Demand Management Innovation Allowance Report 2018-2019

Submission to AER

Endeavour Energy

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1.0 Executive Summary

Endeavour Energy currently have five Demand Management Innovation Allowance (DMIA) projects, the Residential Battery Energy Storage Trial which commenced in FY2016/17, the Air Conditioner Control Trial using 3G DRED which commenced in FY2017/18, the Grid Connected Battery Energy Storage Trial which commenced in FY2017/18, the Residential Inverter Control Trial which commenced in FY2018/19 and the Low Voltage Static Var Compensator Trial which commenced in FY2018/19. The total DMIA claim for FY2018/19 is $1,394,192.

Project	**Operating Expenditure** ($ nominal)	**Capital Expenditure** ($ nominal)	**Total Expenditure** ($ nominal)	**New or Continuing**
Residential Battery Energy Storage Trial	$14,117	$0	$14,117	Continuing
Air Conditioner Control Trial using 3G DRED	$320,210	$128,281	$445,491	Continuing
Grid Connected Battery Energy Storage System Trial	$0	$700,629	$700,629	Continuing
Residential Inverter Control Trial	$45,000	$0	$45,000	New
Low Voltage Static Var Compensator Trial	$0	$188,955	$188,955	New
Total	**$379,327**	**$1,014,865**	**$1,394,192**	

2.0 Background

This report has been prepared in accordance with the AER's Regulatory Information Notice in response to paragraph 6 of Schedule 1. The information provided will constitute the provision of an annual report for the purposes of paragraph 3.1.4.1 of the Demand Management Incentive Scheme (DMIS) applying to Endeavour Energy (as set out in the 2014-2019 Distribution Determination).

As per paragraph 6 of the AER's Regulatory Information Notice Schedule 1, Endeavour Energy is requested to provide responses describing its expenditure and the nature of its demand management activities for review by the AER. The annual reporting requirements are outlined below.

Endeavour Energy's response on the Demand Management Incentive Allowance must include:

1. *Identify each demand management project or program for which Endeavour Energy seeks approval.*

2. *For each demand management project or program identified in the response to paragraph 1:*

    - *explain:*
        - *how it complies with the Demand Management Innovation Allowance criteria detailed at section 3.1.3 of the demand management incentive scheme;*
        - *its nature and scope;*
        - *its aims and expected outcomes;*
        - *the process by which it was selected, including its business case and consideration of any alternatives;*
        - *how it was/is to be implemented;*
        - *its implementation costs; and*
        - *any identifiable benefits that have arisen from it, including any off peak or peak demand reductions;*

    - *confirm that its associated costs are not:*
        - *recoverable under any other jurisdictional incentive scheme;*
        - *recoverable under any other Commonwealth or State Government scheme; and*
        - *included in the forecast capital or operating expenditure approved in the 2014-19 Distribution Determination or recoverable under any other incentive scheme in that determination; and:*

    - *state the total amount of the Demand Management Innovation Allowance spent in the Relevant Regulatory Year and how this amount has been calculated.*

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

3.0 Previously Approved Projects

This section reports on the progress of projects previously approved by the AER.

3.1 Residential Battery Energy Storage Trial

The Residential Battery Energy Storage Trial is focused on investigating how Endeavour Energy can use battery storage technology to reduce peak demand, improve power quality and defer or avoid capital investment in terms of technical viability and financial attractiveness to both the customer and the company.

Parklea Zone Substation (ZS) has been chosen for the trial, as the area has an existing high penetration of solar systems with the potential to maximise the energy storage benefits for customers. The site is also identified as a future network constraint due to the increased growth from re-zoning and developments along the North West Rail corridor.

Endeavour Energy will offer a fixed subsidy of 75% on the purchase price of the supplied battery system to serve as an incentive to those participating in the trial. The 75% is based on the long-term cost of the battery energy storage system.

The recruitment target for this trial is 41 customers with existing PV systems.

