# Energex
# DMIA Report 2019-20

September 2020

energex

Part of Energy Queensland

# Contents

# 1. Introduction

## 1.1 Purpose and Compliance

Energex is pleased to present the Demand Management Innovation Allowance (DMIA) Report for the 2019-20 regulatory year. The purpose of this report is to allow the Australian Energy Regulator (AER) to:

- assess Energex's 2019-20 DMIA initiatives and Energex's entitlement to recover the expenditure under the AER's Demand Management Incentive Scheme (DMIS)
- confirm Energex's compliance with the annual reporting requirements of the AER's Regulatory Information Notice (RIN).

This report has been completed in accordance with Schedule 1, paragraph 6 of the AER's RIN (refer Figure 1), which requires a DNSP to which the DMIS applies to submit an annual report to the AER on its expenditure under the DMIA. This report, and the information contained in the report, is suitable for publication by the AER.

**Figure 1 DMIA reporting requirements Schedule 1: Item 6 – Demand Management Incentive Allowance**

6.1 Identify each demand management project or program for which Energex seeks approval.

6.2 For each demand management project or program identified in the response to paragraph 6.1:

a) Explain:
   (i) how it complies with the Demand Management Innovation Allowance criteria detailed at section 3.1.3 of the demand management incentive scheme;
   (ii) its nature and scope;
   (iii) its aims and expected outcomes;
   (iv) the process by which it was selected, including its business case and consideration of any alternatives;
   (v) how it was/is to be implemented;
   (vi) its implementation costs; and
   (vii) any identifiable benefits that have arisen from it, including any off-peak demand reductions.

b) confirm that its associated costs are not;
   (i) recoverable under any other jurisdictional incentive scheme;
   (ii) recoverable under any other Commonwealth or State Government scheme; and
   (iii) included in the forecast capital or operating expenditure approved in the 2015-20 Distribution Determination or recoverable under any other incentive scheme in that determination; and:

c) state the total amount of the Demand Management Innovation Allowance spent in the relevant regulatory year and how this amount has been calculated.

6.3 Provide an overview of developments in relation to projects or programs completed in previous years of the regulatory control period, and any results to date.

## 1.2 DMIA projects summary

In its Distribution Determination the AER decided to apply Part A of the DMIS (i.e. the DMIA component) to Energex, approving an innovation allowance amount of $5 million over the 2015-20 regulatory control period. Energex's 2019-20 DMIA program comprised seven projects active during the year. The total cost incurred for the DMIA initiatives during 2019-20 was $1,137,142. This total amount is exclusive of indirect costs (financial overhead and fleet on-cost). The table below summarises Ergon Energy's DMIA program expenditure recovery for the 2019-20 regulatory year

**Figure 2: 2019-20 Expenditure ($)**

| Project | Budget | Capital | Operating | Total | Status |
|---|---|---|---|---|---|
| Enabling Dynamic Export Limits | 258,520 | | 52,061 | 52,061 | Continuing |
| Springfield Net Zero | 100,000 | | 100,000 | 100,000 | Completed |
| IPDRS Pilot | 553,707 | | 8,182 | 8,182 | Continuing |
| Expanded Network Visibility Initiative | 692,939 | | 394,692 | 394,692 | Continuing |
| Market Driven Battery Storage Pilot | | | 211,582 | 211,582 | Continuing |
| Solar Enablement Project | 562,178 | | 71,289 | 71,289 | Closed |
| LV System Static-State Estimation | 75,000 | | 296 | 296 | Completed |
| WP4 - Large Commercial BESS | | | 15,886 | 15,886 | Closed |
| WP4 Tesla Eagle Farm DC | 178,206 | | 15,797 | 15,797 | Continuing |
| Electric Vehicle Research | 745,942 | | 218,041 | 218,041 | Continuing |
| DOE Phase 1 Commercial | 241,854 | | 3,544 | 3,544 | Continuing |
| **Totals** | | | **1,091,370** | **1,091,370** | |

Energex confirms that the costs of the projects specified in this report are:

- not recoverable under any jurisdictional incentive scheme;
- not recoverable under any other Commonwealth or State Government scheme;
- not included as part of:
  - the forecast Capital Expenditure or the forecast Operating Expenditure; or
  - any other incentive scheme applied by the 2015-20 Distribution Determination.

## 2. DMIA Project development and selection process

Energex considers DMIA investments an important component of its commitment to delivering customer value over the longer term. The DMIA program complements our demand management program, which is geared toward providing a more efficient solution to network augmentation. The DMIA initiatives have enabled Energex to investigate and test innovative approaches to a range of network issues, customer behaviours, renewable integration and tariff enablement.

For the 2019-20 DMIA program, all nominated DMIA projects are subject to a screening and feasibility processes, consistent with the AER's DMIS. This governance process was reviewed and enhanced during the year, in-line with the merger of Energex and Ergon Network and alignment of application of DMIA funding with the respective DNSP's. The general DMIA project development and assessment process applied in Energex involves:

- Promotion of DMIA funding and criteria to internal stakeholders to encourage project ideas to be submitted, as an EOI or more formal DMIA Project Scope;
- Review of EOI or DMIA Project Scope against DMIA criteria as a minimum, and against relevant internal strategy documents, including the Energy Queensland Future Grid Roadmap*, the Demand and Energy Management Strategy and Load Control Strategy;
- Project proponents are encouraged to discuss project ideas with other Energex or Ergon subject matter experts, which helps guide and refine the idea;
- Projects that are deemed to meet the DMIA criteria are then formally submitted to the DMIA Program Manager for approval, or endorsement to the appropriate financial delegate.

*The Future Grid Roadmap is a document that outlines a range of themes and supporting activities and no-regret investments necessary for the Energy and Ergon Energy to achieve a transition to the intelligent grid of the future over the next 10-20 years. It is not essential to meet criteria other than the stated DMIA criteria, however project proponents within EQL should, where possible, ensure their project aligns with these existing EQL strategic network direction and priorities.

Budgets are prepared in accordance with Energex standard project methodology, detailing information including project goals, deliverables, milestones and resources required. Cost estimations were developed for the requirements identified, for each phase of the project. These cost estimations drew upon various sources including the cost of similar projects undertaken by Energex, current preferred contractor panel contracts and market research.

During this year, a DMIA case study template was developed to capture and promote learnings and project outcomes, when a project is completed (as appropriate) – these will be included as in the annual AER reports and we will also make these available publicly (subject to any confidentiality requirements where third parties are involved). We have also included a reference to the DMIA program on the Energex website, allowing potential project proponents to make contact with us to discuss potential project ideas.

Looking forward to the 2020-25 reg period, our intention is to develop a five-year strategic plan for Energex DMIA funding, in early 2020/21. This will identify key focus areas for DMIA project development, aligning with DMIA criteria and internal priorities around the changing way customers are using the network, increased deployment of distributed energy resources, two-way flow of data and energy.

# 3. DMIA Project updates

This section of the report details the status of Ergon Energy's DMIA projects in 2019-20 by describing each project, its objectives, progress and findings to date.

## 3.3 Enabling Dynamic Export Limits

This is a trial to demonstrate the benefits to customers and network of moving from zero export limits to dynamic export limits.

