

# **AusNet Electricity Services Pty Ltd**

## **Electricity Distribution Price Review 2022-26**

### **Appendix 11A: Innovation Business Cases**

**Submitted: 31 January 2020**

**PUBLIC**

## INNOVATION BUSINESS CASES

Project 1	Efficient network balancing
Criteria	Description
Initiative description	<p>An alternating current power system has three “phases” which need to have similar loads balanced across each phase to avoid quality problems for other users. Imbalances in the network can also cause outages, degraded power quality can limit the ability of customers to import or export energy. For example, many of the 2018 Australia Day outages were caused by imbalances of the low voltage (LV) network.</p> <p>As more customers connect DER to the network there are increased challenges with ensuring the network stays in balance. Past practice, when there were few imbalances, was to send out technicians to address problems. This is an expensive approach that would not be sustainable as more DER is connects to the network and the number of imbalances increases substantially.</p> <p>This innovation project tests two solutions to LV network balancing in a variety of network situations experiencing imbalance to the extent of impacting the performance of customer solar power systems. Both solutions are network side devices that do not involve customer interaction. The devices have not been used before for this application. They have been used overseas (China) for balancing loads, but have not been used to balance the impacts of solar and have not been commercially deployed in Australia.</p> <ul style="list-style-type: none"> <li>• <i>Solution 1:</i> Using a unique device called a Power Compensation Device. This is like an advanced type of three-phase inverter that can independently balance power flows across phases (using real power) and voltages across phases (using reactive power). There are now low-cost options available that have the opportunity to be economic if performance can be proven.</li> <li>• <i>Solution 2:</i> Using electronic switching devices capable of balancing supply and demand on local networks. This option would use the devices to switch customers’ supply between phases to balance power flows and therefore voltages in real time. The pilot will select relevant locations of unbalanced network with a high penetration of DER, and design and install a switching device and algorithm to determine which switching times have least customer impact.</li> </ul>

Project 1	Efficient network balancing
Criteria	Description
Improved service to customers	<p>A key goal is to create a network which enables DERs and utilises them to benefit all customers through maintaining network reliability, power quality and reducing long-term costs in a far more complex environment than when there was largely one way flow of electricity. Successful solutions would be expected to allow: more DER resources to be connected to the network and customers to import and export energy without constraints. This would maximise customers' personal bill reduction along with increasing their revenue from feed in tariffs. It would also reduce electricity costs for all customers by replacing higher cost electricity sources with solar exports.</p> <p>The pilot would be successful if it were able to maintain voltage levels at a lower cost and more effectively than would traditionally be incurred through repetitive manual load balancing works, or further constraining DER connection. A single instance of a manual load balance can incur \$5,000 to \$15,000 of opex, and multiple instances may be required over the lifetime of a network segment with high DER uptake. Furthermore, manually rebalancing is a static change that does not respond to network conditions, therefore limiting its effectiveness. For example, swapping phases for some customer might help with balancing in summer months, but might make the imbalance worse at other times of year. A manual rebalance will not assist in this type of situation, but the dynamic balancing technologies in this project may prove to be effective.</p> <p>It has been estimated that expanding renewable generation will reduce wholesale prices at the rate of around \$0.09/MWh, per one MWh of additional wind generation. For solar – almost all of which has so far been on household roofs –the wholesale price reduction is a rate of around \$0.26/MWh, per one MWh of additional solar production.<sup>1</sup></p>
Driven by customer needs and expectations	<p>This initiative aims to reduce risks with ongoing reliability of supply, avoid expensive asset augmentation and operational costs (therefore charges) and reduce the need to curtail customers' ability to import or export energy – outcomes that we know from our customer engagement that customers want.</p> <p>Successful implementation will allow us to accept additional solar on the network at the lowest cost, further enabling more customers to be paid for their exports and thereby reduce all customers' electricity bills. The different network devices will have the ability to shift loads and improve all customers' experience.</p>

<sup>1</sup> Mountain, B., Percy, S., Kars, A., Saddler, H. and Billimoria, F (2018), *Does renewable electricity generation reduce electricity prices?*, Victorian Energy Policy Centre, December.

Project 1	
Efficient network balancing	
Criteria	Description
Involves collaboration	<p>The original concept for this initiative was an ARENA-funded proof-of-concept project which we are carrying out in collaboration with Jemena and the University of New South Wales. We intend to extend this collaboration with these parties to trial these technologies in the next regulatory period. However, as discussed below, specific settings and designs will need to be developed in relation to our network and its particular characteristics. We will, however, ensure widespread publication of the results of our trials to reduce the costs of other parties that look to adopt and localise the approach.</p>
Solves a specific issue	<p>There are no established network solutions to dynamic load balancing on LV networks as demand (and supply) has traditionally been predictable. We have relied on “diversity”, which means having a sufficiently large number of users doing similar things at slightly different times to balance out the network.</p> <p>LV connection of DER introduces sources of relatively concentrated change to local supply and demand which means that some customers will have a disproportionate effect on the power balance of their local circuits. This is a new problem, which is why there are no conventional economic solutions. Both of the pilot options identified above are feasible and have been identified by ARENA. However, the unique characteristics of each electricity network requires each business to tailor the solution to their own local conditions. In effect, we need to test which approach would work best at scale on our network.</p>