3.1.1 Nature and Scope

Project scope includes:

- Recruit customers in the targeted area by developing the appropriate marketing material and recruitment systems;
- Engage a service provider, via the procurement process, to supply, install and commission battery energy storage systems of a suitable size at customers' premises, including the communications, control and signalling technology to ensure battery control and utilisation at the appropriate time;
- Collect and analyse customers' import and export energy consumption patterns;
- Quantify the total demand reduction in the targeted network area;
- Demonstrate the power quality benefits offered by battery energy storage systems;
- Model the technical benefits by developing network models utilising the data gathered from the trial;
- Determine the potential conflicts between parties wishing to access battery systems and how to manage conflicts; and

- Enhance the Demand Response Management System that manages the administration of customers and event signalling with a view to a large-scale program implementation.

3.1.2 Aims and Expectations

The deliverables of this project are to report on:

- The network demand reduction that can be reliably achieved by installing battery energy storage systems in residential premises and validating the average demand reduction per customer;
- The power quality benefits that battery energy storage systems can offer;
- The price point at which residential customers will pay for a battery energy storage system;
- Marketing and recruitment method for battery energy storage Demand Management programs; and
- The type and method of communication and control required to properly utilise the battery capacity.

3.1.3 Project Justification

The growth in residential developments particularly in Western Sydney highlights the need to upgrade network assets in the near future to accommodate the additional demand from new connections. The North West Rail corridor development has resulted in rezoning of the existing area to high and medium density housing and commercial development along the rail corridor. Parklea ZS is one of several zone substations supplying this area and is forecast to exceed its firm capacity due to the additional load from the re-development.

Parklea ZS supply area has 3,413 residential customers with PV installations, which represent around 1 out of 5 customers. This supply area has the highest penetration of PV within the Endeavour Energy distribution area.

This trial aims to understand energy storage technology and how Endeavour Energy can utilise it for peak demand reduction, power quality benefits and deferral of capital expenditure.

3.1.4 Implementation Plan

The trial will be implemented as follows:

- A service provider to supply, install and commission the battery energy storage systems will be selected through Endeavour Energy's procurement process;

- Customers within the target area will be invited to participate in the trial via a letter and promotional materials, customers with PV systems will be selected within the target area;
- The service provider will inspect the customer's premises to determine its eligibility for an installation;
- The service provider provides a quote to the customer, which includes the 75% subsidy from Endeavour Energy and asks the customer to agree on the program terms and conditions;
- The system is installed and commissioned; and
- Endeavour Energy sends an instruction to the battery systems through the communication and control platform to discharge the energy stored during times of peak demand.

The trial commenced on 1 December 2016 and finished on 31 March 2019 and included two summer periods (2017-18 and 2018-19) and one winter period (2018) of operation. An evaluation report for the trial was completed in July 2019.

3.1.5 Implementation Costs

The total cost of the Residential Battery Energy Storage Trial was $797,605 for FY2016/17 to FY2018/19 to be funded under DMIA.

Expenditure claim in FY2018/19 is $14,117 in OPEX covering the costs for access to the battery management and control system, and to a survey program, and project management. All expenses are accounted in several work orders linked to the project.

3.1.6 Results

Endeavour Energy incentivised customers to join the program by subsidising 75% of the battery system cost. The 41 positions on the program were rapidly filled. Some customers who registered their interest to join the program had to be rejected due to the lack of a suitable location to install the battery and associated equipment. All systems were installed and commissioned by November 2017.

Under the trial, the performance of the RBESS was evaluated under various operating and environmental conditions, how to maximise battery performance was established and the benefits to customers from these systems were confirmed. The major findings of the trial include:

- RBESS can deliver peak demand reduction for summer and winter peaking assets to address network constraints;
- Batteries can be aggregated into a single or multiple VPPs, and customise the dispatch based on the capacity required and peak demand time;

- Precise timing of dispatch events to coincide with peak demand period of the asset experiencing constraint is important;
- The system operates at an average system efficiency of 77% for ambient air temperatures between 26ºC to 43ºC;
- There is value in using a staggered dispatch method in order to match the peak load profile of the zone substation with the battery dispatch profile;
- Higher amounts of excess solar generation results in greater financial benefit to the owner; and
- Technologies in distributed energy resources are continuously improving, which will address the market needs as they change.

A post trial survey was conducted in May 2019 to obtain feedback from participants on their experience and satisfaction with the program, and to gauge the benefits the batteries delivered.

