Evoenergy 2019-2020 DMIA Project Specific Reports

1. **Demand Management Aggregation - Residential Battery VPP**

Nature and Scope

The project was a trial to determine how much impact we can have on network performance through operating distributed energy resources and gauge the implications of third-party signals to the DER fleet on availability, capacity and functionality for the network.

Aims and Expectations

In addition to previous iteration of the project, Evoenergy teamed up with DER aggregators to observe:

1. The impact of ancillary services behaviours from the residential DER fleet on Evoenergy's network
2. The practicality of third-party service engagement for network support including voltage management
3. The network implications for the Virtual Power Plant (VPP) participating in Australian Energy Market Operator's (AEMO's) Reliability and Emergency Reserve Trader (RERT).

Project Criteria

A Virtual Power Plant (VPP) is a collection of Distributed Energy Resources (DER), such as residential PV and batteries (nodes), that can be aggregated and controlled in real time to help meet the demand needs of a distribution network. VPP platforms provide a system that can be used to dispatch aggregated DER to manage network capacity constraints.

The project attempts to control the capabilities of solar PV generation and battery storage to dispatch when energy demand requirements on the Evoenergy network are at their maximum, typically on extremely hot or cold days. Furthermore, the VPP fleet was used to investigate innovative techniques to value add to the functionality of the DER in the network to manage power quality issues that end users, the customers, were reporting.

The fleet based management of the DER was previously only trialled for specific demand reduction and peak shaving events for system wide issues. This year the fleet of DER in total almost increased by 30% as additional customers in the ACT opted for solar and battery solutions at their residences. This meant Evoenergy had a wide array of devices and combinations of inverters and batteries to test the functionality of network support from customer residences and observe the typical usage pattern of the customers based on the data reported back from the devices.

Evoenergy also investigated the viability of aggregators other than Reposit including from Evergen and Combined Energy. These systems are approved aggregators under the ACT Government's Next Gen battery scheme – which is why they are likely to have a substantial number of DER aggregated under them in the ACT. All aggregators were provided with basic understanding of Evoenergy's architecture and connectivity requirements to send data from their fleet. This was an innovation under the trial as the functionality and use cases of these aggregators vary and will be beneficial for Evoenergy's requirements.

Implementation

In the 2019/2020 period the VPP also participated in AEMO's RERT and the Frequency Control Ancillary Services (FCAS) markets. This was the first time that DER on Evoenergy's network were participating in RERT or FCAS. The trial provided Evoenergy the opportunity to monitor and analyse the impact of participation on local demand and localised network constraints.

Minimum requirements for data collection and demand response from DER were established in the trial. These minimum requirements and capabilities developed are being leveraged in other Demand Management trials, including the Realising Electric Vehicle-to-grid Services (REVS) and the ARENA DER Integration and Automation projects.

Additionally, multiple aggregators provided Evoenergy showcases and demonstration of their fleet capability as well as provided Evoenergy API level schematics and metrics from the DERs that have been aggregated by these providers. Evoenergy has advanced its learning of the various fleet capabilities and the aggregator integration challenges and solutions that are required to incorporate real time data and visibility from these assets.

Outcomes

The following outcomes are expected from the DER aggregation trials

1. Development of capabilities and Evoenergy specific minimum standards for DER integration into the network, VPP operations, VPP platform integration with the ADMS, and Demand Response provision through DER.
2. Demand Management learnings incorporated into Molonglo RIT-D process
3. Process and technology for concurrent procurement of Quality of Supply management and Demand Management network support services from DER through the VPP mechanism
4. Monitoring, analysis, and mitigation of local network implications of VPP operation, specifically for RERT and FCAS participation.
5. Operational capabilities and process development for coordinating DER/VPP Operation with aggregators in Lack of Reserve (LOR) events.
6. Basis for trial design aimed at managing no gas, 100% PV penetration suburbs.
7. Operational experience in DER and VPP operations, enabling informed responses to regulatory consultations.

Costs

The 2019-20 implementation cost for the DER Aggregation trial was [redacted]. The expected costs for this project going forward will transition based on the number of DER nodes added by Evoenergy during the next financial year. Evoenergy's costs are based on data and control ability of each DER asset and as the uptake of systems increase – the costs may increase as well. Additionally, multiple aggregators have now been investigated and position to join the VPP aggregation model that Evoenergy is running and their costs are yet to be finalised. There would not be an exact final end date for this project as the aim is to transition this to business as usual during this regulatory period.

Project Activity to date and Results

Evoenergy has much to learn from the increasingly relevant DER and battery storage environment, and to this end, has subscribed to Reposit Power's Fleet management system and customer network data from their growing fleet of residential batteries. Evoenergy's transformation to a Distribution System

Operator (DSO) is dependent on our ability to learn from and utilise internal and external data sources and make use of intelligent tools and techniques to create value for the wider network.

