Ergon Energy Demand Management Innovation Allowance Mechanism Report 2022-23

September 2023

Part of Energy Queensland

Contents

1. Introduction

1.1 Purpose and compliance

Ergon Energy Network (Ergon Energy) is pleased to present the Demand Management Innovation Allowance Mechanism (DMIAM) Report for the 2022-23 regulatory year. The purpose of this report is to allow the Australian Energy Regulator (AER) to:

- assess Ergon Energy's 2022-23 DMIAM initiatives and Ergon Energy's entitlement to recover the expenditure under the AER's Demand Management Incentive Allowance Mechanism; and
- confirm Ergon Energy'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, item 7 of the AER's RIN (refer Figure 1), which requires a distribution network service provider (DNSP) to which the DMIAM applies, to submit an annual report to the AER on its expenditure. This report, and the information contained in the report, is suitable for publication by the AER.

Figure 1: DMIAM reporting requirements Schedule 1: Item 7 – Demand Management Incentive Allowance Mechanism

7.1 Identify each demand management project or program for which Ergon Energy seeks approval.

7.2 For each demand management project or program identified in the response to paragraph 7.1:

a) Explain how it complies with project criteria detailed at section 2.2.1 of the Demand Management Innovation Allowance Mechanism

b) Submit a compliance report in accordance with section 2.3 of the Demand Management Innovation Allowance Mechanism

2.2.1 Project Criteria:

(1) An **eligible project** must:

(a) be a project or program for researching, developing or implementing **demand management** capability or capacity; and

(b) be innovative, in that the project or program:

i) is based on new or original concepts; or

ii) involves technology or techniques that differ from those previously implemented or used in the **relevant market**; or

iii) is focused on customers in a market segment that significantly differs from those previously targeted by implementations of the relevant technology, in relevant geographic or demographic characteristics that are likely to affect demand; and

(c) have the potential, if proved viable, to reduce long term network costs.

(2) A **distributor's** costs of a project or program are not eligible for recovery under the **mechanism** if those costs are:

i) recoverable under any other jurisdictional incentive scheme;

ii) recoverable under any state or Australian Government scheme; or

iii) otherwise included in forecast capital expenditure or operating expenditure approved in the **distributor's** distribution determination.

(3) For avoidance of doubt, the **mechanism** does not require a **distributor's eligible project** to be geographically constrained to its **distribution network**.

2.3 Compliance Reporting

(3) Each compliance report must include, for the regulatory year to which the compliance report relates:

(a) the amount of the allowance spent by the distributor;

(b) a list and description of each eligible project on which the allowance was spent;

(c) a summary of how and why each eligible project complies with the project criteria;

(d) For each eligible project on which the allowance was spent, and in a form that is capable of being published separately for each individual eligible project, a project specific report that identifies and describes:

i) The nature and scope of the eligible project;

ii) The aims and expectations of the eligible project;

iii) How and why the eligible project complies with the project criteria;

iv) The distributor's implementation approach for the eligible project;

v) The distributor's outcome measurement and evaluation approach for the eligible project;

vi) The costs of the eligible project:

1. incurred by the distributor to date as at the end of that regulatory year;

2. incurred by the distributor in that regulatory year; and

3. expected to be incurred by the distributor in total over the duration of the eligible project.

vii) For ongoing eligible projects:

1. a summary of project activity to date;

2. an update of any material changes to the project in that regulatory year; and

3. reporting of collected results (where available).

viii) for eligible projects completed in that regulatory year:

1. reporting of the quantitative results of the project;

2. an analysis of the results; and

3. a description of how the results of the eligible project will inform future demand management projects, including any lessons learnt about what demand management projects or techniques (either generally or in specific circumstances) are unlikely to form technically or economically viable non-network options.

1.2 Demand Management Innovation Allowance Mechanism projects summary

In its Distribution Determination for the 2020-2025 period, the AER decided to apply the Demand Management Innovation Allowance Mechanism to Ergon Energy, approving an innovation allowance amount of $5,564,333 over the 2020-25 regulatory control period.

The DMIAM is provided to investigate opportunities that are not yet commercial, in addition to any business-as-usual capital and operating expenditure allowances for demand management and embedded generation projects approved in Ergon Energy's Distribution Determination. This provides a direct incentive for DNSPs to assess emerging opportunities for potentially efficient non-network alternatives, to manage the expected demand for standard control services in some other way or to enable more efficient connection of embedded generation other than through network augmentation.

Ergon Energy's 2022-23 DMIAM program comprised six projects. The total cost incurred for the DMIAM initiatives during 2022-23 was $333,933.55. The table 1 below summarises the costs of eligible Ergon Energy DMIAM projects.

Table 1: DMIAM Eligible Project Costs ($)

DMIAM Project	The costs ($) of the eligible projects[1]:			
	expected to be incurred in total over the duration of the eligible project	incurred in 2022-23 regulatory year	incurred to date[2] as at the end of the 2022-23 regulatory year	Status (as at 30 June 2023)
Alternate Supply Bustard Head	932,673	54,047.85	436,201.53	Continuing
Clairview Stanage Project	688,884	40,349.97	137,663.67	Continuing
West Leichhardt Single Wire Energy Return (SWER)	3,716,371	51,418.96	984,779.92	Continuing
Allawah Fringe of Grid Field Trial	281,500	93,418.96	171,101.41	Continuing
Fringe of Grid Phase 2 Development	291,500	46,729.89	46,729.89	Continuing
Model Free Dynamic Operating Envelopes	141,849	47,967.92	47,967.92	Continuing
Total	**6,052,737**	**333,933.55**	**1,824,444.34**	

[1] As per DMIAM reporting requirements Schedule 1: Item 7 –DMIAM section 2.3 (3) (vi) 1,2,3
[2] For the current 2020-25 regulatory period

Ergon Energy 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 2020-25 Distribution Determination.