Overall satisfaction amongst the program participants was very strong with a rating of 8.5 (out of 10) and 91% of respondents stating their expectations had been met or exceeded. The upfront financial incentive of a 75% subsidy of a fully installed battery system was the biggest reason for signing up to the program for participants.

94% of respondents noticed savings on their electricity bill after having a battery installed, and 61% of these participants thought this was a moderate reduction, equal to what they expected.

The residential battery energy storage trial has demonstrated the demand reduction benefits of residential battery energy storage. Endeavour Energy will use learnings from this program in future demand management initiatives to achieve peak demand reduction where required. Endeavour Energy will also consider providing incentives for residential battery energy storage installations where this technology would contribute to general peak demand reduction and where shown to be cost effective in addressing network limitations.

3.2 Air Conditioner Control Trial Using 3G DRED

Air conditioning load is the most significant contributor to peak electricity demand and correlates highly with hot days, which is when the capacity of the distribution system is at its lowest.

Endeavour Energy has developed several technologies and strategies over the years to enable residential demand management programs. These include *Peak*Saver, *Cool*Saver, *Pool*Saver and Endeavour Energy *Solar*Saver. It is expected that future demand management programs, particularly in the North West area of Sydney, will require a level of demand management that will need all programs working together. It has been identified that the proportion of available demand reduction available from air conditioners could be improved using a 3G Demand Response Enabling Device (DRED).

The trial will involve the control of AS 4755 compliant air conditioners in residential premises to reduce peak demand, particularly during summer periods. A DRED will be installed and connected to the compliant air conditioner. The DRED offers the functionality to remotely switch the air conditioner into demand response mode 2 (DRM2) where it continues to provide cooling for the duration of the demand response event but limits the total electrical energy (kWh) consumed to 50% of its rated capacity. The DRED can receive instructions from SMS messages via the 3G mobile communications network. Air conditioner control via the DRED is more effective in terms of maintaining thermal comfort while reducing demand compared to the old method of switching off supply to the unit. The DRED also offers flexibility of reducing demand from air conditioners by 25%, 50% and 100%.

Eligible residential customers in the target areas will be invited to participate in the program. Participants will receive cash incentives for signing up and remaining in the program for each summer period. Endeavour Energy will work with air conditioner manufacturers, dealers, electrical retailers and builders to identify eligible customers and sign up 100 participants during the trial period.

The main objectives of the trial include quantifying the network demand reduction potential from controlling air conditioners using 3G DRED technology, and testing the performance of the DRED and the reliability of using 3G mobile communications in performing demand response functions. The trial also aims to assess the willingness of customers to accept some level of external control of their air conditioner compared to previous trials and the possibility of implementing this technology as a cost-effective broad-based program.

3.2.1 Nature and Scope

Project scope includes:

- Recruit customers in the target areas by developing a marketing strategy and supporting collateral;
- Engage air conditioning dealers who have customers with AS 4755 compliant air conditioner installations within the target areas to inspect and validate the air conditioner's eligibility for the trial and install the DRED;
- Provide incentives to air conditioning dealers/installers to recruit participants;
- Engage electrical retailers and builders with customers that will be installing an AS 4755 compliant air conditioner, to recruit participants for the trial;
- Provide incentives to trial participants;
- Call peak demand event days when necessary;
- Identify potential issues with the solution (the DRED and 3G mobile communications);
- Collect and analyse customers' energy consumption data;

- Quantify the demand reduction in the target network areas;
- Conduct a customer survey at the end of the trial; and
- Prepare a project evaluation report at the end of the trial with the view of incorporating the learnings in future demand management programs.

3.2.2 Aims and Expectations

The objectives of this trial are:

- To test the performance of 3G DREDs to limit the demand from AS 4755 compliant air conditioners during peak periods;
- To test the reliability of using mobile communication technology in demand control;
- To quantify the network demand reduction potential from installing 3G DREDs to control air conditioners in residential premises;
- To assess the willingness of customers to accept some level of external control of their air conditioner;
- To evaluate the effectiveness of recruiting customers through various channels, including air conditioning dealers, electrical retailers and builders; and
- To assess the possibility and cost-effectiveness of implementing air conditioning control using 3G DRED as part of a broad-based program.