In the first stage of integration with the ADMS, data and monitoring has been established. In the transition to BaU, the second stage would be focussed on incorporating this data into load flow analysis and developing manual control capability through the ADMS. The third stage is envisaged to be a complete transition from trial to BaU by developing automated control through the ADMS for real-time orchestration of DER based on network constraints.

The lessons learnt through the trial are informing both Evoenergy's operations and indirectly benefiting the broader industry through Evoenergy's involvement in industry wide demand management, DSO, and Future Networks coordination events and forums. Evoenergy is also leveraging the learning from the trial to inform responses to regulatory consultations.

The lessons learnt have also directly informed Evoenergy's Molonglo RIT-D non-network options analysis and credible options assessment. The DER operational data from the aggregators was anonymised and provided to the PhD scholar for research, and utilised for the Evoenergy led ARENA DER Integration and Automation project. Leveraging this data for multiple innovation projects has maximised the demand management benefit of this project for Evoenergy, potentially reducing electricity costs for ACT customers in the long term.

One of the challenges on Evoenergy's horizon are greenfield developments that are a 100% powered by electricity (no gas connections) and have mandated rooftop solar to be installed on all houses. The local government has a strong focus on minimising the Territory's carbon footprint so DER uptake is further accelerated by government initiatives. Evoenergy is using the lessons learnt from this trial to form basis of network trials to leverage DER/VPPs to tackle the upcoming challenges for the local network.

Driven by its 2045 goal of zero carbon emissions, the ACT Government continues to support grid-side batteries too. Lessons learnt from this trial will prove invaluable in determining

- the effectiveness of having grid-side batteries in particular location of the network;
- the minimum capabilities required from the batteries; and
- the type of data and parameters of control required from these batteries for them to be useful to Evoenergy.

Evoenergy's approach is to transition the trial to BaU based on the number of DER installed and their concentration in parts of the network where they can help alleviate network constraints. This would be a phased transition from the trial. The first step in this transition is to use DER data in ADMS for operational purposes, including incorporating it in to load flow analysis. This needs supporting work to be completed and is expected to start in the 2020/2021 period. The second stage of the transition to BaU will be implementing manual control through the ADMS and the third stage would include automated control through the ADMS. The trial is expected to run in parallel with this transition as the DER and VPP space is still evolving, both from regulatory and market design perspectives.

2. University of Wollongong – PhD scholarship (Continuing Project)

Nature and Scope

The project involves sponsoring a 3-year PhD of a student at University of Wollongong to gain insight to how smart grid technologies will interact with the greater network on a local and precinct level. The project will develop and test optimal control system for smart residential house which optimises the consumption and storage of energy along with the operation of several controllable loads.

Aims and Expectations

The project will develop a network interactive home energy management system that utilises model predictive control to optimise the consumption, generation, and storage of energy within an individual household and subsequently the greater precinct to achieve net zero energy. Upon completion of the project, Evoenergy expects the development of real time multi-objective control framework for behind the meter distributed energy resources (DER) which can be further evaluated for deployment with DER assets in the ACT network.

Project Criteria

This project is a broad based demand management project, where Evoenergy sponsored the funding of a PhD student at University of Wollongong to study the optimal demand response strategies for home energy management systems (HEMS) in smart grid to achieve net zero energy. This project is innovative as Evoenergy will be able to gain a greater understanding of how demand management strategies assist in deferring capital investment while also reducing peak demand within the network. This project is designed to build demand management capability in Evoenergy's network and provide a new potentially efficient demand management solution for future estate developments in the ACT.

Implementation

The student is undertaking the project through the University of Wollongong and provides progress updates through reports back to Evoenergy. The student also provides briefings to Evoenergy representative on an ad-hoc basis in relation to updates and milestones. During the 2019/20 FY, the student along with representation from the university conducted a workshop and seminar where he presented the finding and research outputs from the project. This session was attended by university personnel as well as Evoenergy staff to gain more insights into the development pathway of the HEMS algorithm and the software/hardware optimiser.

Evoenergy also provided anonymised data around load and generation from solar and battery customers (sourced from the DMIA funded VPP Aggregation project) as well as network infrastructure data for feeders with higher penetration of DER for the student to further analyse and optimise the algorithm.