2. Demand Management Innovation Allowance Mechanism Project development and selection process

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

For the 2022-23 DMIAM program, all nominated DMIAM projects are subject to a screening and feasibility processes, consistent with the AER's DMIAM criteria. The standard DMIAM project development and assessment process applied in Ergon Energy involves:

- Promotion of DMIAM funding and criteria:
    - To internal stakeholders to encourage project ideas to be submitted, as an expression of interest (EOI) or more formal DMIAM Project Scope;
    - To external stakeholders through improved web presence invite any interested parties to make contact
- Review of EOI or DMIAM Project Scope against DMIAM criteria as a minimum, and against relevant internal strategy documents, including the Energy Queensland Future Grid Roadmap[3], the Demand Management Plan;
- Project proponents are encouraged to discuss project ideas with other Ergon Energy subject matter experts, which helps guide and refine the idea;
- Projects that are deemed to meet the DMIAM criteria are then formally submitted to the DMIAM Program Manager for approval, or endorsement to the appropriate financial delegate.

Budgets are prepared in accordance with Ergon Energy 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 Ergon Energy, current preferred contractor panel contracts and market research

[3] The Future Grid Roadmap is a document that outlines a range of themes and supporting activities and no-regret investments necessary for 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 DMIAM criteria, however project proponents should, where possible, ensure their project aligns with these existing strategic network directions and priorities.

3. Demand Management Innovation Allowance Mechanism Project updates

This section of the report details the status of Ergon Energy's DMIAM projects in 2022-23 by describing each project, its objectives, progress and findings to date.

3.1 Alternative Supply Bustard Heads

Trial a stand-alone power system (SAPS) as a network support device, with the long-term aim to reduce network costs.

3.1.1 Compliance with DMIAM Criteria

The Bustard Head SAPS project complies with the DMIAM criteria as the project will enable the substitution of costly network components with alternative supply arrangements that provide improved power quality and reliability whilst enabling improved value to all customers.

3.1.2 Nature and Scope

Trial a stand-alone power supply system as a network support, with the long-term aim of using SAPS as a lower cost solution to network maintenance/replacement.

3.1.3 Aims and expected outcomes

Direct outcomes and benefits:

- The customer outcomes will be a more reliable power supply.
- The network outcome will be a reduced operating cost and reduced network losses on the distribution system

Indirect outcomes and benefits:

- Ergon Energy has developed new approaches to working with customers towards more cost-effective supply solutions through the development of a SAPS Customer Engagement Strategy;
- Ergon Energy will develop new equivalent electricity supply standards for solar/battery hybrid systems including working with Energy Networks Australia (ENA) to develop new business standards and guidelines for utility grade SAPS;
- Ergon Energy is using the knowledge and experience gained from the SAPS trials in working with ENA and other distribution network service providers (DNSPs) to develop national guidelines for DNSP led SAPS.

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

All Ergon Energy DMIAM projects are selected and scoped to respond to current and emerging network limitation drivers and adhere to the standard governance framework. The eligibility-screening process is performed on nominated projects as a high-level assessment, to determine whether the projects meet the DMIAM criteria. Other internal criteria are then assessed – including how the findings of the project, should it be successful, could be applied within the business. Provided all the specified conditions are met, then the project proceeds to the feasibility assessment and approval stages, as per the gated governance framework and with internal subject matter expert review and feedback. Information from the development activities undertaken enables implementation scheduling, milestone planning and confirmation of resources.

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

The Bustard Head SAPS was installed and commissioned in December 2020 (see photo below). It has been in operation since this time supplying the full energy needs of the two customers it supplies. The SAPS is being monitored and its performance measured, and a customer survey has been undertaken to gather customer insights through the whole project process. The SAPS will continue to be monitored and lessons learnt captured for the development of future standardised DNSP SAPS. This trial will lead into new work to enable appropriate life-time management of alternative supply dependent on the criteria set under the new regulatory framework that will enable DNSP's to supply customers by SAPS.

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

The project has already developed some criteria for equivalency in design that now need to be tested. Customer engagement has been positive for the project and has included discussions around the topic of appliance use and load management to optimise the systems. As a result of this project, a Stand-Alone Power Systems Customer and Community Engagement Strategy has been developed which can be used for any future similar engagement.

Image 1: Bustard Head SAPS

3.2 West Leichhardt Single Wire Earth Return (SWER)

Trial two larger scale SAPS as network support devices as an alternative to grid supply.

3.2.1 Compliance with DMIAM Criteria

The West Leichhardt SAPS project complies with the DMIAM criteria as the project will enable the substitution of costly network components with alternative supply arrangements that provide improved power quality and reliability whilst enabling improved value to all customers.

3.2.2 Nature and Scope

Trial SAPS as network support and develop supporting policies, processes and systems that can more broadly enable DNSP led SAPS across Ergon Energy's network.