Project 1	Efficient network balancing
Criteria	Description
Customers are willing to pay	<p>Customer research conducted with a variety of customers and their advocates and conducted in a variety of ways has consistently found that customers support modest innovation to prepare for, and assist, energy system transformation – as long as tangible benefits for customers are delivered, there is no duplication of existing projects and the learnings are shared.</p> <p>The Customer Forum has previously accepted the case for an innovation allowance, and it has concluded that an innovation budget of \$7.5 million based on a modest contribution of approximately \$2 per annum per customer for the regulatory period is reasonable.</p> <p>Our customers expect to be able to export excess solar onto the network and the majority would be very unhappy if this were restricted. There was support for sensible investment to allow solar exports so this valuable energy is not wasted and can reduce cost pressures for all customers. However, a clear understanding of the consequences for the amount of constraints was sought, with and without investment. There was support for sharing of the costs of allowing solar exports, including with government.</p> <p>Specifically, through customer engagement we found that there is strong concern about the possibility that customers' solar exports may need to be limited. For example, research found that 80% of customers would be dissatisfied if restrictions to export DER were in place.</p>
Options and proposed expenditure	<p>As mentioned above, traditional manual adjustment and historic switching devices are uneconomic and in many cases ineffective for the extent of work being driven by DER connection. Both Solution 1 and 2 are feasible and have been identified by ARENA. However, the unique characteristics of each electricity network which have developed over decades requires each distributor to tailor solutions to local conditions. In effect, we need to test which approach would work best at scale on our network.</p> <p>As there is no established large-scale deployment of either proposed option, our approach is intended to test the technical effectiveness of each option in solving an existing network issue, the relative costs and the consumer impact.</p> <p>We propose running both trials as a 2-year initiative. The total costs of \$0.8m (\$2021), of which the Power Compensation Device trial would be approximately \$0.5m (primarily the costs of the device) and the phase switching trial, approximately \$0.3m.</p>

Project 1	Efficient network balancing
Criteria	Description
	<p>We expect the trial will enable us to assess whether a Business-As-Usual implementation is justified in terms of costs and benefits to customers. In particular, the potential benefit from a successful trial and subsequent implementation of a solution is the avoided loss of value to customers where:</p> <ul style="list-style-type: none"> <li>• Exports were curtailed</li> <li>• Load appliances cannot operate correctly; and</li> <li>• If battery charging and other loads were curtailed.</li> </ul>
Not replicating existing projects	<p>Dynamic balancing of loads and generation across phases of the LV network is a new area of investigation in the industry and little precedent work exists. Currently phase balancing is a manual exercise for all networks involving a truck visit and can only apply a static balance at a point in time. This project investigates the use of new technologies to automatically and dynamically achieve phase balancing. The project takes as an input our experience with a three-phase network stabiliser at the Mooroolbark Mini-Grid in islanded operation mode, but seeks to apply the technique to help manage solar-driven phase unbalance in grid-connected mode.</p> <p>The project also includes the commercial scale pilot of technologies that are being trialled as a technical proof-of-concept under the current “Solar friendly neighbourhoods” project in collaboration with Jemena and the UNSW. In doing so, this will be a first-of-its kind project in Australia and will look to test the economic viability of the “Solar friendly neighbourhoods” concepts at commercial scale. The project will firm up a strategy for implementation as a new tool for networks to use in balancing phases for the purpose of enabling greater uptake of solar power and increased single phase loads and will add to the body of knowledge in the Australian network sector. Academic partnerships will also be employed.</p>

Project 2	
Supporting network voltages with new technologies	
Criteria	Description
Initiative description	<p>As customers increasingly connect DER to our network, there are increasing challenges with keeping voltage within regulatory limits and keeping power flows within capacity limits on LV networks. Failure to keep voltage within regulatory limits reduces the performance and lifespan of customer DER and appliances, as well as risking damage to appliances. DER export also increases the scope to overload the network, which in-turn increases the chance of network equipment failure and/or interrupted energy supply. Failure to keep power flows within asset limits risks asset overload and supply outages and results in expensive asset upgrades. For example, many of the 2018 Australia Day outages were caused by imbalances of the LV network.</p> <p>This initiative is looking to test three solutions to keep LV networks within their regulatory and asset limits and avoid the negative customer outcome identified above, whilst avoiding the need to curtail or limit the operation of DER that can otherwise help put downward pressure on electricity prices for all customers.</p> <ul style="list-style-type: none"> <li>• <i>Solution 1:</i> Use Static Synchronous Compensators (STATCOMs) – devices that control power flow on parts on our network (such as some overhead lines) – to test whether injecting/absorbing “reactive power” on the HV network can help control voltage on the LV network in a relatively low-cost manner.</li> <li>• <i>Solution 2:</i> Use energy storage (batteries) &amp; inverter systems to control power flow (and therefore influence voltages) on problematic parts on our network such as rural powerlines including ‘Single Wire Earth Return’ lines (SWER) and new housing estates that are 100% solar. This technology can supply and “absorb” power which can influence voltage.</li> <li>• <i>Solution 3:</i> Develop in partnership with an equipment vendor new substation technology for SWER lines to change output voltage in real time.</li> </ul>
Improved service to customers	<p>The objective is to mitigate the degradation of power quality and reduce the risk of asset overload that can cause outages and trigger network upgrades. Customers benefit from better power quality and lower costs.</p>