The multi – objective control algorithm will have three modes for optimisations

- Economic operation –Minimise cost for customer based on a TOU tariff
- Voltage regulation –Reduce voltage rise due to reverse power flow from solar PV
- Peak shaving –Reduce net consumption during periods of high feeder loading

Outcomes

This project quantifies the benefits of implementing model predictive control on residential solar PV and energy storage systems considering a time-of-use demand tariff, feed-in tariff and varying PV system sizes and battery life-cycle costs. The control system analysed makes use of economic model predictive control (EMPC) whereby the objective function is directly tied to the economics of the system. Using residential load and PV data from Evoenergy, the EMPC controller is compared to a rule-based controller, highlighting the benefits of EMPC in regards to annual economic performance and

battery energy throughput. The EMPC algorithm is then tested using 10 residential customers at the low voltage feeder level showing the capacity for the EMPC controller to shift peak demand and flatten the aggregated load profile of 30 residential customers.

Implementing EMPC on Energy Storage units in distribution networks could assist DNSPs in deferring the need for network augmentation due to increased demand. These savings could subsequently be passed on to their customers, providing further financial benefits. With the progression of residential estate development in greenfield sites with significant uptake of DER, this project was deemed an ideal test case to provide learnings back to Evoenergy.

Costs

The project is a continuing project which was started in the final years of the previous regulatory period of 2014-19. As the project was committing to support the PhD study of the student, Evoenergy committed to the full 3 year period of the project and hence the final support for the project was provided during 2019-20 financial year. The total expenditure incurred by Evoenergy for 2019-20 was [redacted] while in 2018-19 the total costs for the project was $[redacted]. The project will close out and there will be no further DMIA funds allocated to this project going forward.

Project Activity to date and Results

The research has resulted in the development of a fully functioning, smart, model predictive control (MPC) algorithm for the control of residential energy storage, EV chargers and air conditioners for demand response. The algorithm now allows for coordinated control of distributed energy resources at a precinct level as well as individual control (i.e in a VPP).

The student also undertook in-depth statistical analysis of a year's worth of anonymised customer data as well as network infrastructure data in the Evoenergy network. This helped in developing multiple statistical models looking at the ratio of load to PV generation and how much excess energy from each customer is available to be stored in the battery from the PV.

Using the data the MPC algorithm was simulated over a course of a year and benchmarked against several different scenarios including a customer with no PV, just PV, PV and battery with standard control and PV and battery with MPC control. The MPC provided the following advantages:

- Decreased overall electricity bill for the year
- Significantly less energy imported during peak times (i.e 7am – 9am and 5pm-8pm)
- Significant less battery energy throughput (leading to longer overall battery life)

While the project has not fully concluded with reporting and anaylsis, Evoenergy considers the project closed but awaiting final results in terms of Evoenergy's funding under DMIA for this project.

The project results will help demonstrate

1. Maximising financial benefit for customer and the network, assisting in peak demand reduction, and providing voltage regulation
2. Control framework must be distributed and able to be implemented with existing software and hardware utilised by DNSPs
3. Implementation and testing of framework on UOW's smart solar powered house, the Desert Rose
4. Implementation and testing of framework across UOW's innovation campus microgrid for precinct level coordinated control of DER

The project has resulted in the student submitting papers to two journals:

1. ‘A Comparison of Economic Model Predictive Control and Rule-Based Control for Residential Energy Storage Systems’ –Accepted to IET Smart Grid
2. ‘Coordinated MPC of Residential Energy Storage for Voltage Regulation and Peak Shaving Along Radial Distribution Feeders’ –Under review for IEEE Transactions on Energy Conversion: Special Issue on MPC

Future work for this research will be the inclusion of deferrable loads such as residential air conditioners and EV chargers into the control problem. This would increase the potential to reduce overvoltage and peak demand, while minimising the number of critical control points required to alleviate network constraints and operate within the limits while maximising the benefits to end use customers.

3. Realising Electric Vehicles to Grid Services (REVS)

Nature and Scope

The REVS project seeks to unlock the full economic and grid benefits of electric vehicle-to-grid (V2G) services in Australia. The Project complements and builds upon previous international trials, which have validated the technical feasibility of V2G hardware, by demonstrating the delivery of a market service Frequency Control Ancillary Services (FCAS) at a fleet scale. The project will culminate in the deployment of over 50 V2G capable vehicles and bi-directional chargers in the ACT. Evoenergy is largely engaged in the project in an advisory capacity and will receive data and visibility from V2G chargers.

Aims and Expectations

1. Evoenergy aims to facilitate the installation of one of the first V2G enabled chargers within a distribution network and receive data in real time from the vehicles when connected to the charger.
2. Evoenergy aims to develop a streamlined connection process for the connection of V2G chargers.
3. Additionally, the regulatory and technical barriers for roll-out of V2G enabled vehicles will be investigated which Evoenergy hopes to learn from.
4. Evoenergy also aims to develop its demand management capabilities with this new class of DER assets.