### 3.3.1 Compliance with DMIA Criteria

The objective of this trial is to demonstrate the benefits to customers and our network of moving from zero-export limits to dynamic export limits. This proposal is aligned with Stream 1 of the Future Grid Roadmap - Managing two-way energy flows, specifically around Customer Distributed Energy Resources (DER) Active Management. A number of research collaborations including the Solar Enablement Initiative (SEI), Queensland Integrated Power Platform (QIPP), Advance Queensland Platform Technology Program and the Evolve DER Project are developing techniques for more active DER management.

### 3.3.2 Nature and Scope

The scope of the trial includes the installation of a commercially available 50 kW, 3 phase Solar PV system complete with a Dynamic Export Limit Controller (DELC) which enables the solar inverter to respond to near real-time network demand support requests. The DELC system responds to published demand requests based upon the local network LV transformer demand status. The purpose of this trial is to investigate the viability of enabling energy flow from distributed renewable sources rather than the typical zero export connection agreements more regularly resultant for connections by small to medium commercial Solar PV customers.

### 3.3.3 Aims and expected outcomes

The potential learning objectives will include the following:

- Customers
  - Understanding customer drivers and barriers to taking up Solar PV with active DER control; and
  - Understanding what level of control can be implemented which has minimal impact on customers' use of the Solar PV whilst providing maximum benefit to the network and the customer.
- Technology
  - Foster and drive the development of technologies and interface techniques required for active management of Solar PV;
  - Gain a better understanding of the technology impacts of potential increased levels of solar PV penetration with active management take up on the electricity network and how Energex/Ergon might need to evolve the LV network design to

accommodate customer technology requirements (Solar PV, BESS, and Energy Management Systems); and
    - Gain a better understanding of the inverter technology configurations, sizing and optimal control methodologies to enable active DER to support network real-time conditions and load requirements.
- Energex/Ergon
    - Gain an understanding of what role Energex/Ergon should play in the Solar PV enablement market incorporating active management of DER;
    - To demonstrate operational real-time active DER response to network constraints as part of the Solar Enablement Initiative; and
    - Test if the existing Energex/Ergon connection requirements allow easy access to increased levels of Solar PV output with active management capability on the EQL distribution network.
    - Determine how to minimise the technological changes required to enable active DER management.

### 3.3.4 The process by which it was selected, including its business case and consideration of any alternatives

The business case for the projects was reviewed against the DMIA criteria by both Demand Management and Regulatory Departments. The projects were deemed to meet the DMIA criteria and costs confirmed to be not in any way recoverable from another source. The business cases were presented to the Energex Investment Review Committee which endorsed the projects for DMIA funding.

### 3.3.5 How it was/is to be implemented (ie general project update)

The Enabling Dynamic Export Limits for Commercial Solar PV trial has been constructed and commissioning was completed (mid August 2019). The Trial and testing phase has been initiated.

The trial site was selected to represent a site that a customer would be likely to install solar PV to reduce their annual energy consumption to below the maximum 100 MWh / year which is the threshold for a network demand-based tariff threshold. This sector of customers often apply for a zero-export solar PV connection application to mitigate additional engineering costs and assessment process delays. In this case there is no ability for the distribution network to benefit from any excess generated energy to be exported from these sites or the ability of the customer to receive a Feed-In-Tariff (FIT). The Dynamic Operating Envelope (DOE) enables both of these opportunities to be available with little to no impact on the customer's Solar PV system operation and only a moderate investment in comparison to the financial earning capability of the FIT over the lifetime of the Solar system.

All of the Technology outcomes outlined above have been demonstrated and are now operational in the stage one trial site at Cleveland. The DOE and network control platform has been further developed and will align with other state and national energy trials to include compliance with existing and influence future Australian Standards for DER connection capabilities as more customer

connections are sort. This will require the adoption of the DOE platform at the inverter manufacture stage to offer widespread deployment to realise the holistic distribution network support opportunities.

Energex has expanded the Solar PV DOE trial to five sites based upon the initial success of the Cleveland trial, as part of the Dynamic Operating Environments Phase 1 Commercial project (refer to 3.11 below).

Both internal and customer connection processes are being reviewed to allow greater DER hosting capability utilising the real-time DNSP network monitoring operational characteristics of the Solar PV DOE platform. These trials have already demonstrated the successful stage one operation for customer owned Solar PV to support the distribution network while minimising the power quality and reverse energy flows currently being experienced on high penetration DER network sectors. Stage two of the trial is underway to integrate two-way energy flows and has direct benefit to meet current 50% renewable energy targets by 2030 in Queensland.

### 3.3.6 Any identifiable benefits that have arisen from it, including any off peak or peak demand reductions

The site has the capability to export excess Solar PV generation beyond the site demand to support the local LV and 11 kV feeder network, to date up to 32 kW of peak demand network export support have been measured at the NMI. This is a near real-time dynamic network support based upon the actual network measured requirements rather than a fixed export value.

## 3.4 Springfield Net Zero

This project involved partnering with Springfield Master Planned master planned community in the development of a proposed Net Zero energy community.

### 3.4.1 Compliance with DMIA Criteria

The project was viewed as meeting DMIA Criteria by investigating ways to shift or reduce demand for standard control services through non-network alternatives. Working directly with a developer researching net zero sub divisions provides a detailed insight on how DNSPs can interact with developers, and what strategies, programs or initiatives can be implemented to manage lowest cost

net zero whole of development demand, in the face of rapidly changing use of energy technologies, including distributed energy resources.

### 3.4.2 Nature and Scope

This project endeavoured to develop an understanding of the infrastructure required for net zero energy real estate developments. The project examined key aspects of a master planned community designed for net zero including:

- Energy transitions;
- Mobility;
- District services (cooling/heating); and
- Water and energy.

### 3.4.3 Aims and expected outcomes

Energex and Ergon Energy will benefit from understanding the electrical infrastructure impacts of a net zero development and be able to explore:

- The potential peak and minimum demand risks (impact on After Diversity Maximum demand ADMD, risk mitigation options and net benefits to all parties);
- The opportunity for working directly with a developer for controllable loads/generation in greenfield developments;
- Risks associated with electrification of mobility; and
- The likely size, location and operation of energy storage.

A direct output of the project will be an understanding of the energy density and load profile of various demographic segments and building designs when engaging directly with developers of new estates.

### 3.4.4 The process by which it was selected, including its business case and consideration of any alternatives

Energex and Ergon Energy were exploring other opportunities with Springfield surrounding local energy markets, DSO, and network constraint information within the Springfield development. This

project was selected as it directly supports the long-term network planning, integration and control required under a DSO arrangement and can leverage learnings and knowledge from other projects.

### 3.4.5 How it was/is to be implemented (i.e. general project update)

The project was an information sharing project and was developed with a collaborative sharing of knowledge and information between Springfield, Springfield's subcontractors (Tractebel) and Energex and Ergon Queensland.

The project will be used to inform several aspects of future activities for Ergon Energy and Energex, including:

- The development of future projects that provide network benefits which may be delivered in collaboration of greenfield developers;
- The integration of outcomes from the report to feed into energy density and demand density for future strategic planning models;
- Integrated development planning which includes allowance for electrification of transport;
- The future of greenfield development guidelines and how the future of energy integrates into these guidelines; and
- The report will support future reviews of planning systems and standards such as ADMD and the integration requirements for Distributed Energy Resources.