Project 2	Supporting network voltages with new technologies
Criteria	Description
Driven by customer needs and expectations	<p>This initiative aims to reduce costs and prices, facilitate ongoing reliability and ensure customers' ongoing ability to export energy from DER. It does this by:</p> <ul style="list-style-type: none"> <li>• avoiding costs associated with physical network upgrades to accommodate the concentrated supply and demand from new DER and appliances which cause phase imbalances;</li> <li>• ensuring consumers are able to use the DER and appliances that they have purchased without constraint; and</li> <li>• maintaining power quality, supply and safety.</li> </ul> <p>Managing the voltage impacts of solar reduces the likely problems and costs of damage to customers' appliances and will also enable us to comply with regulated safety standards. The estimated potential benefit to customers is the avoided loss of value to customers:</p> <ul style="list-style-type: none"> <li>• If exports were curtailed; and</li> <li>• If battery charging and other loads were curtailed.</li> </ul> <p>The estimates will need to consider the relevant volumes and the average estimated benefit per unit, discounted over the relevant planning horizon.</p> <p>It has been estimated that expanding renewable generation will reduce wholesale prices at the rate of around \$0.09/MWh, per one MWh of additional wind generation. For solar – almost all of which has so far been on household roofs –the wholesale price reduction is a rate of around \$0.26/MWh, per one MWh of additional solar production.<sup>2</sup></p>
Involves collaboration	<p>We intend to work with both ARENA and ENA to identify collaboration partners for these trials – in particular, other DNSPs and Universities working on similar issues. Specifically, we have identified interest in similar projects from Endeavour Energy in NSW and United Energy in Victoria.</p>

<sup>2</sup> Ibid.



Project 2	Supporting network voltages with new technologies
Criteria	Description
	<p>Collaboration with other networks can fast-track project development and reduce costs however as already noted, it is necessary to tailor solutions that can be implemented to address specific issues on our LV networks. We have designed our project such that it does not overlap the projects of other networks. For example, United Energy is primarily interested in urban three-phase overhead networks, whereas our applications are more targeted towards SWER networks and underground housing estates. Endeavour Energy and Ausgrid have identified LV STATCOMs as an area of interest, whereas we have identified HV STATCOMs as having a greater chance of success for our network. We have spoken to both Endeavour and Ausgrid about sharing results from our trials.</p> <p>A research partner will be identified for this project. There is widespread interest amongst research organisation in the challenge of DER integration and we expect to have strong interest in this project. An existing arrangement that is planned to be leveraged is our partnership with Monash University through the Grid Innovation Hub (GIH). The GIH has a research stream on Regional and Local Energy Systems that would suit this project. We have engaged with Monash University and they intend to provide us a letter of support for this project.</p> <p>To help the industry progress in this general area we will ensure widespread publication of the results of our trials.</p>
Solves a specific issue	As discussed above, this initiative aims to find an acceptable customer solution to keeping electricity supply within regulated power quality limits and keeping network assets within their thermal ratings due to increased uptake of DER (which we do not want to curtail).
Customers are willing to pay	<p>Customer research conducted with a variety of customers and their advocates and conducted in a variety of ways has consistently found that customers support modest innovation to prepare for, and assist, energy system transformation – as long as tangible benefits for customers are delivered, there is no duplication of existing projects and the learnings are shared.</p> <p>The Customer Forum has previously accepted the case for an innovation allowance and it has concluded that an innovation budget of \$7.5 million based on a modest contribution of approximately \$2 per annum per customer for the regulatory period is reasonable.</p>

Project 2	Supporting network voltages with new technologies
Criteria	Description
	<p>Our customers expect to be able to export excess solar onto the network and the majority would be very unhappy if this were restricted. There was support for sensible investment to allow solar exports so this valuable energy is not wasted and can reduce cost pressures for all customers. However, a clear understanding of the consequences for the amount of constraints was sought, with and without investment. There was support for sharing of the costs of allowing solar exports, including with government.</p> <p>Specifically, through customer engagement we found that there is strong concern about the possibility that customers' solar exports may need to be limited. For example, research found that 80% of customers would be dissatisfied if restrictions to export DER were in place.</p>
Options and proposed expenditure	<p>The conventional alternatives to the options proposed are to curtail or refuse customers' use of DER or overbuild networks to accommodate it – neither of which customers should tolerate. However, there are no established network solutions to power quality management on LV networks as it has not been necessary before.</p> <p>None of the options we have proposed have been demonstrated at scale, although all of them draw on proven approaches in HV transmission networks. Our approach is intended to test the technical effectiveness of each option, its relative cost and the consumer impact.</p> <p>All three of our options would involve 2-year trials, starting with the STATCOM trial in year one, followed by the voltage-regulating distribution transformer trial in the next year. Importantly, we are proposing to run the storage/inverter trial as an “opex” model (buying storage as a service).</p> <p>Of the \$0.8m (\$2021) total cost for the pilot:</p> <ul style="list-style-type: none"> <li>• The STATCOM trial is approximately \$0.3m (for equipment, engineering, field work and project management);</li> <li>• The voltage-regulating distribution transformer pilot is \$0.3m (for equipment, engineering, field work and project management); and</li> <li>• The battery storage/inverter trial will be procured as an opex service to test this business model, at a cost of \$0.2m.</li> </ul>
Not replicating existing projects	<p>We have not identified any commercially available economic alternatives. This project seeks to progress the body of knowledge within the Australian industry around cost-effectively managing voltage and capacity on the LV network through application of non-network devices installed upstream of the customer point of supply. This project</p>