Project Criteria

The project researches, develops and implements demand management capability for V2G enabled vehicles to partake in network services and operate in the ancillary markets. The project is an ARENA funded project led by ActewAGL Retail in conjunction with ACT Government, JETCharge, ANU, SG Fleet, Nissan and Accenture. The project will demonstrate the economic, technical and social case for leveraging V2G services within the electricity grid, and reduce the complexity and confusion for consumers, business and policy decision-makers. The deployment of the systems and capabilities outlined by the project, as well as the research and analysis from all parties will provide the roadmap for accelerated V2G adoption nationally. The project involves technology – vehicle to grid – not previously used in the ACT for any network or market services. Evoenergy’s network will be the first Australian distribution network to allow for a V2G enabled charger to be connected to the network thereby allowing for EV owners to further monetise their assets. The target market for this trial is also specifically marketed at fleet vehicles where the scale of the future system take-up will be more pronounced and at a level that can be aggregated and procured with consideration of the commercial aspects.

Implementation Approach

The project will be largely implemented in ACT Government's office buildings along with targeting the fleet vehicles in the buildings. This section of the customer base has not been targeted for any similar purposes and could potentially lead to a seamless integration of V2G enabled vehicles into the network providing reduced costs to customers and better utilisation of the network. Evoenergy is proactively engaging with the project partners to partake in the project to get early insights into the technical and commercial aspects of these V2G enabled vehicles and bi-directional chargers. Evoenergy is also potentially looking into whether the charger platforms and market operation can adhere to the network limits at the connection points via an operating envelope. These inverter-based bi-directional chargers can also be potentially mapped onto Evoenergy's Advanced Distribution Management System (ADMS) to enable real time visibility and signalling for aggregated control.

Outcomes

- Evoenergy will facilitate the first V2G charger installation in an Australian jurisdiction for commercial consumers, showcasing a streamlined connection process and approval.
- The project will highlight the technical and commercial viability of V2G capable fleet and provided Evoenergy with the regulatory changes required for DNSPs to efficiently plan and roll out investment for this new DER class.
- The project will build options for future Demand Management capability in ACT for Evoenergy as the industry explores interoperability and regulatory readiness.
- The REVS project will showcase Evoenergy's Strategy to transition to a Distribution System Operator (DSO).

Costs

1. This is the first year that Evoenergy has run this project and the total costs incurred by Evoenergy at the end of the regulatory year until 30 June 2020 was [redacted].
2. The total cost expected to be incurred by Evoenergy over the duration of the project is around [redacted] which will be allocated under the DMIA funding.

Project Activity to date and Results

The project kicked off in late 2019 with workshops and desktop research from V2G projects conducted internationally. Evoenergy partook in these and are currently engaging in weekly project meetings, knowledge sharing workshops. Additionally, technology specific discussion with the project partners regarding the connection process and the requirements are discussed. As the chargers are bi-directional inverters, careful consideration must be given on standards, certification, connection guidelines and policies. Evoenergy is part of the steering committee and has advisory role for the project to ensure that customer connected assets are in line with the network requirements. As the project is ongoing, results, analysis and regulatory knowledge sharing pieces are released for public consideration in line with ARENA specified milestones. As the project develops, Evoenergy expects to learn about how a new fleet of DER assets such as V2G enabled vehicles will be able to provide network support and value to customers. By incorporating these assets into the ADMS, they can potentially be called upon like virtual power plant (VPP) assets and can help peak shave and manage constraints within the ACT network through platform based control systems and social behavioural learnings from fleet operated vehicles. Evoenergy expects a potential immediate demand response capability of 367 kW and if proven this technology can be scaled up to all future V2G enabled chargers. This in turn could

potentially reduce the required investment from the network thereby reducing costs for all ACT customers. The project only kicked- off in early 2020 and so further results and outcomes will be publicised over the coming months and years.

4. Community Energy Models (CEM)

Nature and Scope

The CEM project involves looking at the regulatory and commercial barriers to front of meter or community level battery energy storage devices that can be ideally rolled out in the distribution network.

Aims and Expectations

The project will assess the value of different community energy models deployed throughout Australia. These analysis tools will then be used to provide recommendations for new tariffs that incentivise community energy models and underpin more efficient use of distributed generation and storage. Evoenergy will also aim to learn of the regulatory barriers to shared use of network owned energy storage which encouraging regulatory change and implementing innovation pilots with storage assets. Evoenergy also aims to potentially access a modelling capability to inform business strategy around energy storage value stack.