3.2.3 Aims and expected outcomes

- Improved reliability and power quality for the two customers involved in the trial
- Informing design rules and scenarios for SAPS
- Developing customer engagement strategies and plans to transition customers from grid to SAPS supply
- Identifying changes to Ergon Energy's connection policy and connection agreements to ensure a consistent approach for single wire earth return (SWER) customers and encouraging alternate solutions where appropriate rather than extending the SWER network
- Acquiring the knowledge and experience to inform:
  - future business requirements for SAPS supply; and
  - future product solutions to enable a more flexible approach to connections in the future by the planning teams.

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

All Ergon Energy DMIAM projects are selected and scoped to respond to current and emerging network limitation drivers and adhere to the standard governance framework. The eligibility-screening process is performed on nominated projects as a high-level assessment to determine whether the projects meet the DMIAM criteria. Other internal criteria are then assessed – including how the findings of the project, should it be successful, could be applied with the business. Provided all the specified conditions are met, then the project proceeds to the feasibility assessment and approval stages, as per the gated governance framework and with internal subject matter expert review and feedback. Information from the development activities undertaken enables implementation scheduling, milestone planning and confirmation of resources.

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

Two SAPS to supply the two customers involved in this trial were commissioned in February and March 2021 and have been operational since this time supplying the operational needs of the two customers (installation photo's below).

The SAPS are being monitored and their performance measured, and customer surveys have been undertaken to gather customer insights through the whole project process. The SAPS will continue to be monitored and lessons learnt captured for the development of future standardised DNSP SAPS.

This trial will lead into new work to enable appropriate life-time management of alternative supply dependent on the criteria set under the new Australian Energy Market Commission rules for SAPS.

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

The project has already developed some criteria for equivalency in design that now need to be tested. Customer engagement has been positive for the project and included discussion around the topic of appliance use and load management to optimise the system – for example, scheduling use of appliances during the daytime to maximise solar energy use.

Image 2: SAPS Trial Site 1

Image 3: SAPS Trial Site 2

3.3 Model Free Dynamic Operating Envelopes

This project is part of a broader dynamic operating envelopes (DOE) Program. It is focused on exploring alternative methods for determining DOE without any network model data, leveraging available LV visibility from Network Service Monitors and procured smart meter data. A DOE specifies a varying operating range at the connection point for exports and/or imports within the operational limits of the network. DOEs will play an important role in supporting ongoing uptake of consumer energy resources (CER) by enabling dynamic CER connections at scale to provide benefits to customers and the wider market while mitigating risks to the operation of the network.

3.3.1 Compliance with DMIAM Criteria

The project was viewed as meeting the DMIAM criteria by developing a method for determining more optimal DOE in parts of the network, particularly the LV, where network model data is poor which can reduce the degree of curtailment in comparison to more conservative alternatives – zero (ZOE), fixed (FOE) or scheduled (SchOE) operating envelopes for example. DOEs can also be applied to flexible loads such as EV chargers reducing the need to restrict charging to times when the network is truly approaching constraints rather than on a more frequent (eg. SchOE) or constant (eg. FOE) basis. Improving DOE performance enables demand and generation management with the lowest impact possible without further network augmentation.

DOEs maximise utilisation within existing network capacity only driving augmentation when excessive/unacceptable curtailment or load reduction is caused. A model free DOE can generate a more optimised DOE on networks with poor model quality (such as LV). It leverages available network visibility and machine learning based methodology via Software as a Service, to determine DOE in a new innovative way, potentially reducing DOE implementation costs.

3.3.2 Nature and Scope

This Project has two stages, the first focuses on three LV networks with high PV penetrations (60% - 120% of transformer rating) that also have moderate coverage of Network Service Monitors or procured smart meter data to provide LV visibility. The second extends the focus to the rest of the MV network the stage one LV networks are supplied from and all other LV networks with some monitoring. In the second stage near real time closed loop performance of DOEs will also be tested from different LV visibility sources and the performance will be compared with other methods for generating DOE such as a basic calculated methodology and a capacity constrained optimisation.

3.3.3 Aims and expected outcomes

The purpose of this project is to develop and demonstrate a new DOE generation engine that determines DOEs based on customer and network monitoring but independent of network model or topology. The project has the following objectives:

- Demonstrate generation of DOE based on machine learning (ML) using LV and MV telemetry
- Compare model free DOE with other DOE determination approaches in terms of curtailment and computational requirements
- Identify minimum data requirements to generate a model free DOE that reliably outperforms basic DOE