3.2.3 Project Justification

Peak demand in Endeavour Energy's network area has grown significantly in greenfield development areas over the past decade, reflecting the transformation of rural and semi-rural land into new urban areas, and a continued growth and use of air conditioners. In addition, peak temperatures within Endeavour Energy's network area are typically higher and more sustained than in coastal areas, resulting in a significantly higher probability of extreme weather events, which contributes to the increased use of air conditioners. Peak demand is the primary driver of network augmentation investment, which contributes to electricity prices paid by consumers through the network component of electricity bills.

Data collected from the Energy Use and Conservation Survey conducted throughout Australia in March 2014 by the Australian Bureau of Statistics provides an estimate of the percentage of households with some form of air conditioning. In 2014, two out of three households in NSW or about 64%, had an air conditioner. A survey conducted in 2012 by an independent consultant identified that air conditioning penetration in Western Sydney is as high as 80%. It is believed that this figure would be higher in greenfield residential development sites.

The supply areas of Parklea, Penrith 11kV and Kingswood Zone Substations were identified as target areas for this trial. It is forecast that these zone substations will approach capacity limitations in the next two to five years. The Parklea ZS supply area is a more recent release area and is likely to contain higher penetration of AS4755 compliant air conditioners. However, the Penrith 11kV and Kingswood ZS area will provide a good insight into the penetration of AS4755 compliant air conditioners in more established areas.

3.2.4 Implementation Plan

The trial will be implemented as follows:

- Air conditioner dealers that service the target areas will be approached by Endeavour Energy to act as service providers for the program. Service providers will install the DRED on participants' air conditioners;
- Electrical retailers located within close proximity to the target areas that offer compliant air conditioners will be approached by Endeavour Energy to promote the program at the point of sale.
- Builders of new homes in the target areas who install compliant air conditioners will also be approached by Endeavour Energy to promote the program in their handover pack;
- Customers within the target area will be invited to participate in the trial via a letter and promotional materials and will be asked to register online.
- Once a customer registers, the service provider will conduct a site audit to check the customer's eligibility based on set criteria. A 3G DRED will be installed by the service provider for eligible customers so Endeavour Energy can control the operation of the air conditioner during event days; and
- Endeavour Energy will manage the demand response events by sending a control signal to the DREDs

The trial commenced on 1 September 2017 and operated for two summer periods. A post trial survey was conducted in May 2019 and an evaluation report will be completed by September 2019.

3.2.5 Implementation Costs

The total cost of the Air Conditioning Trial using 3G DRED was $743,573 for FY2017/18 to FY2018/19, to be funded under DMIA.

Expenditure claim in FY2018/19 is $320,210 in OPEX and $125,281 in CAPEX covering the costs for the supply and installation of DREDs, project management, marketing, customer engagement, survey and customer incentives. All expenses are accounted in several work orders linked to the project.

3.2.6 Results

An evaluation report will be completed by September 2019.

3.3 Grid Connected Battery Energy Storage System Trial

Battery storage can provide several network benefits to Endeavour Energy. Primary network benefits such as peak load lopping, voltage management, load balancing and reliability improvement can be realised in the foreseeable future and may reduce or defer investment decisions. There is strategic value in understanding the operation of battery storage in order to position the company to realise storage related opportunities and applications as they are developed.

Utilising a BESS to defer the construction of a greenfield zone substation (ZS) is one such opportunity. In this application, the BESS can be used as an alternative to a Mobile ZS for deferral periods of up to 3 years. Short term demand growth can be met with supplementary supply from a BESS to defer both the augmentation of the existing network and the establishment of the final supply infrastructure.

3.3.1 Nature and Scope

Project scope includes:

- Identify the functional requirements of the BESS for connection and operation on Endeavour Energy's network;
- Procure a grid connected BESS with a minimum of 1MWh storage capacity, and 500kVA inverter, with a modular and transportable design;
- Deploy BESS onsite at West Dapto;
- Prove the BESS can provide 1MWh at a peak of 500kVA as required for peak shaving;
- Confirm round trip charge/discharge energy efficiency of 80%;
- Understanding the SCADA control and protection requirements for the grid connected BESS; and
- Test the voltage, power quality, power factor management and reliability support functions of the BESS.