Project Criteria

The CEM project was an ARENA funded project led by The Australian National University (ANU) with Evoenergy partnering along with Yurika, Totally Renewable Yackandah, Repower Shoalhaven, Enova Community Energy, Energy Consumers Australia, TasNetworks, Thinking in Colours and Energy Networks Australia. The project researches the implications for front of meter storage devices and the varying ownership models that underpin the viability of such systems. Through this work, the project aims to provide the basis for greater adoption and deployment of community energy models both in Australia and around the world. In Evoenergy's network the project will potentially lead to grid connected battery storage assets deployed in greenfield/brownfield estates for consumer and network benefits. Greenfield estates in ACT are mandating solar panel uptake on every residential home and grid connected batteries can potentially provide a way to mitigate power quality issues associated with solar uptake. The focus of these storage devices at the community or suburb level has not previously been investigated and researched within the ACT and to a wider extent within other distribution networks in the NEM. ARENA funding was thus sourced to complement the research and development from ANU to further investigate this unique innovation for mutually beneficial rollout of grid connected storage systems for networks and local network customers.

Implementation Approach

Evoenergy provided cash and in-kind support for the CEM project over the last financial year to support ANU to conduct social and market research and develop methodologies to evaluate the different ownership structures for a grid connected community level battery storage system. Evoenergy allowed access to its planning and future networks team personnel to partake in social and technical research

meeting along with active participation in workshops on dynamic tariff structures for the battery systems to evaluate the financial models underpinning this DER asset class. The various stages of the project also involved review and analysis of draft and final project milestone materials including in-depth survey reports from energy sector professionals on the potential role of
community-scale storage in the Australian energy system. Overall Evoenergy personnel participated in a series of qualitative research activities involving interviews with other project partners; focus groups with key decision makers across government and industry; and focus groups across a diverse section of the community.

Outcomes

Evoenergy expects to gain deep insights into community owned or operated assets which are connected to the distribution network. As a renewable energy focussed jurisdiction, Evoenergy considers it a prudent decision to be proactively involved in discussion around community sized batteries especially given that greenfield suburbs are probably best placed to install these devices. In addition, Evoenergy has no experience in the connection and regulatory and legal requirements around front of meter battery systems. Evoenergy expects the project to deliver a research outcome for the social acceptance for these systems while also identifying the regulatory barriers and drivers and the associated financial models to implement such a solution within the ACT network. A final outcome would be the potential deployment of a community owned storage device either by Evoenergy or a third party which can show benefits for network and end use customers.

Costs

1. This is the first year that Evoenergy has been part of the CEM project and the total costs incurred by Evoenergy at the end of the regulatory year until 30 June 2020 was [redacted].
2. The project has closed out (awaiting final milestone deliverables to ARENA) and hence there will be no further costs allocated under the DMIA funding for this project.

Project Activity to date and Results

Discussion on Evoenergy's involvement on the CEM project dated back to 2018, but the activities against the project did not start until the 2019-20 financial year. As mentioned, Evoenergy participated in focus groups and one-on-one discussions with ANU and other project partners to evaluate assess and provide feedback on various topics in relation to front of meter connected battery devices. These meetings took place in person as well as over virtual meetings and sessions. Additionally, Evoenergy reviewed and provided advisory level comments on various CEM project knowledge sharing workshops and seminars that ANU and other project partners were involved in. This included sessions run by The Energy Change Institute and the Battery Storage and Grid Integration Program at ANU. These sessions included webinars and workshops with market bodies and regulatory experts from Australian Energy Market Commission (AEMC), Australian Energy Regulator (AER), Australian Energy Market Operator (AEMO), Energy Security Board (ESB) among others. These sessions provided the project key insights into the various deliberations and requirements from these organisations pertaining to grid connected batteries. These evaluations helped Evoenergy understand the complex nature of this DER asset if it were to be part of the ACT distribution network.

Additionally, the regulatory challenges for network ownership of this asset was heavily deliberated by most project partners and workshop attendees. The policy implications analysis from the research was a key result for Evoenergy. These included:

- The need for trials and sandboxing to resolve key questions about costs and benefits of grid connected storage.
- The current nature of regulation and the pace of change which could potentially hinder the deployment of these assets. Clarifying the regulatory framework for organisations interested in pursuing local storage to accelerate takeup within communities by providing safeguards against safety and consumer rights.
- Tariff structures that are not conducive to the deployment of grid connected storage such as DUOS and how they are currently being dealt with in different jurisdictions within Australia.
- Guidelines and mechanisms on ownership structure and how they relate to the outcomes being delivered. Each objective function of a community level battery storage would determine the optimal ownership and financial structures to make it viable.
- Financial value stacking to de-risk the project and encourage investment in this DER asset.

For Evoenergy this project has delivered a key learning that grid connected community level batteries can provide valuable network services in many of its greenfield estates. The learnings from this project have already led to the ACT Suburban Land Agency (SLA) investigating the potential for a community owned battery asset at one of its newest suburbs called Jacka – which is located in north part of ACT. The suburb will be a renewable energy showcase with incentivised solar panels as well as being an electric only suburb which have implications on the network demand and customer power quality.