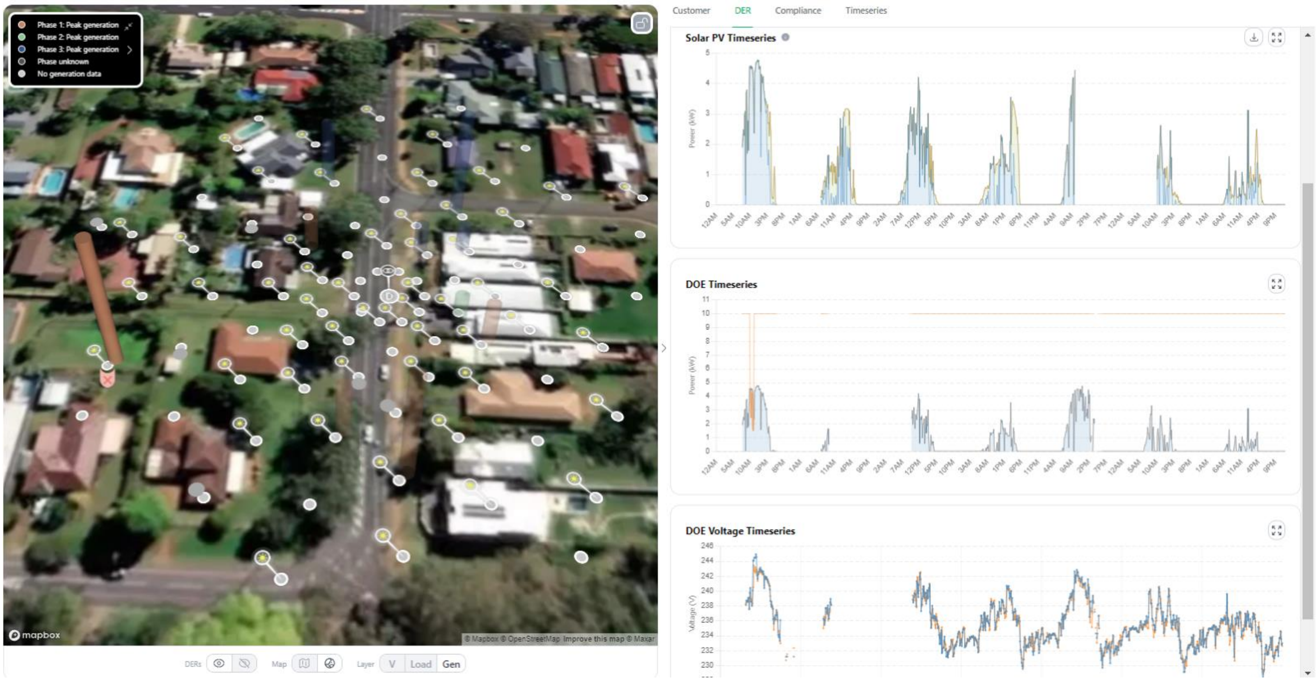

Figure 2: Model Free DOE platform (source Gridsight, 2023)

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

The DMIAM project approval process was followed for selecting this project (Model Fr. Potential DMIAM projects are selected and scoped to respond to current and emerging network limitation drivers and adhere to the standard governance framework. Accordingly, once projects are identified and nominated, the eligibility-screening process is performed on nominated projects as a high-level assessment, to determine whether the projects meet the DMIAM criteria. Other internal criteria are then assessed – including how the findings of the project, should it be successful, could be applied within the business. Provided all the specified conditions are met, then the project proceeds to the feasibility assessment and approval stages, as per a gated governance framework and with internal subject matter expert review and feedback. Information from the development activities undertaken enables implementation scheduling, milestone planning and confirmation of resources

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

Transformer and anonymised LV telemetry data has been uploaded to the Model Free DOE for key months in Spring (peak export) and summer (maximum demand) to enable training of the system. The platform, shown in Figure 2 is now estimating accurate voltages for the networks it has been trained on, without a network model or LV connectivity as shown in Figure 3 for a specific site and Table 2 for one of the modelled LV networks.

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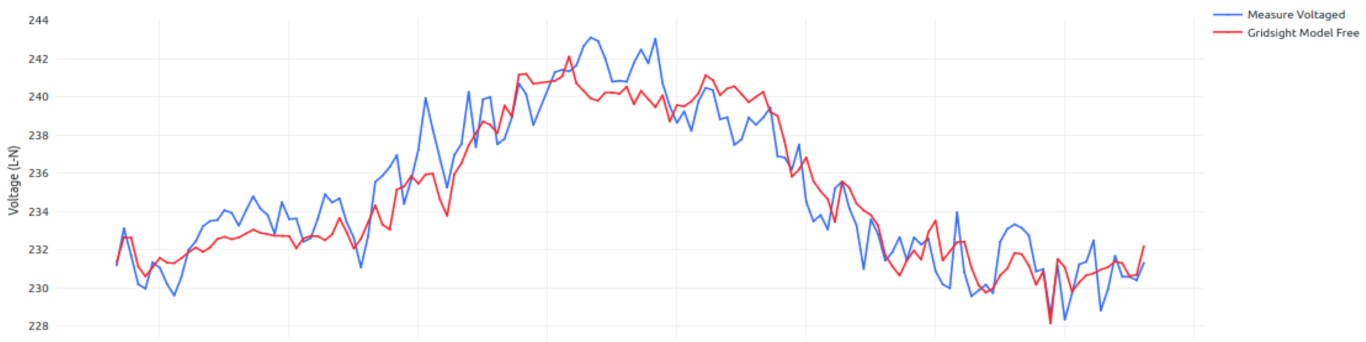

Figure 3: Example of LV network voltage estimation compared with measurement

DOE determination and curtailment has been simulated on the small number of sites where specified limits were exceeded as shown in Figures 4 and 5. 248V was used to induce a response as this LV network did not experience voltages in excess of the 253V limit.