3.3.2 Aims and Expectations

Aims and expectations of the trial include:

- Determine the suitability for peak demand reduction and other network support applications such as voltage, power quality and power factor management;

- Test the use of battery storage as grid backup supply for reliability support;
- Gain an understanding of design considerations such as component losses, charge/discharge rates, system lifecycle, safety, installation, control and monitoring requirements, and any limitations of the equipment;
- Confirm the viability of a relocatable storage solution, in terms of cost and ease of relocation;
- Practicalities of installation, testing and commissioning;
- Check the maturity of the technology and suppliers in the Australian market;
- Understand the cost to procure a grid connected BESS; and
- Viability of intended primary application of the battery storage, that is, as a tool to assist in deferral of zone substation construction.

3.3.3 Project Justification

Battery storage is approaching a price point that makes this technology a contender as an alternative network investment option. BESS have the potential to provide NPV positive returns when used for ZS construction deferral and will also provide a potential opportunity return, as the substations may be amalgamated, relocated or further deferred if load growth does not meet forecast levels.

It is in Endeavour Energy's interest to pilot grid connected storage to position the company to realise the benefits battery storage can provide such as peak shaving, reliability support, quality of supply improvement, and better understand the operational impacts of their application to our network.

West Dapto ZS, planned for construction in 2022, has been identified as a suitable location for the pilot. Pending successful testing of the BESS' peak lopping capability, the solution will remain onsite to alleviate demand growth in the West Lakes Illawarra development area and assist to defer West Dapto ZS construction.

3.3.4 Implementation Plan

The trial will be implemented as follows:

- Develop a functional specification documenting the requirements of the BESS for connection and operation on Endeavour Energy's network;
- Tender for a grid connected BESS with a minimum of 1MWh storage capacity, and 500kVA inverter, with a modular and transportable design;

- Following selection of the supplier, finalise design of the solution to meet the BESS functional requirements;
- Work with the supplier to construct and test the BESS;
- Connect and commission the BESS onsite at West Dapto in time for summer 2019/20; and
- Complete testing of the BESS functions by the end of the 2019/20 financial year.

3.3.5 Implementation Costs

Expenditure claim in FY2018/19 is $700,629 in CAPEX covering engineering development, testing and equipment costs associated with the project. All expenses are accounted in work orders linked to the project.

3.3.6 Results

An evaluation report will be completed by September 2020.

4.0 New Projects For Approval

This section outlines the projects for approval by the AER.

4.1 Residential Inverter Control Trial

Some areas of Greater Western Sydney are experiencing voltage fluctuations causing reliability issues, as more homeowners install solar systems. These voltage fluctuations are caused by significant amounts of solar generation being fed back into the electricity grid. Changes in voltage can inconvenience customers through dim lights, poor appliance performance and intermittent outages.

The Residential Inverter Control Trial is currently conducted by Endeavour Energy and Reposit Power, with the support of the NSW Government's Clean Energy Knowledge Sharing Initiative, to trial reactive power control and determine whether residential solar systems can assist in reducing fluctuations in voltage in Endeavour Energy's network. The results of the trial will be used to guide future decisions about procuring network support services from customer assets by offering incentives based on the value of these services to Endeavour Energy.

4.1.1 Nature and Scope

Project scope includes:

- Recruit customers in the target areas by developing a marketing strategy and supporting collateral;
- Engage local solar installers in the target areas for installation, commissioning and testing of solar systems at customers' premises;
- Provide incentives to trial participants; and
- Conduct reactive power dispatch events to manage voltage.

4.1.2 Aims and Expectations

The objectives of this trial are:

- To assess incentives required for customer acquisition to provide network support;
- To test if solar inverters can provide fixed reactive power output while the active power varies;
- To test if the voltage management and control system operates as expected; and
- To assess the possibility of dynamically controlling residential solar inverters to reduce fluctuations in voltage.

4.1.3 Project Justification

The increasing high penetration of renewables, particularly in Greater Western Sydney, has created voltage issues in parts of the network. Dynamic control of residential solar inverters, managing both real and reactive power exports of customers' systems at the same time, provides a solution that does not involve limiting the customers' ability to install or get the maximum benefit from these technologies.