Project 2	Supporting network voltages with new technologies
Criteria	Description
	<p>takes as inputs the existing and previous industry trials around use of STATCOMS (Essential Energy, Ergon Energy), SWER-scale battery systems (Ergon Energy GUSS), tap-changing distribution transformers (United Energy) and our own pilot work on distribution scale batteries (Mooroolbark Mini Grid).</p> <p>Our project does not replicate these trials as it testing new applications that we believe show promise for economic deployment on our network. For example, our tap changing distribution transformer is intended not a three-phase network but for a SWER network where no product solutions currently exist, our STATCOM trial will employ an HV STATCOM rather than an LV STATCOM, and our battery/inverter device is aimed at our problem areas of underground housing estates and SWER networks rather than urban overhead network. As such, this project focusses on continuing the innovation pathway towards increased performance, optimisation with network operating systems, and reduced costs to test whether economic deployment can be achieved.</p>

Project 3	
Supporting the network through partnering with DER customers	
Criteria	Description
Initiative description	<p>This pilot is focused on keeping voltage within regulatory limits on LV networks where widespread DER would otherwise overload the existing network. It investigates different approaches to using the capabilities of DER on the customer side of the meter, unlike Project 2 that looks at network side solutions. This is consistent with our DER roadmap goal of a network that integrates and is enriched by DERs.</p> <p>Our proposed pilot will test different commercial and technical approaches to achieving improved network management to understand the cost, performance and reliability of each option and how they might be deployed at scale:</p> <ul style="list-style-type: none"> <li>• <i>Initiative 1:</i> Flexible solar PV exports. In order to manage the voltage and loading impacts of high solar uptake, one approach that is gaining interest within the energy industry is flexible export management, where the network can dynamically set the limits of customer exports to ensure that network ratings are not breached. This may allow more DER to connect and export in aggregate, whilst minimising network augmentation</li> <li>• <i>Initiative 2:</i> Enablement of voltage support. This builds on our learnings from the Networks Renewed project with the University of Technology Sydney, this project seeks to develop a commercial offering to customers to incentivise the voltage support capabilities of their DER inverters.</li> <li>• <i>Initiative 3:</i> Using prices to allow customers to determine their electricity usage and export decisions. This trial would use variable/dynamic network pricing on a sample of customers with DER that have an autonomous price response capability and network support ability. It is currently proposed that this trial would include a peer-to-peer or virtual net metering pricing approach that can help provide the right price signals to customers to match loads with times of generation.</li> </ul>
Improved service to customers	<p>This initiative seeks to ensure customers will be able to continue to use their DER and appliances without:</p> <ul style="list-style-type: none"> <li>• constraining the size of installed systems;</li> <li>• minimising the operational limits on export; and</li> <li>• imposing power quality issues.</li> </ul> <p>These customers will reduce their energy costs and gain additional revenue through lesser export constraints. All customers would also be able to benefit from lower electricity costs.</p>

Project 3	Supporting the network through partnering with DER customers
Criteria	Description
	<p>We also recognise that ‘control’ is a key issue for our customers. Specifically, through customer engagement we found that there was also a strong preference for voluntary rather than automated demand response programs, again emphasising the desire of our customers to retain control. This project is focused on giving customers options where they can choose how much control they or the network has.</p>
Driven by customer needs and expectations	<p>This initiative will allow DER resources to continue to be used by customers and provides a way of managing network voltage to avoid reliability issues and avoids the need to install costly network-side equipment. It also strongly supports choice and participation outcomes that the Customer Forum has identified as desirable.</p> <p>In addition, under this pilot DER owners would benefit as they would either be allowed to install larger systems, be paid to allow control of their resources or enjoy lower prices when responding to price signals. Such payments will contribute to addressing customer energy affordability concerns. This program also involves different devices that improve the overall customer experience and will provide them with efficient, simple and easy-to-understand energy data.</p> <p>This project will also allow development of our customer offer and messaging around the concept of remote management of DER. There is a risk that this can be perceived negatively by DER customers so it will be important to highlight the customer benefits such as increasing their ability to install DER and potentially be financially rewarded.</p>
Involves collaboration	<p>By its very nature, this project will involve collaborating closely with our residential customers. Developing the customer engagement approach and value proposition will be key to enabling this close collaboration.</p> <p>In terms of industry collaboration partners, each of the three initiatives is at a different stage of feasibility, including assessment of partners:</p> <ul style="list-style-type: none"> <li>• <i>Initiative 1:</i> We have already partnering with SA Power Networks and several leading DER equipment providers on an ARENA proposal to develop and test Flexible PV Exports. This is a continuation of prior work by SAPN on their VPP projects and the joint industry work on developing an internet-based DER communications protocol.</li> <li>• <i>Initiative 2:</i> This project builds on our prior work with University of Technology Sydney and Essential Energy in proving the concept of voltage support from customer DER. We have maintained a dialogue with these partners and will assess whether there is mutual interest in working together on this next stage.</li> </ul>