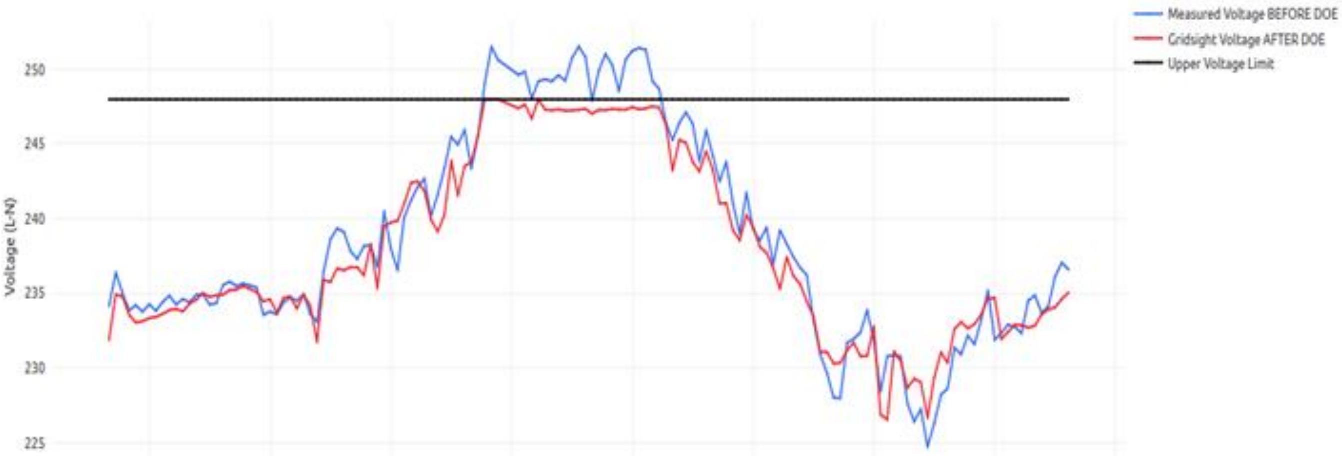

Figure 4: The modelled reduction in voltage from a DOE intended to limit voltage to 248V

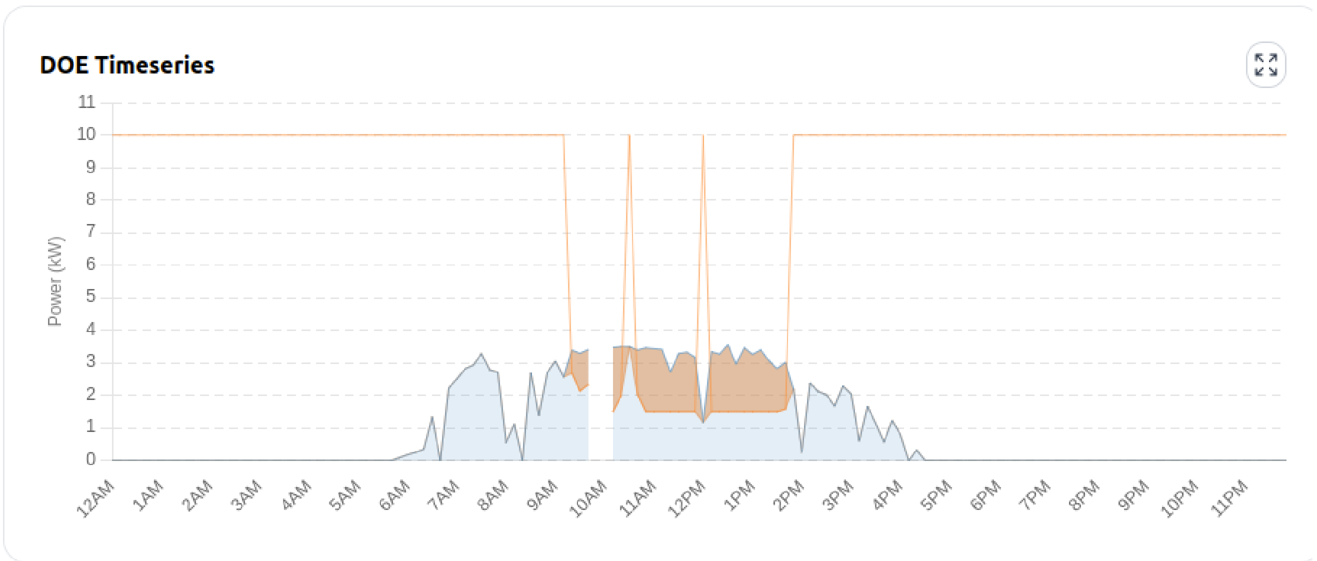

Figure 5: The DOE determined at a site to limit voltage to 248V by restricting export

Both equitable and a more optimal individual DOE have been generated with substantially higher curtailment resulting from an equitable allocation method as shown in Table 2. It also shows the expected reduction in the 99th percentile voltage (V99%) from the DOE and the max and root mean square error (RMSE) of voltage estimated for all monitored sites.

Allocation Method	Total Energy Curtailed (kWh)	Total Energy Released (kWh)	Average % Time < Max DOE	Max V99% Before	Max V99% After	RMSE (V)	Max Error (V)
Individual	96.1	2260.6	0.4%	250.1	248.0	1.28	6.0
Equitable	203.1	2154.4	2.88%	250.1	248.0		

Table 2: The performance of a simulated Model Free DOE on an LV network with two allocation methods

The next step is automating data transfer and closing the loop to publish DOE in real time and observing performance.