The final report can be accessed from https://www.greaterspringfield.com.au/wp-content/uploads/2020/05/Roadmaps-ENGIE-Tractebel-Report-18052020-Final.pdf

### 3.4.6 Any identifiable benefits that have arisen from it, including any off peak or peak demand reductions

The final project deliverable was the project report outlining master planning opportunities for a net zero development, including no regrets options for immediate project implementation. The final project report provided Energex and Ergon Energy Network with insights into:

- How developers are considering urban environments and the inclusion of sustainability, renewable energy and public places;
- Opportunities to work collaboratively with developers for mutually beneficial outcomes in co-ordinated urban and infrastructure design;
- Net zero energy and demand density therefore network requirements;
- The network demand needs at LV, MV and substations for a net zero energy or a net zero carbon to inform future potential network configurations;
- Urban mobility and potential impacts of electric vehicles;
- Energy generation and distribution around a net zero development;
- The energy and demand density of net generation building infrastructure;
- Opportunities for integrated local energy control solutions.

The project will help inform future research projects that focuses on mutually beneficial outcomes. A case study was developed for this project – refer to Attachment 1.

## 3.5 IPDRS Pilot

The purpose of this project was to undertake market discovery to establish a complete end-to-end energy management system that enables the Internet Protocol Demand Response Device (IPDRED) functionality. Regulatory change regarding a DNSPs ability to own assets behind the customer meter has led to a Network strategic change as to the securing of demand management/response direct with customer. The movement away from direct firm load control has shifted to market procurement. This project is jointly funded under Energex and Ergon DMIA allowances.

### 3.5.1 Compliance with DMIA Criteria

The project aims to orchestrate improved energy management (peak lopping, valley filling, neutralise otherwise disruptive loads) to reduce network augmentation requirements. The purpose of an IPDRED is to increase the amount of load under management (more appliances, improved geographic coverage), improved the ability have more granular / targeted load control; and to complement existing load control based around audio frequency-based load control. As the project was initiated in 2019-20 but expected to carry forwarded into the 2020-25 regulatory period, its was assessed against the DMIA criteria applicable in both Regulatory periods. The project was deemed to be in compliance as it was a program for researching, developing or implementing demand management capability or capacity, that could be used broad based or in specific network demand constraint areas.

### 3.5.2 Nature and Scope

Undertake market discovery to establish a complete end-to-end energy management system that enables the IPDRED functionality already identified. Market discovery will enable improved costings for a Gate 3 Business Case. The scope covers engagement of potential service providers of solutions being sought for platform and communication pathway solutions.

### 3.5.3 Aims and expected outcomes

The aim is to identify suitable service providers for a complete energy management platform (from platform serve to a demand response communications pathway). The outcome will be a detailed business case to move forward with market roll-out Internet Protocol Demand Response Enabling Device (IPDRED) requirements if the pilot is successful.

### 3.5.4 The process by which it was selected, including its business case and consideration of any alternatives

With regulatory requirements seeking DNSP movement away from any activity behind customer meters and encouraging a market that can release greater value to customers via other market players, this program seeks to meet this opportunity. Supporting a pathway to an enabled market-delivered demand response market will broaden the variety and number of loads and DER accessible for network support and augment the existing audio frequency load control / demand management platform.

### 3.5.5 How it was/is to be implemented (i.e. general project update)

The project was meant to operate through the engagement of service providers of technology solutions being sought for platform and communication pathways. Service providers were asked to secure new participants to their existing “home energy management systems” based on a set of

DNSP requirements, including an incentive payment. Unfortunately, this customer acquisition model has not been successful. Alternatives to boost customer participation are in review.

### 3.5.6 Any identifiable benefits that have arisen from it, including any off peak or peak demand reductions

Given the regulatory moves toward market procurement of load control, part of the original objective to have a better understanding of the cost to deliver an end to end control methodology has morphed to being that of formalising with the market, a DNSP's requirements of their vendor solutions to enact demand management/response on the DNSP's behalf.

## 3.6 Expanded Network Visibility Initiative

The purpose of the Expanded Network Visibility Initiative (ENVI) is to build on the work of the Solar Enablement Initiative and LV State Estimation project, former DMIA projects, which successfully demonstrated a novel state estimation in operation on Energex's network. ENVI will develop the tools and systems to enable the scale-up of Distribution System State Estimation (DSSE) across Energy and Ergon Energy Network medium and low voltage feeders. This project is joint funded with Ergon Energy Network DMIA funding.

### 3.6.1 Compliance with DMIA Criteria

The Expanded Network Visibility Initiative complies with the Demand Management Innovation Allowance criteria detailed at section 3.1.3 of the demand management incentive scheme. The visibility over historical and near real-time network performance that can be achieved by application of DSSE will improve the business' ability to identify areas of network which may benefit from additional demand management and facilitate better orchestration of Distributed Generation on the low voltage network.

### 3.6.2 Nature and Scope

Broadly, this project will focus on developing and deploying the capability to load and generate state estimation runs on medium and low voltage feeders in Energex and Ergon Energy with minimal manual intervention. In addition, the ability to automatically return or access the outputs of the state estimator within the business.

### 3.6.3 Aims and expected outcomes

The purpose of the Expanded Network Visibility Initiative (ENVI) is to expand on the work of the Solar Enablement Initiative (SEI), a previous DMIA project, which successfully demonstrated a novel State Estimation Algorithm (SEA) in operation on Energex's network. ENVI has one primary objective and three secondary objectives:

1. Development of the tools and systems required for Ergon Energy and Energex to scale-up the SEA across their MV and LV networks to provide expanded network visibility as an intelligent foundation to enable distributed energy resources (DER) and facilitate demand management activities (Primary).
2. Refine the prototype semi-automated network analysis tool developed by the SEI to enable engineers to accurately predict the impacts of future Distribution Energy Resource connections – both generation and load (Secondary).
3. Further refine and maintain the SEA to facilitate Dynamic Operating Envelope trials which seek to dynamically signal customers or third parties, such as Virtual Power Plants (VPPs)

or aggregators, to operate within an operating envelope based on near real time network operating conditions (Secondary).

4. Develop a tactical plan for the use of the SEA's companion Capacity Constraint Optimisation to inform and automate existing manual Load Control Schedules (LCS) (Secondary).

The work will be undertaken in a collaborative engagement with external company GridQube who has been granted the rights to commercialise the SEA from the University of Queensland.

### 3.6.4 The process by which it was selected, including its business case and consideration of any alternatives

This project was selected based on the multiple benefits it can provide to many areas of the business, demand management being one. DSSE is seen to be an efficient approach to gaining visibility over the network, without the need for extensive and costly network monitoring. It can achieve the same level of visibility using less data. Using the business' Opportunity Matrix it was identified as an innovative venture with high opportunity potential.

### 3.6.5 How it was/is to be implemented (i.e. general project update)

The project is progressing well with DSSE operational in EQL's Amazon Web Services tenancy. The next stage will involve developing the ability to transfer large amounts of network and monitoring data securely and efficiently between on-premises systems and the cloud. This is critical to scale-up operations and transition the capability into BAU processes.