Project 3	
Supporting the network through partnering with DER customers	
Criteria	Description
	<ul style="list-style-type: none"> <li><i>Initiative 3:</i> There are various parties interested in testing different pricing structures as a means of managing DER. The most promising prospect for collaboration at present is with a renewable energy company that is installing a local DER precinct on a farm property in Gippsland. This project suits the application of virtual net metering as a means of economic incentive for the matching of loads and generation. Funding will also be sought from State and Commonwealth Government.</li> </ul>
Solves a specific issue	This initiative directly focused on emerging voltage and capacity problems caused by expanding and concentrated DER on LV networks.
Customers are willing to pay	<p>Customer research conducted with a variety of customers and their advocates and conducted in a variety of ways has consistently found that customers support modest innovation to prepare for, and assist, energy system transformation – as long as tangible benefits for customers are delivered, there is no duplication of existing projects and the learnings are shared.</p> <p>The Customer Forum has previously accepted the case for an innovation allowance and it has concluded that an innovation budget of \$7.5 million based on a modest contribution of approximately \$2 per annum per customer for the regulatory period is reasonable.</p> <p>Our customers expect to be able to export excess solar onto the network and the majority would be very unhappy if this were restricted. There was support for sensible investment to allow solar exports so this valuable energy is not wasted and can reduce cost pressures for all customers. However, a clear understanding of the consequences for the amount of constraints was sought, with and without investment. There was support for sharing of the costs of allowing solar exports, including with government.</p> <p>Specifically, through customer engagement we found that there is strong concern about the possibility that customers' solar exports may need to be limited. For example, research found that 80% of customers would be dissatisfied if restrictions to export DER were in place.</p>
Options and proposed expenditure	The conventional alternatives to this initiative are to employ fixed export limits, curtail customers' use of DER, or overbuild networks to accommodate it – none of which provide good outcomes to customers.

Project 3	Supporting the network through partnering with DER customers
Criteria	Description
	<p>The options that we are considering have not been implemented in as part of a commercial trial on distribution networks and relying on prices to influence rather than control customer behaviour, is a new initiative.</p> <p>Our proposal involves running all three trials in a staged approach over a 5 year period to collect time series data on the performance and reliability of each approach so that their costs and benefits can be compared across years.</p> <p>The \$1.1m (\$2021) total cost for the pilot will cover a: flexible export trial (approx. \$0.4m); voltage support trial (approx. \$0.4m); and a pricing-based trial (approx \$0.3m).</p>
Not replicating existing projects	<p>This project is unique in aiming to define the optimum mix of customer-facing DER control pathway options specifically for network management, and the conditions within which each control options is applicable. No clear direction for optimum DER control yet exists in industry and no standardised guidance is available. Hence, this project will assist all Australian networks in moving to a high DER future. In particular, there is much focus within the industry on flexible export management, and our partnership with SAPN will help the whole industry move forwards towards a standardised and more technically defined approach.</p> <p>The project builds on a growing body of experience with retail-lead VPPs (AGL South Australian VPP, Simply Energy VPPX), network-lead VPPs (SAPN VPP grid integration), bespoke control solutions (Mooroolbark Mini Grid), proprietary optimised solution (Bruny Island Network Aware Coordination, Networks Renewed) and automated demand response (AusNet Services' GoodGrid, Jemena's Powerchangers, AGL's NSW Demand Response Trial). It completes the option suite through testing new and emerging approaches that exhibit a strong pathway to low-cost application including automated DER response to dynamic price signals (building on the theory of the Oakley Greenwood project "Pricing and integration of DER"), utilisation of DRM modes within customer inverters and utilisation of native cloud-connected functionality within inverters. This project will benefit from experimentation in practice with a focus on customer experience as well as technical performance and cost.</p>

Project 4	
Maximising the benefits of solar for commercial customers	
Criteria	Description
Initiative description	<p>This initiative seeks to test, via a pilot, how the adoption of an energy management system by commercial customers can both maximise the value of solar for the customer while at the same time reducing the impact of solar exports onto our network and reducing the customer's contribution to peak demand (thus potentially deferring network investment). The project will also test ways we could reward customers who implement such solutions and provide net benefit to the network.</p> <p>The energy management system would be programmed to shift flexible loads to times of day that best align to solar production. This benefits the customer financially through increasing their self-consumption of solar, which in turn reduces the stress on the network.</p> <p>The nature of the commercial customer loads tends to mean a better alignment with solar peaks than for residential customers. By itself, this means that there may be mutual benefit in encouraging commercial customers to install solar in parts of the network where the demand peak is earlier in the day. This alignment can be improved even further if the customer's loads are actively managed to shift away from peak network times and better match solar production times. A technology solution for active load management, combined with building customer awareness and knowledge would serve to strengthen the benefits to both customers and the network. This project will seek to deploy such a solution and assess the benefits.</p>
Improved service to customers	<p>This initiative has the potential to reduce customer bills and provide more options for how owners of PV can be involved with the energy market. It also has the added benefit of promoting efficient investment in solar capacity.</p> <p>All customers benefit from the lower network costs from avoided augmentation.</p>
Driven by customer needs and expectations	<p>This initiative aims to address concerns with affordability and allow DER resources to continue to be used by customers. Specifically, this initiative aims to:</p> <ul style="list-style-type: none"> <li>• help identify new means to defer or avoid augmentation expenditure which will allow our services to be delivered at far lower cost than using traditional network techniques, thus reducing customer bills; and</li> <li>• reward (providing a revenue source to) customers who provide this support, which may make further solar investment in constrained parts of the network economic, therefore helping increase solar uptake and reduce carbon emissions.</li> </ul>