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

The Model Free DOE approach has different pros and cons compared with other methods for DOE generation. It holds promise on networks with poor network model data but high grid visibility such as LV networks with smart meters reporting data in near real time or significant penetrations of dynamic connections that can provide near real time telemetry. This has the potential to increase network utilisation and only curtail distributed supply or demand when the network is constrained during minimum or maximum demand.

3.4 Fringe of Grid (FOG) Phase 2 Development

The purpose of this project is to develop the next evolution of Fringe of Grid (FOG) technologies in several areas; more reliable and lower cost communications for monitoring systems, improvement in battery technology and improvement of fault response in Stand Alone Power Systems (SAPS).

3.4.1 Compliance with DMIAM Criteria

The project was viewed as meeting DMIAM criteria because SAPS and FOG improvements increase the possibility to provide standard and more cost-effective battery/inverter/solar options, and advance standardisation which will result in economies of scale which will further enable cost reductions for the supply and management of SAPS.

SAPS cost is a key consideration in their use and effectiveness as a lower cost alternative to network augmentation.

3.4.2 Nature and Scope

The purpose of this project is to address three key areas that still need development that will enable new technologies and test safety aspects of SAPS and FOG technologies:

1. Develop reliable and lower cost communications to remote systems using LTE-M LPWAN IOT communications.
2. Ensure safe fault operation of SAPS and microgrids through testing of customer fault current responses

3. Assess new energy storage technologies which are fit for purpose, in float and deep cycle and provide adequate fault current.

3.4.3 Aims and expected outcomes

1. Achieve LTE-M communications between the Selectronic SP Pro Inverter and battery BMS and the Intercel SAMXT modem back to a non-OTE service that can be implemented for the SAPS Pilot.

2. Identify any changes to current communication asset process and procedures for LTE-M LPWAN infrastructure to be utilised for SAPS and FOG applications

3. Achieve comms back to an OTE Ergon service for the next round of SAPS Pilot.

4. Determine capability of managing fault currents for SAPS and provide standard protection paper for ongoing management as part of the Safe by Design process for SAPS and microgrids.

5. Have a viable and safe standardised battery and inverter solution for long term SAPS and FOG operations.

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

Market scans, and discussions with industry partners, regarding alternatives for the most appropriate next steps in both reliable communications and battery technology were carried out.

A DMIA business case to fund testing of the selected alternatives was submitted and approved.

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

LTE-M Communications:

- A Teltonika TRB 255 modem has been flagged as a suitable modem for LTE-M communications. A unit has been sourced. Next steps are testing the unit in the Innovation Lab with a suitable inverter and field testing its abilities in remote areas.

New Energy Storage technology:

- Polarium has been identified as a robust battery technology. 9 batteries with a suitable testing rack have been procured. Next steps are to set up and test capabilities in the Innovation Lab.

Fault Operation testing:

- The appropriate methodology and test plan to safely and effectively test this is under development.

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

The project is in its very early stages and concrete benefits are yet to be realised at this stage.

3.5 Clairview Stanage Project

Ergon Energy recently secured Australian Government funding from the Regional and Remote Communities Reliability Fund (RRCRF) to investigate the feasibility of establishing microgrids at the communities of Clairview and Stanage Bay to improve customer reliability. As part of the funding agreement, Ergon Energy is required to fund a portion of the feasibility study project, which it will do under DMIAM.

3.5.1 Compliance with DMIAM Criteria

This project meets DMIAM criteria. It will identify customer energy usage trends through customer metering and energy audits and will combine this with community energy literacy education. Customers will have the opportunity to optimise their energy usage and identify potential renewable generation and energy storage technologies that will enable them to manage their load, which in turn reduces the potential impact on the local network in terms of peak and minimum demand.

A key consideration in the development of a microgrid is to understand the customers' load and where there are opportunities for demand management to optimise the design and cost of the microgrid. Microgrids will be a future demand management tool as they will allow load to be moved off the network as a financially viable alternative to investing in traditional network upgrades.

Irrespective of the conclusion of the feasibility study to deploy a microgrid, the demand management learnings will have positive utilisation impacts on the local network. The feasibility of DNSP-led microgrids for grid connected communities has not yet been explored in detail by the business and therefore this project is the first of its kind. The concept of a microgrid is an innovative solution that would potentially utilise controlled renewable generation and energy storage to increase customer reliability and the network's resilience to disturbances, while reducing the need to upgrade existing infrastructure. The aim of the microgrid is to automate seamless switching between the grid and island mode, using smart grid controls to ensure a continuous reliable energy supply, while additionally offering grid support services while in grid connected mode.

3.5.2 Nature and Scope

Establishing microgrids in FOG communities, particularly in remote and challenging environments, will enable Ergon Energy to cost effectively improve or maintain the reliability of supply to customers in these areas and increase community resilience to extreme weather events such as cyclones, flooding and bush fires, that impact the upstream network. Advances in intelligent control systems and reductions in the cost of renewable energy and storage technologies will further enable microgrids to become economically viable compared to traditional network supply from poles and wires. The feasibility study will focus on the Clairview and Stanage Bay townships with community and stakeholder engagement, data acquisition and analysis, microgrid network and economic modelling and simulation of viable and sustainable solutions.

3.5.3 Aims and expected outcomes

The objectives for this project are to:

- Determine the technical and financial feasibility of installing microgrids at the communities of Clairview and Stanage Bay and use the lessons learnt from the feasibility study for other FOG locations;
- Understand customers' energy needs and their interest and willingness to be involved in a future microgrid solution; and
- Develop business intelligence to include deployment of microgrids by Ergon Energy as an option for addressing network constraints such as reliability, power quality or capacity, where viable as an alternative to augmenting the network.