### 3.6.6 Any identifiable benefits that have arisen from it, including any off peak or peak demand reductions

The project was not targeting a specific quantity of peak or off peak demand reduction but is targeted as establishing platforms and capability from which sound demand management decisions can be made based on the increased network visibility provided by DSSE.

## 3.7 Market Driven Battery Storage Pilot

A battery trial for residential homes who already have solar to understand customer and grid impacts / benefits (15 residential sites in Brisbane).

### 3.7.1 Compliance with DMIA Criteria

The BESS Pilot complies with the Demand Management Innovation Allowance criteria detailed at section 3.1.3 of the demand management incentive scheme. The BESS project focuses on an emerging technology that is anticipated to be taken up by customers at an increasing rate over the coming years. It is imperative that Energex gain early insights into how customers will take up BESS, how Energex can provide a direct demand load control value proposition, how the systems will be integrated into the network and what changes need to be made to the network to accommodate the technology.

### 3.7.2 Nature and Scope

A targeted Market Based Battery Trial was undertaken in cooperation with BESS manufacturers who were selling BESS to customers in South East Queensland. The Market Based Battery Trial was planned to run in two stages: firstly, with 15 staff sites and secondly with customers in selected areas

of the network. The trial is focussing on the coordination of demand response capable BESS that are compliant with AS/NZS 4755.3.5. The trial aimed to investigate the value to the network from coordinated and standardised BESS demand response, particularly during peak demand and peak export periods.

Since commencing the first stage of the trial, several larger scale BESS trials looking at coordinated demand response have been undertaken throughout Australia, Consequently, the second stage of the trial will not be undertaken.

### 3.7.3 Aims and expected outcomes

The trial objectives were to:

- understand how customers use batteries and what the impact of these new customer load profiles will be on the network;
- investigate coordination of standardised demand response from batteries to enable more customers to connect solar PV and batteries to the network; and
- explore customer incentive options that provide new value to the industry and ultimately to our customers.

### 3.7.4 The process by which it was selected, including its business case and consideration of any alternatives

The business case for the project was reviewed against the DMIA criteria by both Demand Management and Regulatory Departments. The projects were deemed to meet the DMIA criteria and costs confirmed to be not in any way recoverable from another source. The business cases were presented to the Energex Investment Review Committee which endorsed the projects for DMIA funding.

### 3.7.5 How it was/is to be implemented (ie general project update)

The Market Based Battery Trial continued throughout this year. The 3-year trial was due to end December 2019, however the trial was extended to March 2020 to allow the capture of data over an additional summer period. The batteries were then removed between the period of March and August 2020.

### 3.7.6 Any identifiable benefits that have arisen from it, including any off peak or peak demand reductions

The trial has produced several benefits including:

- Peak demand reduction. This project successfully demonstrated that batteries do provide peak demand reductions, and can be successfully called upon, using existing Load Control System (LCS) infrastructure, to reduce demand when required. Refer to preliminary finding report.
- Data for use by external parties. Data from the trial has been requested by University of New South Wales for analysis on effectiveness of battery energy systems to reduce peak demand, and by Powerlink for analysis as part of a chronological demand trace for different parts of Powerlink's network.
- Learnings and insights on battery installation. Learnings from the battery installation phase of the trial were published in May 2017, including an Energex report on practical

learnings and tips for battery installers and a Clean Energy Council (CEC) Inspections Summary report.

Working with different third-party battery applications has highlighted the need for standardised demand response communication protocols.

## 3.8 Solar Enablement Project

This project involved application of state estimation technique that generates an estimate of the networks operational conditions to help assess connection of additional customer PV system to the medium voltage (MV) network.

### 3.8.1 Compliance with DMIA Criteria

The Solar Enablement Initiative complies with the Demand Management Innovation Allowance criteria detailed at section 3.1.3 of the demand management incentive scheme as the improved data and information that can be achieved by application of an estimator on the MV network level can be used to improve the benefits of demand management and coordination of distributed generation across the medium voltage network.

### 3.8.2 Nature and Scope

The project aims to further develop, implement and test an innovative state estimation algorithm for monitoring medium voltage electricity distribution networks by running a trial on seven feeders across three distribution network service providers. The aim is to provide an improved understanding of electricity network behaviour to maximise the capacity of new solar PV installations and their export into the Australian grid, thereby enabling an increase in the percentage of renewable energy

connected to the grid. This two year project is being run by University of Queensland (UQ) in partnership with nine stakeholders including Energex.

### 3.8.3 Aims and expected outcomes

The objectives of the project are to support the University of Queensland to:

- Further develop the Distribution System State Estimation algorithm to be applied to the medium voltage networks
- Provide trial networks, including monitoring devices, for field trials of a prototype application
- Improve the PV connection assessment process and associated PV connection costs through the development of a network assessment tool
- Improve the dispatch of Distributed Energy Resource
- Improve the demand management response
- Minimise future network investment.

### 3.8.4 The process by which it was selected, including its business case and consideration of any alternatives

This was a follow-on project from a previously funded DMIA project and was approved on the basis of compliance with DMIA criteria and the requirement to continue development of this project concept.

### 3.8.5 How it was/is to be implemented (i.e. general project update)

The approach for UQ delivering this initiative is to:

- Nominate seven MV feeders across the three project partners' networks to serve as a trial and demonstration platform. The seven trial feeders have been selected including three feeders in Energex's network, two in TasNetworks and two in United Energy. A fourth Energex feeder has been included to support real-time application of the estimator on the MV network.
- Generate models of nominated MV feeders and establish network simulation capabilities. All eight feeder of the partner networks has been successfully modelled.
- Install suitable additional measurement devices on the trial feeders where required. Completed. This was only necessary in TasNetworks.
- Re-design LV State Estimation algorithm for MV network operation. This is completed.
- Develop a semi-automated network analysis tool based on the State Estimation Algorithm to be used to improve the existing PV connection assessment process. This is completed
- Perform desktop analysis of scope and costs to deploy State Estimation algorithm and Network Assessment Tool on entire MV network in each project partner network.
- Perform a real-time demonstration using State Estimation to support the application of dynamic PV export limits for customer owned systems. Real time state estimation is implemented, generation of a PV export limit from the state estimation was completed in December 2019.

This project finished in December 2019 with final reports submitted to funding partner ARENA – project details can be found on the Arena website. The project successfully demonstrated that the

novel distribution system state estimation algorithm refined through this work can be effectively implemented on distribution networks with the varied data sources that DNSPs have available.

### 3.8.6 Any identifiable benefits that have arisen from it, including any off peak or peak demand reductions

This project has successfully demonstrated that Distribution System State Estimation is possible on MV networks using existing network monitoring data as input with limited need for additional monitoring.

Three disparate sets of input data have been tested across the three DNSP partners.

The project also developed a protype tool to assess new PV connection applications. The tool uses state estimation to provide a broader picture of the historical performance of a feeder, identifying multiple critical cases which are used as the basis on which to ascertain the impact of a new connection. This work, tested on only a few cases, will be built-on by the business.