The results from this project have already helped Evoenergy explore many avenues of implementing community level DER assets in its network. Gaining insights into the technical and commercial level barriers that currently are in place has given Evoenergy and the project partners the opportunity to collaborate further with local ACT Government bodies to assess the viability of community batteries from a financial and ownership point of view. The project has also led to collaborations with other DNSPs within the NEM who are proactively seeking to implement grid connected storage in their networks as well. Overall Evoenergy expects that the final outcome of this project will showcase demand management mechanisms and strategies to be implemented with community storage devices for the benefit of customers while assisting with the DER uptake within communities.

5. Distributed Energy Resources Lab (DER-Lab)

Nature and Scope

The DER Lab project is an ITP Renewables led project for the development of a Lab located at ANU to enable industry to test and troubleshoot the interconnectivity and communications of technologies that monitor, control and coordinate distributed electrical generation, storage and demand response assets. The scope of the project covers Evoenergy providing steering committee level advice on the various stages of the project including the setup, network and DER assets procurement and operationalisation to essentially mimic a distribution network configuration for modelling and testing of third party equipment. The lab will be an open-access facility for third party hardware/software developers, universities, and network and market operators.

Aims and Expectations

The project aims to lift availability of testing facilities for DER devices including control and monitoring equipment to drive increased compliance, interoperability, and performance of DER assets. Evoenergy aims to have increased confidence in new technology by gaining acceptance/performance tests within a controlled environment that is representative of a distribution network. The project aim is to develop

protocols for multi-technology solutions to avoid early technology lock-in, streamline research and development and maximise the number of products which can be used across Australian networks. The DER Lab hopes to become a national focal point for the ecosystem of DER developers, researchers, and utilities.

Project Criteria

The DER Lab project is an ACT Government's Priority Investment Program (PIP) funded project which is led by ITP Renewables with the ANU partnering with Evoenergy and University of New South Wales (UNSW). The project is a research and development project that will build the demand management capacity for newer technologies to provide valuable network services and customer benefit. The DER-Lab will be a new facility to allow for safe testing of new technologies such as monitoring and communication devices, smart controllers, aggregation (e.g. Virtual Power Plant) and market participation software and other innovative new products under development, in a multi-platform environment that simulates real-world conditions prior to roll-out. This project has not been previously implemented outside of certification labs and even then are not dedicated to DER assets in particular. The project targets a segment of the DER market in technology providers who will provide end use customers and utility operators a verified product for roll-out in their sectors. The vision for the DER Lab is to establish, and grow over the long term, the leading facility in Australia for research, rapid prototyping, testing, and verification and certification of the integration of DER devices into the distribution system thereby reducing trial and testing costs for both vendors and network providers.

Implementation Approach

The DER Lab project came about through the recognition that ITP and ANU were developing concepts for labs that had strong complementarity. The use cases of this lab focused not on single device testing but on questions of grid integration that are being asked by networks, system operators and researchers. The laboratory will function as a test berth for technology developers and also as a research facility for academic partners. Along with the supporting electrical infrastructure, the lab will contain a number of commercial products typical for residential houses that are both producers and consumers of electrical power. This will include battery energy storage, real or simulated distributed generators and real or simulated load devices. Since the project launched, Evoenergy has been providing engineering review and analysis of project milestone materials including regular reporting under the PIP funding agreement.

Evoenergy is providing support for the project as part of the steering committee for the project. This committee which includes Evoenergy has the authority to:

- Approve project management plans for the DER-Lab project and approve any changes to the project scope that are within the bounds of the Funding Agreement.
- Approve conceptual design, technical design and operational design for the DER-Lab project.
- Ensure that the project is consistent with priorities and objectives of the ACT Priority Investment Program
- Oversee and make recommendations on the allocation of project resources, including human, physical and capital resources of the project;
- Ensure an appropriate risk management framework is in place for the project;
- Make recommendations to the Project Manager and Team Leaders on all matters relating to the implementation;
- Receive project reports, and in conjunction with the take action to support the project meeting planned milestone dates and deliverables;

Outcomes

The project is a two-year project which will involve the construction of a lab facility within the ANU campus in the Engineering building. This project will enable Evoenergy to provide a pathway for early stage innovations from the network and third parties to interact in a simulated network with real DER assets and provide clarity to networks and other parties on the validation of their products. In addition, Evoenergy will be able to steer interested parties to the DER Lab to provide verifiable results to their test regimen and network specifications.

Evoenergy will gain:

- Knowledge of emerging devices that can assist with DER integration into the network.
- Knowledge of control protocols that can easily communicate to Evoenergy current ADMS and IoT hub specifications as well be able to keep abreast of new standards that are in development for DER technologies.

