demand and defer network asset investment; and
- Investigate the behaviour of residential storage alongside solar PV and its contribution to network voltage management.

RESULTS

The residential battery systems were installed during the summer of 2013-14 and operated in a "peak lopping mode". Data gathered during the summer of 2013/2014 was analysed and lead to the identification and development of several improvements in the functional operation of the systems for the 2014-15 summer. Some of these functional improvements included; maximising network demand reduction, minimising solar exports and maximising customer benefits.

The results to date indicate that residential storage can be controlled in such a way as to generate significant benefits to both the network and the customer, but that further cost reductions in battery system products will be required in order to become an economic demand management solution.

AUSTRALIAN ENERGY STORAGE KNOWLEDGE BANK

Project Name
Australian Energy Storage Knowledge Bank

Member Company
SA PowerNetworks

Project Timeline
Completion due in 2017

Project Application
System testing and Knowledge sharing

Funding
This project is being led the University of Adelaide with the syndicate comprising SA Power Networks, Solar Storage, ZEN Energy Systems and Power and Drive Solutions, with further funding support from the South Australian Government and the Energy Networks Association. In addition this project has attracted ARENA funding of $1.4 million to support the project.

Contact
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RATIONALE

With the increasing number and types of Energy Storage System technologies and their applications, this project will produce a mobile testing environment to further develop these technologies and to understand their use in Australian conditions. The project will create a knowledge base for industry and system developers whilst also providing for advanced training facilities for researchers, utilities and technology developers on an operational system.

DESCRIPTION

The mobile testing platform will comprise a mobile testing unit approximately similar in size to a shipping container with 200KW inverter, associated control equipment and network protection and SCADA interface. This will include a Labview installation to provide comprehensive monitoring of the performance of both the inverter and any associated battery systems. This data will be made available as part of the Knowledge Bank.

A second container will be deployed which houses the selected battery bank immediately adjacent the testing platform with suitable interconnections to the testing platform.

Initially this unit will be deployed within the SA Power Networks distribution system, it will be relocated interstate to test different conditions and network operations. As part of the project, the unit will also operate within the testing environment at the University of Adelaide's Thebarton precinct as well as on a larger commercial customer's premises.

The system will be deployed on the distribution network to trial its performance when operating to provide peak shaving, voltage management and micro grid applications.

APPROACH

The project is in the initial design stage with industry consultation and peer review in progress.

Expected availability of the system for initial field trials is Q3 2016 where it will be deployed on a 11KV feeder after extensive testing at the Thebarton precinct. Subject to final design it is intended that this unit may also be suitable for deployment within the SWER network during the 2017.

RESULTS

No results have yet been gathered as the project is still in the design and implementation phase.

GRID UTILITY SUPPORT SYSTEM (GUSS)

Project Name
Grid Utility Support System (GUSS)

Member Company
Ergon

Project Timeline
Commencement: Current phase of deployment commenced in August 2014

Expected Completion
Deployment will be complete by June 2016

Funding
This project has been funded from Ergon Energy Network Investment Operating and Capital budgets, as well as DMIA in the past.

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RATIONALE

Ergon Energy's Single Wire Earth Return (SWER) network is expansive and costly to upgrade, with very few customers able to support the high cost of network upgrades. Whilst peak loads on most of Ergon's SWER networks are problematic, they only occur for short periods of the day.

Despite the relatively high cost of energy storage, the application of energy storage locally to support SWER networks through times of peak loading can be cost effective, as well as providing easily and quickly deployable solutions. The Grid Utility Support System (GUSS) has been developed by Ergon Energy as a single phase 25kW/100kWh energy storage system with integration capability specifically to meet the challenging needs of Ergon's rural and remote SWER networks.

APPROACH

Ergon Energy is currently in the process of deploying 20 commercially made GUSS units. These units were developed after a long research and development process to find suitable solutions. This included:

- Development of concept and functional specifications;
- Trials of prototype units as a collaborative arrangement with Magellan Power Systems;
- Development of control and network interface protocols specifically to suit SWER applications;
- Development of internal business cases to determine costs and identify potential sites where GUSS would provide best value benefit;
- Testing the market for provision of products, resulting in a supply contract with S&C Electric; and
- Deployment process throughout Queensland consisting of:
  - Installation;
  - Development of new work methods;
  - New design methods; and
  - New training material and skill sets within Ergon Energy.

RESULTS

The product trialled for this project has proven highly successful. GUSS is able to resolve short term capacity issues on SWER networks. Subsequently, numerous SWERs on Ergon's network have been identified as being able to benefit from GUSS. A commercially developed product has now been delivered, and is in the process of being rolled out across the network.

Other key outcomes of this project have included:

- Learnings around deployment of energy storage across an electrical storage network;
- Development of smart control algorithms to best manage power and use of battery resources;
- Development of new standards; and
- Development of new methods of management for SWER networks.

"TODAY, A WIDE ARRAY OF STORAGE TECHNOLOGIES HAVE BEEN, OR ARE IN THE PROCESS OF BEING DEVELOPED AND DEPLOYED TO ENSURE THAT THE GRID CAN MEET OUR EVERYDAY ENERGY NEEDS."

FURTHER INFORMATION

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