The project was not targeting a specific quantity of peak or off-peak demand reduction but is targeted at establishing platforms and capability from which sound demand management decisions can be made based on the increased network visibility provided by the state estimator.

A case study was developed for this project – refer to Attachment 1.

## 3.9 LV System Static-State Estimation

The purpose of this trial was to develop, implement and test sate estimation algorithm for monitoring LV network. The project will form the basis of coordinating demand and distributed generation with respect to operational limits of local network segments.

### 3.9.1 Compliance with DMIA Criteria

The Low Voltage Network Power System Static-State Estimation complies with the Demand Management Innovation Allowance criteria detailed at section 3.1.3 of the demand management incentive scheme as the improved data and information that can be achieved by application of an estimator can be used to improve the benefits of demand management and coordination of Distributed Generation across the low voltage network.

### 3.9.2 Nature and Scope

The project is to develop, implement and test an innovative state estimation algorithm for monitoring low voltage electricity distribution networks. This algorithm will form the basis for coordinating demand and Distributed Generation with respect to operational limits of local network segments. A ‘state estimator’ can provide a basis for an autonomous low-voltage network management and

monitoring system. This project is a joint project between Energex, Ergon and The University of Queensland (UQ) for a period of three years.

### 3.9.3 Aims and expected outcomes

The objectives of the project are to:

- Develop a Distribution System State Estimation algorithm that can be applied to low voltage networks
- Provide timely control inputs to a number of low voltage connected devices to improve the efficiency of the network
- Provide trial networks for field trials of a prototype application
- Improve the dispatch of Distributed Energy Resource
- Improve the demand management response

### 3.9.4 The process by which it was selected, including its business case and consideration of any alternatives

The business case for the project was reviewed against the DMIA criteria by both Demand Management and Regulatory Departments. The projects were deemed to meet the DMIA criteria and costs confirmed to be not in any way recoverable from another source. The business cases were presented to the Energex Investment Review Committee which endorsed the projects for DMIA funding.

### 3.9.5 How it was/is to be implemented (ie general project update)

The approach for UQ delivering this initiative in partnership with Energex was to:

- Nominate one LV network to serve as a trial and demonstration platform. A suitable trial network has been selected within Energex's network. A Single Wire Earth Return (SWER) feeder in the Ergon Energy Network is also planned for testing.
- Generate model of nominated LV network and establish network simulation capabilities. Completed.
- Identify network parts most likely at risk of operational issues and identify suitable measurement scheme for monitoring these sections. Completed.
- Install three additional measurement devices at strategic points on the selected LV network. Completed. Real-time measurement data is available to the estimator within the network's Operational Environment.
- Run State Estimation to identify best location and required size of state influencing equipment and install it. The estimator is running successfully using real-time and static data inputs. Installation of control equipment is in progress.
- Start closed loop control and record performance.
- Apply the State Estimation algorithm as part of a desktop study on additional network areas of interest.

This project was successfully completed in December 2019.

### 3.9.6 Any identifiable benefits that have arisen from it, including any off peak or peak demand reductions

This project has successfully demonstrated that Distribution System State Estimation is possible on LV networks using limited network monitoring data as input. The project was not targeting a specific

quantity of peak or off-peak demand reduction but is targeted at establishing platforms and capability from which sound demand management decisions can be made based on the increased network visibility provided by the state estimator.

The project also proved that the state estimation algorithm could be deployed in a DNSP's Operational Technology Environment processing data gathered from the field in near real-time.

A case study was developed for this project – refer to Attachment 1.

## 3.10 WP4 Large Commercial BESS

Project involved integration of a 150 kW Solar PV and 250 kW BESS and development of a proprietary control platform to run both Island/off-grid modes as well as DRED DM operation of a commercial scale BESS. Additional to this was the installation of a fault level protection scheme when the system is operating in Island/Off-grid mode due to reduced fault clearance capacity of the BESS to operate the existing site LV final sub-circuit protection.

### 3.10.1 Compliance with DMIA Criteria

The Solar PV and BESS trial represents the first operational commercial scale system compliant to AS4755.3.5 with DRED functionality and Island operation. The system has the ability to disconnect completely from the distribution network and operate in island mode for short durations as well as the ability to inject or export energy for grid support if required.

### 3.10.2 Nature and Scope

The scope of the trial includes the installation of a 150 kW Solar PV and 250 kW/488 kWh BESS which was capable of site and network demand support including island/micro-grid operation and DRED functionality to AS4755.3.5. This trial was installed at an operational commercial site and additional works were required to mitigate fault level protection risk during micro grid operation identified during the initial commissioning testing.

### 3.10.3 Aims and expected outcomes

The aim of the project is to gain a better understanding on the commercial customer value proposition and expectations from the electricity network in taking up BESS; how Energex can leverage off the existing load control system with direct load control and tariffs to benefit both Energex and the customer and investigate how the BESS technology will integrate with the electricity network.

### 3.10.4 The process by which it was selected, including its business case and consideration of any alternatives

The business case for the projects was reviewed against the DMIA criteria by both Demand Management and Regulatory Departments. The projects were deemed to meet the DMIA criteria and costs confirmed to be not in any way recoverable from another source. The business cases were presented to the Energex Investment Review Committee which endorsed the projects for DMIA funding.

### 3.10.5 How it was/is to be implemented (i.e. general project update)

The commercial BESS and solar PV located at the Energex Eagle Farm Distribution Centre has been constructed and commissioning was completed in mid October 2018. Activities under this project

during this year was limited to system maintenance etc. The Trial and testing phase is to be initiated under the associated WP4 Tesla Eagle Farm DC project.

### 3.10.6 Any identifiable benefits that have arisen from it, including any off peak or peak demand reductions

The Eagle Farm Solar PV and BESS Trial consists of a separately integrated control platform which controls all aspects of the commercial scale Solar PV and BESS. This monitors and controls the energy flow throughout the site and has the ability to mitigate the network peak demand to a predetermined level by managing the Solar PV generation rate and BESS storage and injection capability. During peak demand periods, the combination of generated and stored energy supports the site demand and manages the Site NMI/Network demand to a pre-determined kVA. In times of reduced demand excess solar generation is stored within the BESS for later support. This is a dynamic process and operates on variable site demand conditions. To date it has proven reliable and enabled up to 20% reduction in peak demand and equates to approximately $10k deduction in monthly billing for the site.

## 3.11 WP4 Tesla Eagle Farm DC

Following on from the installation and commissioning of the Eagle Farm 150kW PV system and 250kW BESS identifying opportunities for network support from large scale BESS and PV.

### 3.11.1 Compliance with DMIA Criteria

The Solar PV and BESS trial represents the first operational commercial scale system compliant to AS4755.3.5 with DRED functionality and Island operation. The system has the ability to disconnect

completely from the distribution network and operate in island mode for short durations as well as the ability to inject or export energy for grid support if required.

### 3.11.2 Nature and Scope

Testing of the installed system post commissioning to ensure stable operation, ability for the system to manage peak demand on site and operate for short durations in an islanded mode.