Project 4	
Maximising the benefits of solar for commercial customers	
Criteria	Description
	<p>Like the Dynamic customer DER control initiative, maximising solar for customers provides them with easy-to-understand energy information as well as control solutions that they can use to inform their decision making and behaviour. Our experience in engaging with commercial customers is that there is a knowledge gap around the types of energy management solutions that can provide them benefit in reduced energy costs. Part of the value of this project is helping customers overcome this knowledge gap and identify where investment in energy management systems can provide attractive returns.</p> <p>A quantification of the potential benefit from a successful trial would assess the avoided cost of network augmentation and other expenditure as a result of this initiative as well as the reduction in customer bills.</p>
Involves collaboration	<p>By its very nature, this project will involve collaborating closely with our commercial customers. Developing the customer engagement approach and value proposition will be key to enabling this.</p> <p>In terms of industry collaboration partners, The University of Technology Sydney, Monash University and the Australian Alliance for Energy Productivity have a planned research program that would inform this investigation. In particular, we have discussed with these parties their project concept called REALM (Renewable Energy and Load Management). The REALM concept is well suited to this project as it centres on the benefits of matching on-site solar production and loads. We have engaged with UTS and they intend to provide us a letter of support for this project.</p> <p>We will continue to engage with UTS, Monash and the AEP around refining the opportunity to collaborate and seeking external funding opportunities. A collaborative approach to this project would also maximise the value of the research findings.</p>
Solves a specific issue	<p>This initiative is focused on understanding the contribution solar could make to avoid investment associated with peak demand, and the commercial approaches that would best facilitate this outcome.</p>
Customers are willing to pay	<p>Customer research conducted with a variety of customers and their advocates and conducted in a variety of ways has consistently found that customers support modest innovation to prepare for, and assist, energy system transformation – as long as tangible benefits for customers are delivered, there is no duplication of existing projects and the learnings are shared.</p>

Project 4	Maximising the benefits of solar for commercial customers
Criteria	Description
	<p>The Customer Forum has previously accepted the case for an innovation allowance and it has concluded that an innovation budget of \$7.5 million based on a modest contribution of approximately \$2 per annum per customer for the regulatory period is reasonable.</p> <p>Our customers expect to be able to export excess solar onto the network and the majority would be very unhappy if this were restricted. There was support for sensible investment to allow solar exports so this valuable energy is not wasted and can reduce cost pressures for all customers. However, a clear understanding of the consequences for the amount of constraints was sought, with and without investment. There was support for sharing of the costs of allowing solar exports, including with government.</p> <p>Specifically, through customer engagement we found that there is strong concern about the possibility that customers' solar exports may need to be limited. For example, research found that 80% of customers would be dissatisfied if restrictions to export DER were in place.</p> <p>Customer research has also shown that more than 70% of business customers are actively trying to reduce the amount of electricity that they use and business customers with solar panels indicated that they did so largely to save money and reduce their electricity bills. This demonstrates there is an unmet need for advice on maximising savings from investments in renewable energy.</p>
Options and proposed expenditure	<p>Peaks that exceed the capacity of a network have traditionally been managed by augmentation capex, which is expensive and could be inefficient if there are commercial mechanisms that would allow us to either defer or avoid the upgrade. As a prudent and efficient operator, we need to test whether any of these options are feasible in practice. The conventional alternatives to the curtailment of peak demand are response to price and active demand management. Both techniques are well understood, and we are participating in work under the Demand Management Innovation Allowance.</p> <p>Some jurisdictions have investigated the use of controllable generation and storage either under the direct control of Distribution System Operators (DSOs) or responding to price incentives as "flexibility mechanisms". We are proposing similar investigations in our DSO pilot. This initiative differs because solar is intrinsically uncontrollable but does have characteristics that could support network investment deferral.</p> <p>One option is to address demand peaks through traditional augmentation and demand management means, however this misses out on the opportunities afforded by low-cost solar power in offsetting commercial customer loads. Purely customer led installation of solar power will not target areas of peak demand. Our experience is that</p>

Project 4	Maximising the benefits of solar for commercial customers
Criteria	Description
	<p>commercial customers need much more encouragement to install solar power than residential customers and that they are not typically matching solar power with on-site load management to derive best value.</p> <p>Our preferred option to address is to:</p> <ul style="list-style-type: none"> <li>• undertake a desktop study using real solar and network data to identify the level of contribution and benefit from solar in network areas dominated by commercial users;</li> <li>• based on those results, develop a customer offering to encourage commercial customers in these network areas to install solar power and deploy a load management approach or system to move loads away from peak times and into solar generation times; and</li> <li>• approach customers to take part in the trial and evaluate benefits to both the customer and the network.</li> </ul> <p>The \$0.3m (\$2021) total proposed cost for the pilot will cover the costs of an analytical study, customer engagement strategy development, and engineering coordination and support. Each of these elements will account for around a third of the project costs.</p>
Not replicating existing projects	<p>The alignment of solar production with commercial customer load profiles is likely to be significantly better than for residential load profiles where alignment is poor. This project seeks to investigate and quantify network net benefits for solar on commercial customers and to propose customer offers for testing that reflect this value. We are not aware of any existing research projects in this specific area and consider it to be unique. There is good opportunity to partner with a research body on this project.</p>