Selected areas in Blaxland and Glenbrook supplied by overhead mains are experiencing voltage fluctuation and reliability issues, thus, were selected as the target areas for the trial.

This trial aims to understand dynamic control of residential solar inverters and how Endeavour Energy can utilise it as a non-network option for controlling voltages in the network and potentially defer capital expenditure.

4.1.4 Implementation Plan

The trial will be implemented as follows:

- Customers within the target area will be invited to participate in the trial via an Endeavour Energy and Reposit co-branded letter;
- Customers contact an approved local solar installer to install a compatible solar inverter and Reposit Box (if required); and
- Endeavour Energy conduct reactive power dispatch events using the Reposit Fleet voltage management and control system to request a change in power factor for solar generation for a set duration.

Recruitment of 50 target customers commenced in September 2018 but was unsuccessful. Participant incentives were redesigned to include a free solar inverter supplied and installed, and the recruitment target was reduced to 25 customers accordingly, to remain within the project budget. The second round of customer recruitment occurred in February 2019 and was able to recruit all 25 participants. The trial, which commenced in April 2019, will be conducted for 12 months.

4.1.5 Implementation Costs

The Residential Inverter Control Trial has a cost of $45,000 for FY2018/19, which is the funding committed by Endeavour Energy to provide to Reposit in respect of this trial, to be funded under DMIA. This covers the costs for customer recruitment, project management and access to the voltage management and control system. All expenses are accounted in work orders linked to the project.

4.1.6 Results

An evaluation report will be completed by July 2020.

4.2 Low Voltage Static Var Compensator Trial

Static Var compensators (Statcoms) have been available for some time, but it is only recently that smaller systems designed for low voltage applications have become available. Statcoms manage voltage through injecting or absorbing reactive power and can help to manage voltage constraints on the network. For example, reducing LV feeder voltage during high solar generation or increasing voltage during peak demand times.

Low Voltage Statcoms are a viable alternative to network augmentation and can help to defer or avoid network investment in edge of grid applications. This trial aims to test the benefits of LV Statcoms to improve customer voltages and manage LV network constraints.

4.2.1 Nature and Scope

Project scope includes:

- Procure 1 single phase and 3 three phase LV statcom units;
- Identify suitable install locations where voltage regulation is poor;
- Develop designs for installation of the units;
- Commission the systems with remote communications;
- Demonstrate the voltage benefits on constrained feeders; and
- Confirm the cost effectiveness of the technology compared to conventional feeder augmentation, that is, transformer updates and reconductoring

4.2.2 Aims and Expectations

Aims and expectations of the trial include:

- Determine the suitability for peak demand reduction and other network support applications such as voltage, power quality and power factor management;
- Gain an understanding of design considerations such as efficiency, system sizing, system lifecycle, safety, installation, control and monitoring requirements, and any limitations of the equipment;
- Understanding the practicalities of installation, testing and commissioning;

- Ensuring the LV statcoms can maintain a target voltage of between 216V and 253V; and
- Investigating other applications of the technology such as coordinated voltage regulation across multiple LV feeders.

4.2.3 Project Justification

LV statcoms are an emerging technology that have the potential to increase DER hosting capacity, correct power factor, and alleviate network voltage constraints more cost effectively than conventional network augmentation. This technology will be trialled by Endeavour Energy to determine the benefits and potential use cases. If the trial demonstrates the technology is cost effective further applications of the technology will be investigated on a case by case basis.

4.2.4 Implementation Plan

The trial will be implemented as follows:

- Procure 1 single phase and 3 three phase LV statcom units (10kVar/phase);
- Power quality meter data will be reviewed to identify network constraints and determine suitable install locations;
- Design and installation of the units will be completed in August 2019; and
- Monitoring of the systems will be undertaken for 1 year.

The benefits and results of the technology will then be reviewed.

4.2.5 Implementation Costs

The trial has a budget of $250,000 for FY2018/19 to FY2019/20. This is the cost for the engineering development and testing associated with deploying this new technology on the network.

Expenditure claim in FY2018/19 is $188,955 in CAPEX covering the costs for engineering development works associated with the project. All expenses are accounted in work orders linked to the project.