### 3.11.3 Aims and expected outcomes

Benefits anticipated from this project include:

- Identifying opportunities for network support from large scale BESS and integrated PV, which may typically be installed at a commercial premises;
- Demonstrate load control of a large scale BESS and integrated PV via local control software and how networks can interact with the systems;
- Investigate options for control via Demand Response Enabled Devices (DRED);
- Inform the development of a customer BESS control strategy for large scale systems;
- Identify improvement opportunities for existing IES connection standards;
- What modes a customer may operate in and how this might affect their connection to the network (i.e. connection agreements, tariffs, ADMD's, etc.); and
- Identify knowledge and skills relation to:
    - Enabling effective integration
    - Understanding impacts on planning, forecasting, switching and fault finding.

### 3.11.4 The process by which it was selected, including its business case and consideration of any alternatives

This was a follow-on project from a previously funded DMIA project and was approved on the basis of compliance with DMIA criteria and the requirement to continue development of this project concept.

### 3.11.5 How it was/is to be implemented (i.e. general project update)

Operation of the system over the past 12 months has demonstrated relatively stable operation. There were some network events that tripped the system and we have learnings as a result. The system also was taken through a planned network outage to test its automated islanding capabilities which

have been proven. In short the system's day-to-day operation is demonstrating peak site demand limitation, utilising renewable energy as part of the solution. Further testing may be carried out.

### 3.11.6Any identifiable benefits that have arisen from it, including any off peak or peak demand reductions

The combination of battery and solar has enabled overall management of the peak demand of the site. It has highlighted the importance of tight control integration between the BESS and PV to enable effective levels of demand management.

The system has transferred to island mode during grid outages. During these outages a tighter integration with the Building Management system was identified to maximise the available energy.

## 3.12 Electric Vehicle (EV) Research

A longitudinal program (provisionally 3 years) of monitoring EV charging primarily at customer residential properties.

### 3.12.1 Compliance with DMIA Criteria

Through understanding of residential EV charging profiles and acceptance to be managed, Energex will be able to assess the value of demand management within the EV market.

By understanding charging profiles and behaviours and testing the control available to EQL, will further inform:

- how EVs can be managed effectively for network reliability and stability whilst also fulfilling a customer need for assurity of charge for their requirements;
- The value of EV load management for the network and customers in both a broad-based and targeted sense; and
- how the introduction of vehicle-to-home/grid can be optimised to best effect for the customer and the network.

Once EV charging profiles of residential customers is better understood, and trialling of load control of said vehicles illustrates the flexibility available in managing these charging profiles, so value propositions can be established that encourage either:

- behavioural and attitudinal changes to charging profiles that suit the network (generic primary tariff solutions);
- opportunities for third-party (aggregator) influence in managing charging profiles, or
- direct control by the DNSP of charging profile through load control tariffs

### 3.12.2 Nature and Scope

EQL Energex and Ergon Networks need to better understand the charging patterns of residentially used EVs to mitigate potential risks and maximise opportunities that EV's present.

### 3.12.3 Aims and expected outcomes

The objectives of this research program are to understand the charging behaviour of electric vehicle (car) owners to:

- provide charging profile data for Scenario Planning and Forecasting to assess the impact on Queensland networks and other EV-related purposes;

- determine any policy issues and requirements regarding connection of private EV chargers and their ability to be managed;
- inform requirements for any future EV specific data capture systems
- assess the necessity for possible EV LV network monitoring;
- incorporate residential charging models to inform future planning of public charging station locations and network requirements for supply;
- prepare for vehicle to home/grid EVs;
- customer journey mapping to understand buying behaviour and likely spatial take-up using EQL's new market segmentation;
- better educate and communicate optimal options for best charging practices for customers and the network;
- inform EQL on how EVs will influence future tariff requirements, and
- maximise the value of EVs to the EQL networks (maximum revenue for minimum cost).

### 3.12.4 The process by which it was selected, including its business case and consideration of any alternatives

To date there has been no primary research undertaken in Australia to deliver actual charging profiles of residential EVs across a wide model range, their geographic location, potential charging capacity, and the availability of renewables at home.

Through DMIA funding this project will allow Energy Qld to understand charging profiles and behaviours and through testing the control available to EQL will provide bench marking data, inform how existing connection processes may need to be modified to improve customer and network outcomes and provide evidence and direction on what energy management options are available to optimise these network and customer outcomes.

The standard DMIA process was adhered to in seeking funding to support this project. A formal business case was developed, and cross company approval sought.  alternative considerations were identified. These included attitudinal research on how EV owners expect to charge their EV's as well

as modelling of internal combustion engine (ICE) vehicles as a proxy for EV driving and charging data.

Both were eliminated given less reliable and less accurate data as well as only being informative at a static point in time. Additionally, these considerations were limited by lack of customer knowledge of their EV charging, and their intention not matching actual activity.

Real charging data also allows confirmation of assumptions around charging of an EV and importantly the peak demand generated and associated load profile analysis. ICE EV usage patterns are assumed very different and this project will allow confirmation of same.

### 3.12.5 How it was/is to be implemented (ie general project update)

The program will provisionally extend over 3 years.

**Stage 1/Year 1** (Recruitment & Data Baseline): The program launched end of May 2020, and as at 30 June 2020, 140 participants approximately had been recruited in the program. Recruitment of participants has been promoted and targeted via several EV related channels.

Small financial incentives of $100 for sign-on have been provided to entice participant involvement in addition to access to individual poral dashboards for participants. Additional promotional enticements included a 'participant refer a friend' campaign which attracted an additional 20 new participants.

All channels to market have embraced the program well and been proactive in on promotion to constituent or member bases.

Participant sub segment user groups were identified and targeted during recruitment phase considering:

- EV details – make/model, model year, max charge rate, rego, purchase date
- Vehicle size and categorisation- BEV small/large or PHEV
- Geography- urban, regional and rural
- Electrical connection type & tariff connected to, retailer association
- Charge method
- Dwelling type- detached house, apartment, townhouse
- Integration of solar and BESS

Expectations are that 180 participants will be recruited by end August 2020. This is a positive response rate of approximately 5% of the current EV base in Qld. Consideration will be given to final recruitment numbers being made up of Energex or Ergon Energy and/or 3rd party fleet vehicles to provide an understanding of 'work charging' behaviour in addition to residential charging behaviour 'at home' and 'away from home'.

Participants must have EVs registered in Queensland and be Energy Queensland customers. Energy Qld purchased the C2 devices in bulk upfront (from FleetCarma – hardware and licencing partner) and facilitates the participant pre-registration process. Each participant receives a C2, 3G connected car device from Energy Queensland that will monitor their driving and charging data. The majority of participants have activated their C2 'plug and play' device in addition to setting up their dashboard and receiving data on their driving behaviour. Feedback has been very positive from participants.

Some initial teething issues as expected with any new program were experienced but majority of which now rectified. Energy Qld is receiving raw data files in addition to access to its own utility

dashboard. Some definitions and modifications to data sets are being made to ensure usefulness of data going forward for respective internal audiences and external stakeholders.

Following full recruitment, during the first year of the program, EV charging load profiles and daily driving habits will be recorded and established with these participants and evaluated. Individual customer journeys will not be mapped.