Project 5	
Day-ahead network management (or Predictive network management)	
Criteria	Description
Initiative description	<p>This initiative involves the development and trialling of software that aims to forecast network issues on a day ahead basis. It looks to predict what the “state” of the HV/LV network will be in conjunction with any distributed energy market activities. This capability will allow us to anticipate network constraints, which will facilitate optimal DER management through mechanisms such as those proposed in Project 2, including setting flexible solar export limits. That is, if we know the likely network conditions and DER activities ahead of time, we will be better able to send system constraint signals to customer DER that set the safe boundaries of how and when to operate, encouraging greater customer participation in energy markets and more efficient utilisation of existing network infrastructure.</p> <p>This capability has not been an issue previously as electricity distribution has always been reasonably predictable and stable. However, the widespread uptake and use of DER introduces concentrated and rapidly-changing sources of both supply and demand at the “edge” of the network (on LV circuits).</p>
Improved service to customers	<p>Rather than managing network risks by applying a conservative limit to the way in which DER is used, this initiative looks to ensure customers can continue to use DER without concerns/interactions. This would maximise customers’ personal bill reduction along with increasing their revenue from feed in tariffs. It would also reduce electricity costs for all customers by replacing higher cost electricity sources with solar exports.</p> <p>It has been estimated that expanding renewable generation will reduce wholesale prices at the rate of around \$0.09/MWh, per one MWh of additional wind generation. For solar – almost all of which has so far been on household roofs –the wholesale price reduction is a rate of around \$0.26/MWh, per one MWh of additional solar production.<sup>3</sup></p> <p>Importantly, this project will enable greater equity amongst DER customers. In the current situation with no active signalling of network limitations and no day-ahead view, customers are impacted unevenly with some being curtailed well before others. This project will allow us to proactively issue network limitation signals that equitably share any required curtailment between customers.</p>

<sup>3</sup> Ibid.

Project 5	
Day-ahead network management (or Predictive network management)	
Criteria	Description
Driven by customer needs and expectations	<p>This initiative looks to maximise the scope for customers to use DER (and avoid greater curtailment to import and export than would otherwise be necessary). We would be able to send system signals to customer DER around how and when to operate, encouraging and maximising customer participation in energy markets.</p> <p>As noted in relation to other pilots, the potential benefit from a successful trial and subsequent implementation of a solution would be the avoided loss of value to customers as a result of the improved management of DER (reduced energy costs and increased revenue along with lower overall bills).</p> <p>We also know that customers value equity, and this project helps ensure that network limitations are shared equally amongst DER customers.</p>
Involves collaboration	<p>In addition to standard collaboration mechanisms, this initiative will build on domain knowledge from the University of Queensland. We will engage with UQ specifically around their research area of state estimation to assess whether there is scope to collaborate. Existing UQ work in this area has focussed on networks where no smart meter data is available, and the state estimation is used to generate pseudo metering points. Our application would be different in terms of leveraging our highly granular smart metering data to predict network limitations at a fine level of detail.</p>
Solves a specific issue	<p>Directly focused on finding a flexible and low-cost solution to forecasting network state to minimise conservative constraints on DER use.</p>
Customers are willing to pay	<p>Customer research conducted with a variety of customers and their advocates and conducted in a variety of ways has consistently found that customers support modest innovation to prepare for, and assist, energy system transformation – as long as tangible benefits for customers are delivered, there is no duplication of existing projects and the learnings are shared.</p> <p>The Customer Forum has previously accepted the case for an innovation allowance and it has concluded that an innovation budget of \$7.5 million based on a modest contribution of approximately \$2 per annum per customer for the regulatory period is reasonable.</p>

Project 5	Day-ahead network management (or Predictive network management)
Criteria	Description
	<p>Our customers expect to be able to export excess solar onto the network and the majority would be very unhappy if this were restricted. There was support for sensible investment to allow solar exports so this valuable energy is not wasted and can reduce cost pressures for all customers. However, a clear understanding of the consequences for the amount of constraints was sought, with and without investment. There was support for sharing of the costs of allowing solar exports, including with government.</p> <p>Specifically, through customer engagement we found that there is strong concern about the possibility that customers' solar exports may need to be limited. For example, research found that 80% of customers would be dissatisfied if restrictions to export DER were in place.</p>
Options and proposed expenditure	<p>This is not an activity that has been undertaken for distribution networks. If our 'state estimation' capability is not improved, we will need to manage network risks by applying a conservative limit to the way in which DER is used. As a result, relatively greater curtailment of imports and exports from DER could result.</p> <p>To address this issue we are proposing to build a big-data analytics model that includes:</p> <ul style="list-style-type: none"> <li>• Locational network analysis of historical Supervisory Control and Data Acquisition (SCADA), Advanced Metering Infrastructure (AMI) data, available customer DER data, weather and other environmental/demographic data, market data etc.;</li> <li>• Day-ahead (or short-term weather event related) forecast of the predicted state of the selected network segments;</li> <li>• Feedback of "state estimation" into the control room; and</li> <li>• Testing and demonstration of control actions that can be taken to optimise the network for DER participation.</li> </ul> <p>We expect this trial will need to run for 5 years of the regulatory period as follows:</p> <ul style="list-style-type: none"> <li>• Year 1 – initial data collection and curation;</li> <li>• Year 2 – analysis and algorithm development;</li> <li>• Year 3 – proof of concept implementation; and</li> <li>• Year 4 and 5 – full pilot.</li> </ul>