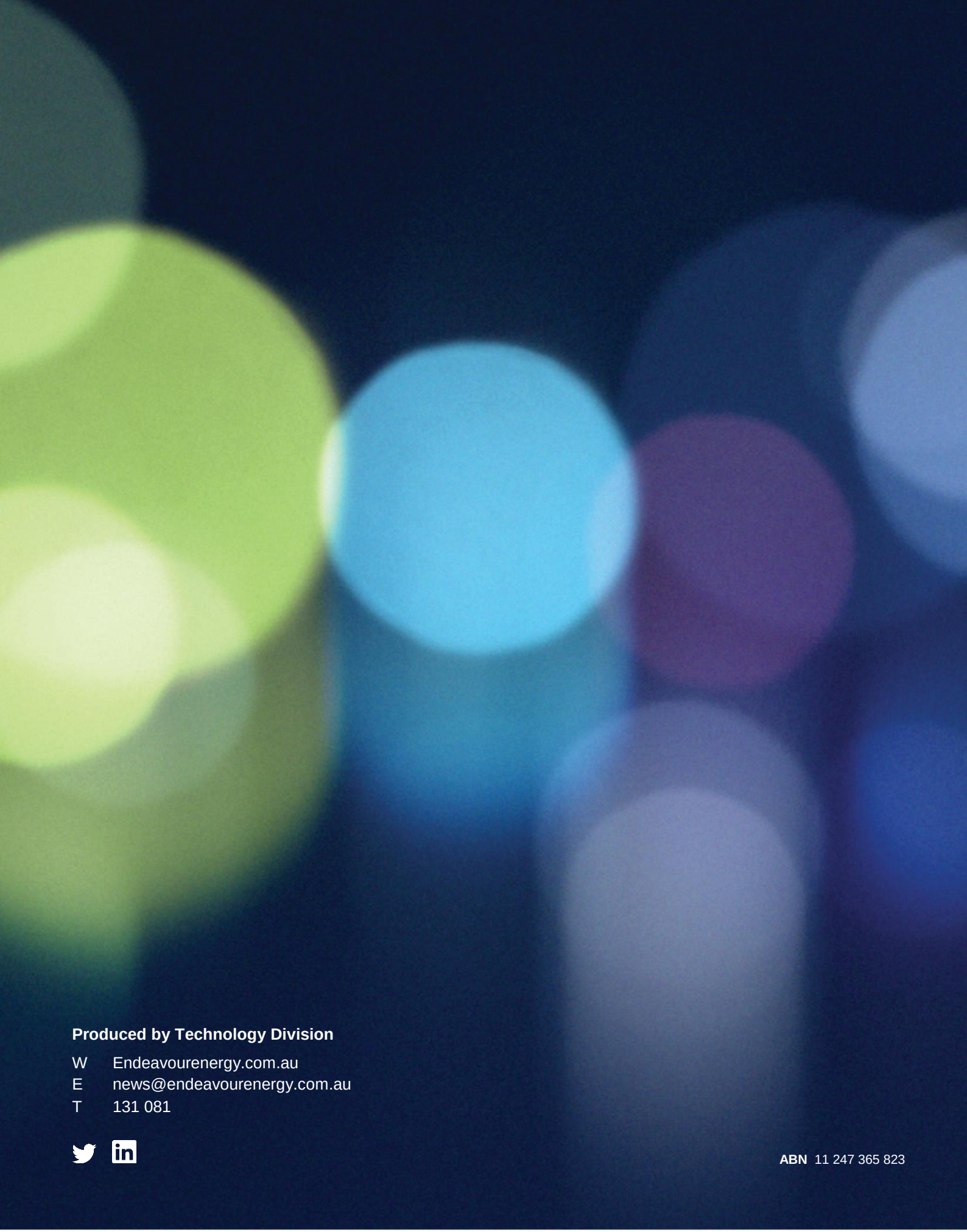
4.2.6 Results

An evaluation report will be completed by November 2020.

5.0 Background

Endeavour Energy confirms the funding of the projects contained in this report are not:

a. recoverable under any other jurisdictional incentive scheme;
b. recoverable under any other state or Commonwealth government scheme; and
c. included in the forecast CAPEX or OPEX approved in the AER's distribution determination for the next regulatory control period, or under any other incentive scheme in that determination (such as the D-factor scheme for NSW).



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