**Stage 2/Years 2 & 3** (Baseline & Control): mid 2021 – mid 2022.

The first-year data analysis insights will assist in determining the opportunity to incentivise participants to change behaviour if normal charging is deemed not at appropriate times for the network i.e. 4-9pm peak periods. The original participants acquired in Year 1, will be introduced to incentive rewards for changing their charging behaviour to understand participant willingness to change charging behaviour and potentially design a dedicated tariff or similar if required. Structure and format of the incentives will be determined following data analysis of participant charging.

### 3.12.6 Any identifiable benefits that have arisen from it, including any off peak or peak demand reductions

Benefits expected from this program include identification and understanding measurable uncontrolled and controlled charging behaviour of private electric vehicle (car) owners. This will assist Energy Queensland networks for planning, forecasting, demand management and other EV-related purposes.

In addition, help support and determine any policy issues regarding connection of private EV chargers.

It is also critically necessary to understand how EV usage and charging behaviour will alter over time as owners become more confident with their EV range, speed of charging and access to suitable public charging. Collated data will also be used to validate the potential for public destination (fast) and travel (ultra-fast) charging station installations for third-party, commercial charging operatives.

To reconfirm, by understanding charging profiles and behaviours and testing the control available to EQL and participants will inform

- how EVs can be managed effectively for network reliability and stability whilst also fulfilling a customer need for assurity of charge for their requirements;
- The value of EV load management for the network and customers in both a broad-based and targeted sense; and

how the introduction of vehicle-to-home/grid can be optimised to best effect for the customer and the network.

## 3.13 Dynamic Operating Environments Phase 1 Commercial

This project is part of a broader Dynamic Operating Envelope (DOE) Program designed to explore the merits, challenges and financial viability of the concept of DOEs as applied to small to mid sized (10kVA - 1500kVA) Distributed Energy Resources (DER). It is postulated that DOEs will play an

important role in managing DER at scale such that the DER is able to provide benefits to customers, the network and the wider market without posing a risk to the operation of the network.

Phase 1 of the program will focus on trialling the concept at a commercial level at five Energex (EGX) owned and operated depots.

### 3.13.1 Compliance with DMIA Criteria

The DOE Phase 1 – Commercial Project complies with the Demand Management Innovation Allowance criteria detailed at section 3.1.3 of the demand management incentive scheme. Having a mechanism to allow a greater penetration of DER into the network through the implementation of Dynamic Operating Envelopes will assist in alleviating demand. A PV connection may not be permitted to export into the network based on a worst-case assessment which considers full export of the system under minimum loading. A system assessed as “Nil” export cannot export at any time, even under times of high network load. The DOE platform also enables managed EV or battery energy storage system charging to reduce demand when the network is constrained. A subsequent customer benefit of a dynamic approach helps customers to access the available capacity of the network at all times.

### 3.13.2 Nature and Scope

DOE Phase 1 is focussed on trialling the DOE concept at a commercial level targeting three phase 30kVA-100kVA LV connected systems typical of small-medium commercial/industrial establishments. This work will build on the prior project at Energex’s Cleveland Depot by transitioning beyond the one-way broadcast concept to a two-way communications approach. DOE enabled PV systems will be installed at five sites with the companion DOE management platform, a robust and secure operational platform developed to support the necessary data capture, processing and publishing of operating envelopes, implemented in the operational technology environment.

### 3.13.3 Aims and expected outcomes

The DOE Program has the following key objectives:

1. Demonstrate as a proof of concept the data, communication and controls required for Dynamic Operating Envelopes to be implemented in near real-time at commercial sites as applied to PV and any available BESS or EVs.
2. Evaluate the effectiveness of DOEs as applied to sources of generation and chargeable loads.
3. Evaluate the impacts of variations in the DOE on other customers connected to the same LV and MV feeder on which the DOE is being trialled. Ensure DOE management does not negatively impact other customers as a result of the dynamic nature of the control.
4. Evaluate the effectiveness of IEEE 2030.5 in implementing Dynamic Operating Envelopes.

Initiate amendments to standards and connection contracts to facilitate the offering of DOE for embedded generation (≤1500kVA) at a broader scale in the EGX/EECL network.

### 3.13.4 The process by which it was selected, including its business case and consideration of any alternatives

The business case for the project was reviewed against the DMIA criteria by both Demand Management and Regulatory Departments. The projects were deemed to meet the DMIA criteria and costs confirmed to be not in any way recoverable from another source.  The business cases were

presented to the Energex Investment Review Committee which endorsed the projects for DMIA funding. The project was evaluated against the business' Opportunity Matrix and identified as being an innovative venture with high opportunity potential.

### 3.13.5 How it was/is to be implemented (ie general project update)

The project is progressing well with PV systems commissioned and operating at all five identified sites. The next task is to bring the DOE functionality online which will require the reconfiguration of selected network monitors to provide near real-time network visibility. It is anticipated that the DOE will be determined based on applying DSSE as developed through the Expanded Network Visibility Initiative together with Capacity Constrained Optimisation which calculates the maximum export permitted from site without breaching network capacity or voltage limits.

### 3.13.6 Any identifiable benefits that have arisen from it, including any off peak or peak demand reductions

The project only recently commenced with all five sites commissioned within the last month. It is too early to report on off peak or peak demand reductions, but it is anticipated that the solar generation available at each site will offset most of the typical energy requirements throughout the day. The business' standard PV connection assessment process was used to evaluate the connection of all five systems. Two systems were evaluated as requiring partial or Nil export, else they are predicted to cause problems for the network at critical times that align with the system having full export. A key outcome of this project will be evaluating if the application of DOE helps to overcome the Nil or Partial export limitation, allowing the systems to export safely during non-critical periods.

# 4. Attachment 1: Case studies

- LV System Static-State Estimation
- Solar Enablement Initiative
- Springfield Net Zero

## 4.1 DMIA case study: LV state estimation

### 4.1.1 Project outline

Distribution System State Estimation (DSSE) is an algorithm which combines knowledge of the physical network with time-series measurement data and average loading patterns to form an estimate of the electrical state of the network at a point in time. With increasing levels of Distributed Energy Resources (DER) in the form of rooftop photovoltaics (PV) connected to the grid at low voltage (LV) it is important that distribution networks develop methods to more comprehensively understand how the LV network is performing. A better understanding of the impacts of DER on the network will allow for improved design and planning process and more targeted and innovative solutions to problems. A real-time view of the performance of the LV network may one day support a future where DER is managed dynamically dependent on network conditions or even as part of a DER energy market with individual customers or aggregators buying and selling energy across thousands of connected DER systems, all orchestrated within the physical limits of the network.

It has historically been challenging to implement DSSE on LV networks due to their 4-wire, unbalanced nature and lack of monitoring. The LV State Estimation project sought to test the application of a novel DSSE engine to determine if it could overcome these challenges and achieve visibility of LV networks.

The project scope covered the implementation of DSSE on a single LV network in Energex. The estimator was executed in near real-time within the Operational Technology Environment.

Project partners and funding organisations: Australian Research Council, The University of Queensland.

### 4.1.2 Project outcomes / findings

Key project findings are:

- DSSE was successfully implemented on the trial LV network handling deficiencies in network model accuracy and the limited data inputs available at LV.
- The algorithm solved sufficiently quickly on the trial LV network (<1 second) demonstrating the viability of near real-time state estimation on distribution networks.
- The accuracy of estimates varied depending on the density and source of measurement data. Voltages estimated at customer premises ranged from ±0.5V to up to ±5V depending on the extent of network and customer monitors available to the estimator.