The outcome of the project will be a lab that contains all the necessary hardware, software and skilled technicians required to test, develop, integrate and coordinate DER technologies. It would be comprised of real DER, such as solar PV and batteries, real demand loads, and Demand Response Enabled Devices (DREDs), on a real network. The project will establish an access fee model (and/or if appropriate, accreditation fee model) through industry consultation with a significant proportion of industry lab users who will be fee paying in order to re-coup operational costs.

Costs

1. This is the first year that Evoenergy has run this project and the total costs incurred by Evoenergy at the end of the regulatory year until 30 June 2020 was [redacted].
2. The total cost expected to be incurred by Evoenergy over the duration of the project is around [redacted] which will be allocated under the DMIA funding.

Project Activity to date and Results

The project kicked off during the 2019-20 financial year with Evoenergy signing a multiparty agreement with ITP Renewables and other project partners. The project steering committee met on bi-monthly basis initially with moving to virtual catchup when possible. Initially all deliverables under the project milestones were met with stakeholder consultation on functional and technical design on the DER-Lab having been completed. The project team also put in effort to develop an operation plan for the facility.

A site for the DER-Lab had also been selected at the ground floor of the Engineering Building (Building No. G032) at the ANU in the ACT. Fit-out works for the facility were completed in March 2020. Electrical works commenced in July 2020 (deferred from March 2020 due to COVID-19 site access restrictions) and equipment delivery and installation is scheduled to occur between July to December 2020. The planned operational date for the DER-Lab is the first quarter of 2021 which is a slippage in time for the project but is fully agreed to by the project participants and ACT Government, due to the COVID-19 delays on construction and procurement.
In terms of publicity to attract companies to use the facility, the DER-Lab has been the subject of presentations at several national and international conferences (including All-Energy and the Asia Pacific Solar Research Conference).

While the project is not fully operational just yet, the prospect for innovative DER technologies to test, trial and modulate their equipment in the ACT with a lab that has a modelled distribution network is a huge benefit to the vendors and utilities who often spend countless iteration of trial phases. This project has a pathway to lead these technologies to faster commercialisation and being part of BAU through real verifiable results at the DER Lab. This in turn will potentially increase the demand management techniques that Evoenergy can deploy in its network with increased confidence and visibility on the performance of these devices reducing long term network costs, helping with DER integration into the network and increasing customer satisfaction with their assets and the local distribution network.

6. Distributed Energy Resources Integration and Automation project

Nature and Scope

The DER Integration and Automation project will investigate and test options for how DER can effectively integrate into the energy system and how they can be used by customers to their full potential. The project will demonstrate how collaboration between a Distributed Energy Resources Management System - DERMS (Schneider Electric's DERMS) and a DER marketplace (GreenSync Decentralised Energy Exchange - deX) platform can unlock existing network hosting capacity to enable consumers gain more value from their energy assets such as solar, batteries and electric vehicles.

Aims and Expectations

The project aims to integrate Evoenergy's existing operating systems, the Schneider Electric Advanced Distribution Management System (ADMS), with GreenSync's Decentralised Energy Exchange (deX) platform through Evoenergy's Internet of Things (IoT) Hub and enrol DER assets into a simulated virtual power plant. This will allow Evoenergy to better manage DER within its network and in the future allow customers to be paid for providing services to the network through their DER assets. The project will aim to demonstrate how increasing DER uptake within Evoenergy's network can be best integrated to manage network needs while providing DER owners and customers a benefit in return for their behaviour. The project is expected to demonstrate provision of network services via a market place, using DERMS module for bid stack validation.

Project Criteria

The DER Integration and Automation project is research and development project which will implement innovative demand management techniques so that DER within the ACT network can potentially play a role in providing network services. The project will simulate DER within a real network model within Schneider Electric's DERMS module which will integrate with Evoenergy's Internet of Things (IoT) hub to pass validation and requests to third party DER via GreenSync's deX platform. This project has not been previously implemented in any other jurisdiction and Evoenergy was able to implement this project as it has a fully verified low voltage map (LV Map). This is potentially a key requirement for the management of DER assets as they connect to the LV feeders in a distribution network and optimal management of DER requires the LV asset data to be incorporated into the analysis for network constraint management. The project will potentially validate that coordinated approach to DER integration will be vital to defer and/or remove investment in network infrastructure while giving the

networks a proof of concept validation on the platforms that can provide the technical and commercial feasibility to enable this vision.