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

Ergon Energy has selected the townships of Clairview and Stanage Bay as the locations for the microgrid feasibility study. Both communities are supplied by the PD-203 ‘Northern’ 22kV feeder. This feeder is over 1,000km in length and has been consistently identified as one of the “worst performing feeders” in Queensland in terms of the Minimum Service Standards requirements. Clairview is located at the northern-most extremity of this feeder and is supplied from the three-phase network, while Stanage Bay is located at the extremity of a 100km SWER network.

After being award funding (approximately 60% of the total project cost) from the RRCRF, Ergon Energy has created a project which has the balance of required funding sourced from the DMIAMM.

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

The project will be delivered through six stages, until completion in April 2024. Each of these stages will be completed with the assistance of the relevant teams and subject matter experts, with reporting, coordination and management of the project conducted by the Project Manager. Project timings are tied to RRCRF funding requirements for feasibility delivery.

The majority of this project will utilise internal skillsets. External work has been required for energy auditing. When procuring plant and equipment or arranging external work, the relevant network business process and procedures will be followed. To date we have conducted an extensive planning study of the network which supplies Standage Bay and Clairview, including background information, reliability statistics, network protection, identification of network constraints and a high-level technical proposal. We have combined network outage data with customer meter data to provide an in-depth look at network reliability, which will help us determine what solutions, in terms of technology and capacity, would provide maximum benefit against the project outcomes.

Basic microgrid operational control scenarios have been developed and are currently being tested using quasi dynamic simulation modelling techniques. This will provide us with a way to determine how a microgrid might be operated with optimised control schemes and system capacity.

We have taken a no-assumptions approach to our community engagement and invited customers to participate in a quick energy survey which provided us with key insights into what customers care most about when it comes to their supply of electricity. In addition, the project team has visited each of the two communities and talked to residents and business owners about their experience with the power supply and our project.

A project webpage was launched which acts as a landing page for all information regarding the project. A flyer was sent out to each of the customers in the two communities, which detailed the project and included a QR code that links back to the webpage. We are currently in the process of procuring an inverter and energy storage system which we will test in our Microgrid and Isolated Systems Test facility and design/optimise the control strategy and architecture.

We are currently working with an Australian inverter manufacturer to design and develop a split phase grid forming inverter for use on SWER networks. Currently there is no market segment for utility scale grid forming inverters in a single or split phase configuration, due to the limited application globally. Due to Ergon’s extensive use of SWER networks, this inverter will have applications beyond microgrids, including Grid Utility Support Systems (GUSS). This unit is due to be delivered to Cairns in late 2023 for testing in our innovation laboratory.

Continual engagement with internal stakeholders has led to an increased understanding of how a future microgrids will be designed and operated. This information will feed into funding applications/business cases to support the construction of future microgrids. Stakeholders include network operations, protection & earthing and SCADA & control design.

We have connected a containerised energy storage system that was previously not being used to our innovation lab. We have used this system to design and test microgrid control schemes and better understand the challenges of islanding (disconnecting) and resynchronising (reconnecting) a load from the grid.

Image 4: SAPS

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

A customer study which included detailed energy audits of major customers in the community was completed. This audit not only provided information to the project team regarding the community's energy usage and requirements but was also used to provide energy efficiency tips back to the customers, ultimately helping them to make informed decisions around reducing consumption and saving money on energy bills. To maximise the utilisation of any microgrid technology, such as battery energy storage, network support functionality can be incorporated to potentially address capacity constraints by reducing maximum demand. The customer and community energy study will help inform the potential for this functionality.

Lessons learnt in this project to date were used to apply for funding in the Queensland Microgrid Pilot Scheme (QMPF) in March of 2023, to pilot two microgrid projects. If successful, these two projects will be Ergons first owned and operated microgrids and will further increase business knowledge and skills regarding the use of microgrids to increase customer reliability and optimise network performance.

3.6 Allawah Fringe of Grid (FOG) Field Trial

The purpose of this project is to field trial battery energy storage system (BESS) technologies that can reduce the overall demand on the Western FOG and SWER by supplementing customer loads and enabling increased value from customer solar PV systems.

3.6.1 Compliance with DMIAM Criteria

The storage of customers renewable energy in batteries with a hybrid inverter can be used on problematic FOG locations to reduce the demand and improve power quality on the grid overall and at the customer connection to an acceptable level, to avoid network capital works.

The project is innovative using commercially available BESS technology programmed in a way to support both the customer and the grid.

Traditionally an overload of a FOG location can lead to major works, including:

- upgrading of conductor size
- upgrade of major plant such as SWER isolators
- installation of additional major plant such as MV voltage regulators

If the trial is successful, a deployment of the trialled system in targeted locations could be used to defer, or eliminate the need for, these works. This project is different from the previous DMIAM funded project, Grid Utility Support System (GUSS), as that relied on purpose designed and built inverter technology that was connected on the network side of the meter, with limited ability to harness the value of customer owned renewable energy. This concept differs from the other SAPS systems already being trialled, because the SAPS are designed to immediately allow complete disconnection from the grid, and in a different customer segment. This concept instead augments the grid connection in the short term, allowing increased maximum demand to be served whilst reducing the maximum load on the grid. This is achieved with lower upfront capital cost than immediate complete disconnection via a SAPS.