### 4.1.3 Next steps

Energex and Ergon Energy Network are pursuing a broader implementation of the DSSE as developed in the Solar Enablement Initiative (refer to separate case study). This work is being

undertaken through the Expanded Network Visibility Initiative and seeks to improve visibility of the network at both medium and low voltages.

Rights to commercialise the state estimator developed through the Solar Enablement Initiative have been granted to GridQube.

### 4.1.4 More information

- For more information on the LV State Estimation project contact terese.milford@energyq.com.au
- For general enquires about DMIA: demandmanagement@energex.com.au

## 4.2 DMIA case study: Solar Enablement Initiative

### 4.2.1 Project outline

Distribution Network Service Providers (DNSPs) are facing the challenge of connecting increasing levels of Distributed Energy Resources (DER) to the grid. DER includes rooftop solar photovoltaics (PV) systems on homes and business; large scale solar and wind farms and batteries. DER contribute to progressively more dynamic and unbalanced distribution networks over which DNSPs have historically had only a limited visibility. In the past, patterns of electricity usage and generation were far simpler so the network could be designed and operated safely and reliability without a great deal of information about what was happening at its extremities. The presence of significant numbers of DER throughout the suburbs can impact the quality of electricity supplied to consumers as well as the stability of the broader electricity grid. This transition has driven the need for networks to explore more data-driven ways in which they can obtain network visibility to better support operational decisions. Distribution System State Estimation (DSSE) is one such option.

The Solar Enablement Initiative sought to test the application of a novel DSSE engine to achieve visibility of medium voltage (MV) networks using data currently available to DNSPs. In addition, the work explored how improved network visibility could be applied to better ascertain the impacts of future DER connections with the goal of enabling additional energy to be exported to the grid.

The project scope covered the implementation of DSSE on seven medium voltage networks across three DNSP partners. Three 11kV feeders in Energex (Queensland), two 22kV feeders in United Energy (Victoria) and two 11kV feeders in TasNetworks (Tasmania). The involvement of multiple DNSP partners allowed the development of a solution that was able to work on differing network topologies and with differing measurement data inputs.

Project partners and funding organisations: Australian Renewable Energy Agency, The University of Queensland, Queensland University of Technology, United Energy, TasNetworks, Energy Networks Australia, Australian Power Institute, Aurecon and Springfield City Group.

Project outcomes / findings

### 4.2.2 Key project findings are:

- DSSE was successfully implemented on all trial networks handling deficiencies in network model accuracy, differing type and density of measurement data and varying feeder topologies.
- The algorithm solves sufficiently quickly to enable near real-time state estimation.
- Offline estimation for the most complex of the trial feeders solved in 20 seconds. The single feeder model was 170% the size of the model for the entire National Electricity Market highlighting the magnitude difference in scale when applying state estimation to distribution networks.
- The value of different sources of time-series measurement data as an input to state estimation varies. For MV state estimation the highest value measurement data was sourced from low voltage (LV) connected distribution transformer monitors and inline MV feeder devices with voltage and power flow measurements. This finding will help to inform the rollout and configuration of future network monitoring devices.
- The accuracy of estimates varied depending on the density and source of measurement data, the complexity of the network and how extensively the network model was refined.

Voltages estimated at the terminals of distribution transformers ranged from ±0.5V to up to ±5V.

- A PV Analysis Tool was developed to run an automated power flow analysis to find the maximum PV hosting capacity at a point on a feeder based on a shortlist of critical cases identified using DSSE. This analysis enables a prediction of the likely voltage and capacity impacts of a new PV connection overlaid on historical feeder performance.
- The project also developed Uncertainty Analysis, Estimation Diagnostics, Critical Case Identification and a Constraints and Optimisation engine which could be employed in the future for DER orchestration.

### 4.2.3 Next steps

Energex and Ergon Energy Network are pursuing a broader implementation of the state estimator as developed through the Solar Enablement Initiative. This work is being undertaken through the Expanded Network Visibility Initiative and seeks to improve visibility of the network at both medium and low voltages.

Rights to commercialise the state estimator developed through this initiative have been granted to GridQube.

### 4.2.4 More information

- ARENA's project page: https://arena.gov.au/projects/increasing-visibility-of-distribution-networks/
- For more information on Energex's role in the Solar Enablement Initiative contact terese.milford@energyq.com.au
- For general enquires about DMIA: demandmanagement@energex.com.au.

## 4.3 DMIA case study: Springfield Net Zero

### 4.3.1 Project outline

This project endeavoured to develop an understanding of the infrastructure required for net zero energy real estate developments. The project examined key aspects of a master planned community designed for net zero including:

- Energy transitions
- Mobility
- District services (cooling/heating)
- Water and energy

Energex and Ergon Energy Network will benefit from understanding the electrical infrastructure impacts of a net zero development and be able to explore:

- The potential peak and minimum demand risks (impact on ADMD, risk mitigation options and net benefits to all parties)
- The opportunity for working directly with a developer for controllable loads/generation in greenfield developments
- Risks associated with electrification of mobility
- The likely size, location and operation of energy storage

A direct output of the project will be an understanding of the energy density and load profile of various demographic segments and building designs when engaging directly with developers of new estates.

This Energex project was undertaken via the Springfield City Group who worked with Tractebel.

### 4.3.2 Project outcomes / findings

A final report detailing all findings can be found here: https://www.greaterspringfield.com.au/wp-content/uploads/2020/05/Roadmaps-ENGIE-Tractebel-Report-18052020-Final.pdf

The final project deliverable was the project report outlining master planning opportunities for a net zero development, including no regrets options for immediate project implementation. The final project report provided Energex and Ergon Energy Network with insights into:

- How developers are considering urban environments and the inclusion of sustainability, renewable energy and public places.
- Opportunities to work collaboratively with developers for mutually beneficial outcomes in co-ordinated urban and infrastructure design
- Net zero energy and demand density therefore network requirements
- Urban mobility and potential impacts of electric vehicles
- Energy generation and distribution around a net zero development
- The energy and demand density of net generation building infrastructure
- Opportunities for integrated local energy control solutions
- The project will help inform future research projects that focuses on mutually beneficial outcomes

### 4.3.3 Next steps

The project will be used to inform several aspects of future activities for Ergon Energy Network and Energex, including:

- The development of future projects that provide network benefits which may be delivered in collaboration of greenfield developers.

- The integration of outcomes from the report to feed into energy density and demand density for future strategic planning models.
- Integrated development planning which includes allowance for electrification of transport.
- The future of greenfield development guidelines and how the future of energy integrates into these guidelines.
- The report will support future reviews of planning systems and standards such as After Diversity Maximum Demand (ADMD) and the integration requirements for Distributed Energy Resources.

### 4.3.4 More information

- Mr Glenn Dahlenburg, Manager Strategic Advice and Modelling, Energy Qld glenn.dahlenburg@energyq.com.au
- Mr Andrew Deme, Manager – Energy Innovation, Springfield City Group a.deme@springfieldcity.com
- For general enquires about DMIA, the group email can be provided: demandmanagement@energex.com.au.