Implementation Approach

The project is co-funded by ARENA with Evoenergy as the lead party on the project along with partners including Schneider Electric, GreenSync and Withywindle (knowledge sharing partner). The project started in late September- early October 2019 with the project partners all gathering at Evonergy's offices in the ACT for a design workshop. Prior to this meeting, during the negotiation and ARENA proposal phases, the project team met regularly via telephone with coordination from personnel from Withywindle to ensure project objectives and key items including budgets were discussed and documented. The project has four milestones due under the funding agreement with ARENA and the project will by the end of October 2020 have completed and delivered three of the four milestones as required. The project involves importing Evoenergy's network map for a particular zone substation, in this case the Woden Zone Substation and associated feeder data, from its current version of the ADMS to the new containerised module with the DERMS module to simulate the network with different DER and weather scenarios.

Outcomes

The goal of the ARENA DERMS pilot project is to utilise DER for avoiding upstream capacity constraint and hence defer the need for grid augmentation investment and at the same time optimise grid capacity to host more DER. The DERMS module will communicate with simulated VPP through integration with IoT hub that is integrated with distribution market platform deX provided by GreenSync. The main tasks of DERMS will be to validate proposed schedule of aggregated DER into virtual power plant (VPP), and to resolve predicted issues utilising VPPs and DER.

The project outcomes include:

1. Improve distribution networks capability to host DER at higher levels of penetration.
2. Enable market operators to manage the power system with a high share of DER while maintaining reliability and system security.
3. Increase the visibility, predictability and control of DER for network service providers (NSPs) or other relevant entities to optimise power system operation within secure technical limits.
4. Increase the visibility, predictability and control of network characteristics and behaviour to improve the efficiency of distribution network connection processes for DER or to optimise investment.
5. Facilitate the integration of distribution management systems and market software for NSPs.
6. Increase hosting capacity on the network and improve business cases through enabling a commercial market for VPPs and DER services.

Costs

1. This is the first year that Evoenergy has run this project and the total costs incurred by Evoenergy at the end of the regulatory year until 30 June 2020 was $[redacted].
2. The total cost expected to be incurred by Evoenergy over the duration of the project is around [redacted] which will be allocated under the DMIA funding.

Project Activity to date and Results

The project kicked off during the 2019-20 financial year with Evoenergy signing bi-lateral agreements with GreenSync, Schneider Electric and Withywindle who are the project partners. The project steering committee met on monthly basis initially with moving to virtual catchup when possible with Evoenergy leading the project management and reporting for the project with the assistance of Withywindle. The technical project team from all parties met on a fortnightly basis including personnel from Evoenergy's subcontractor who were contracted to provide development of the IoT hub integration between DERMS and the deX platforms. Evoenergy also attended one on one catchups with project teams internally withing GreenSync and Schneider to further develop the use cases and demonstration activity to meet the requirement of the funding agreement.

While the project is not just a pure academic exercise, a number of roles within the project are effectively undertaking applied research. These applied research roles are across Schneider Electric, GreenSync and Evoenergy.

Some of the key capabilities that will be developed during the project include:

1. The project will use the Schneider Electric DERMS module to validate intended DER behaviour, effectively determining 'operating limits' for connected DER
2. DERMS model will identify constraints and publish these to market
3. deX Marketplace will evaluate offers to generate new DER behaviour schedules
4. DERMS will evaluate new schedules to resolve potential constraint and set new operational limits for DER which will be engaged by deX Marketplace within the financial parameters
5. Project architecture supports both dispatch of VPPs and autonomous validation of third party VPP operation
6. DER behaviour simulation will occur within both deX and DERMS

With the project consortia, Evoenergy developed the following three use cases to showcase the functionality of orchestrated DER.

1. Use Case 1 – DERMS initiates dispatch request (via IoT Hub to deX) to DER to avoid upstream capacity constraint
    a. Purpose - to use DERMS for avoiding predicted grid constraints (overload, reverse flow) on feeder head section and HV/MV supply transformer.

2. Use Case 2 – Appraisal of VPP call by third party - Individual DER dispatch and constraint identification
    a. Purpose - to use DERMS for validation of planned VPP behaviour as response to call by 3rd party (e.g. Retailer) in order to maintain grid reliability and power quality.

3. Use Case 3 – Avoidance of Network Violation from natural DER behaviour - Individual DER dispatch and constraint identification
    a. Purpose - to use DERMS to adjust DER typical behaviour, and avoid local grid issues caused by high DER penetration.

The project so far has met all its deliverables and further results and knowledge sharing reports will be published in line with the requirements under ARENA's funding agreement. The replication of these has been avoided in this report and further detail will be published on Evoenergy's webpage in due course. Overall Evoenergy considers this project to be a key part of its future plans as it prepares for ACT Government's renewable energy targets which are driving the uptake of solar and electric vehicles. Evoenergy considers this an ideal network environment to demonstrate the growing capabilities of smart energy technology, where customer-owned energy resources can actively participate in providing network services for commercial value.