It should be noted that the project is also complementary to the SAPS project and the GUSS project, with its view to integrate system elements that can be used on all three applications into the future – thus providing a more sustainable way of working through consistency in standards, the ability to reduce overall costs by having greater volume in products, reducing the variety of spares to be managed and through consistency in products and form factor, also ensuring a targeted upskilling for the operation, management and maintenance of these systems.

Along with this trial providing an alternative for specific network upgrades noted above, the trial working to align standardised building blocks across the SAPS, FOG and GUSS technologies will enable reduced costs for products due to quantity of scale and through consistency of products to be carried as spares, for integration into the Telemetry Hub and in relation to service and maintenance skills.

As part of the project learnings, an estimate to install standardised systems of this type on a more widespread basis will be provided to Network Planning to use as an option to consider when network augmentation is being evaluated.

3.6.2 Nature and Scope

The Western FOG refers to extensive SWER and remote powerline networks which are managed by Ergon Energy, mainly constructed in the 1970s and 1980s.

These networks are characterised by long lengths, with some 65,000km (or 40%) of the Qld network comprised of SWER where customer connections are often sparse, and with around 26,000 customers (or 3.5% of the Ergon Energy Network customer base).

These networks are being challenged by a number of issues.

Those most relevant to this project are:

- increasing expectation of customers to add renewable energy;
- increasing expectation of customers for increased reliability and power quality;

- increasing load growth beyond original design capacity; and
- proliferation of loads including more sensitive electronic loads and heavy loads such as air-conditioning.

In some specific cases these SWER powerline networks may be removed and replaced by SAPS to meet overall customer needs. More commonly the most economical solution will be to repair and augment the existing grid to cater for increased demand for power, or to correct network deficiencies causing power quality issues. The reconductoring of powerlines, upgrade of major plant such as SWER isolators, or installation of additional major plant such as MV regulators can resolve these issues but can attract high capital outlay. This project is trialling customer level grid battery storage systems as an alternative method to address grid quality of supply and peak demand issues

3.6.3 Aims and expected outcomes

This project seeks to demonstrate that a targeted installation of local storage of energy in a battery to reduce maximum demand on the grid can provide a reliable and economical methodology to:

- Increase the maximum demand (kW) available to a customer without causing peak demand or power quality issues;
- Provide a demand reduction alternative in grid augmentation scenarios;
- Improve power quality by limiting the export of generated solar photo voltaic (PV) by storing and using the energy onsite; and
- Reduce system losses.

A customer hosting these local energy storage systems can also receive the following side benefits:

- Provide some level of redundancy during grid outage; and
- A power bill reduction where excess PV reduces the bill instead of being exported at a lower tariff.

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

Under the previous Western FOG project, testing in the lab was done to prove the consistency, reliability and functionality of a several devices including battery inverters, HEMS and LV regulators.

From this testing two devices were recommended to be used in field trials as the next step to confirm their suitability for wider application in the network, the SP PRO and the LVR-30.

The SP PRO is a BESS inverter with advanced functionality and reliability, which is what will be trialled in the Allawah project. (The LVR-30 is a voltage regulator which will not be required for this site.)

During lab testing the SP PRO inverter proved its ability to provide:

- Reliable maximum demand limiting;
- Off grid backup power; and
- Consistent performance with a supplier that provides excellent support.

Maximum demand limitation is one major objective of the field trial project. The BESS inverter can be set up to provide power from the battery when the customers load exceeds a certain threshold. The main source of power for the battery is PV. In the event of reduced PV generation the battery is topped up at low load times at night if needed. A DMIAM business case was submitted with a 2-year timeframe to install, monitor and learn from the system in the field.

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

An external contractor will construct a cubicle/s containing the inverters, ~20kWh battery bank and communications equipment. The cubicle will be installed at the Allawah Retreat in Tolga, North Queensland. This site has been chosen as a friendly site with people with good understanding of the technology (and its challenges). The location is ideal as it has good mobile coverage, extreme summer temperatures, is on a spur line and is still relatively close to Cairns, where Ergon Energy staff are located. We have had monitoring installed at this site for more than a year so we also understand the energy usage variability on site.

The system, network and customer will be monitored for 12 to 18 months and the effectiveness of the system throughout various seasons and weather patterns will be evaluated. Learnings along the way will be used to improve the system parameters including export thresholds, battery state of charge targets, grid battery top-up schedules, and other parameters. The project will also provide learnings for development of standardised battery and inverter products.

Whilst the BESS will be physically installed on the customer side of the meter, the trial will explore the pros and cons of both customer side and network side connection.

Whilst examining the customer side connection scenario, direct control of the customers solar PV and possibly some loads by the system will be enabled via communication link.

A contract has been awarded to design, construct and install the BESS external cubicle enclosure.

The design is advanced with construction to commence in August 2022.

Images 5 and 6 - Inverters and rear of batteries during testing

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

Learnings about the layout for a BESS system which is suitable for outdoor deployment including:

- Cubicle design withstanding heat and passively dissipating heat as much as possible;

- Keeping the cubicle layout as compact as possible;
- Beginning the journey of standardisation of such cubicles for widespread replication; and
- Developing the import, export and load support system settings to maximise use of renewables minimise grid load.