Project 5	Day-ahead network management (or Predictive network management)
Criteria	Description
	<p>As there are no precedents for developing state estimators for electricity distribution businesses, we have estimated the pilot costings based on our existing forecasting activities and other large database analytics: a total of \$0.7m (\$2021) to cover: data acquisition and curation (mainly curation) and data engineering for new data sets and integration (approx. \$0.2m); development of “state estimation” forecast methodologies, algorithms and visualisation (approx. \$0.3m); and establishment of operational response mechanisms, testing of scenarios and analysis of outcomes, project management and liaison and reporting (approx. \$0.2m)</p> <p>As noted in relation to other pilots, the potential benefit from a successful trial and subsequent implementation of a solution would be the avoided loss of value to customers as a result of the improved management of DER. In this instance, these benefits will arise from the development of state estimation capability.</p>
Not replicating existing projects	<p>The concept of state estimation of the electricity distribution network is at an early stage of development and not yet applied as business as usual within networks. This project will be unique in taking the theory of state estimation (University of Queensland “Increasing visibility of distribution networks”), applying granular smart meter data to seed the analysis, and testing it in the real world of distribution network operations and constraint management, driven by emerging capabilities in short-term forecasting (such as Solcast and Proa Analytics) and the maturation of machine learning and big data techniques. Under a high DER future there will be increasing value in being able to pre-configure the network in response to near-term estimates of the state of network, and this project will test the real-world value of network controllers being able to respond.</p>

Project 6 DER management platform experimentation	
Criteria	Description
Initiative description	<p>AusNet Services' current Distributed Energy Network Optimisation Platform (DENOP) is a prototype cloud-based software platform that can integrate the operation of customer DER with the operation of the network. This integration is achieved by DENOP sharing data and signals with the customer's nominated DER management platform, aggregation platform or DER exchange in an interoperable fashion. The DENOP was developed to support the early mini-grid pilots that we are currently implementing at Mooroolbark and elsewhere. Under this project, the DENOP will be further developed beyond its current "proof of concept" status using real-world examples (or 'use cases') that allow us to test how different DER activities can be integrated to maximise the benefits to customers. These use cases will provide the inputs necessary to define the strategy for DENOP and DER Management Systems more broadly.</p> <p>This initiative will be progressed as part of an industry-leading DER case study trial. We have partnered with the AEMO, Mondo and the University of Melbourne for an ARENA proposal called the DER Marketplace. This is a high-visibility project that is looking to test the future concept of the Distribution System Operator in the real world on a small population. This project for DER management platform experimentation will form part of the scope of the DER Marketplace project. The DENOP will be significantly enhanced to enable the active control of DER by AEMO, whilst maintaining DER operation within the limits of the distribution network. By exploring this concept, we seek to develop the market requirements, technical requirements and DER management algorithms that can unlock the full value of the network in utilising the capabilities of DER to benefit both DER and non-DER customers whilst maintaining power quality.</p>
Improved service to customers	<p>This initiative is focused on developing our capability to integrate the wide range of DER activities, to deliver an optimal outcome for our customers. The project will test the functional requirements of a DER management system under a high DER scenario to unlock the full value of the network in utilising the capabilities of DER to benefit both DER and non-DER customers whilst maintaining power quality.</p> <p>Longer term, this will enhance the DENOP solution that is being implemented through the proposed DER augmentation program increasing the benefits still further.</p>



Project 6 DER management platform experimentation	
Criteria	Description
Driven by customer needs and expectations	<p>This initiative aims to allow the network to be operated most efficiently in a high DER environment, minimising costs to customers and enabling customers to optimise the value from DER. It is about unlocking value. Both our customers and the community more generally (government, regulators etc) expect that we develop this capability (for example as outlined in the AEMCs recently released recommendations for action in their paper <i>Integrating distributed energy resources for the grid of the future</i>.</p> <p>It has been estimated that expanding renewable generation will reduce wholesale prices at the rate of around \$0.09/MWh, per one MWh of additional wind generation. For solar – almost all of which has so far been on household roofs –the wholesale price reduction is a rate of around \$0.26/MWh, per one MWh of additional solar production.<sup>4</sup></p>
Involves collaboration	<p>As part of the DER Marketplace ARENA proposal, this project will be highly collaborative. The project itself is a partnership with AEMO, Mondo, the University of Melbourne and a cross section of customers in our North-East network region. The knowledge sharing framework that is being proposed for the DER Marketplace project includes not only broad knowledge sharing across industry but includes a targeted DNSP forum to which all DNSPs in Australia are invited to participate. AusNet Services has secured letters of support from all Australian DNSPs for this project.</p>
Solves a specific issue	<p>This initiative seeks to identify a solution for integrating the wide range of DER capabilities that AEMO and our business expect will play an increasing role in the broader power system and the National Electricity Market. In particular this project aims to solve the issue around how we manage this increasing DER activity within the physical boundaries of the distribution network to deliver an optimal outcome for our customers.</p>
Customers are willing to pay	<p>Customer research conducted with a variety of customers and their advocates and conducted in a variety of ways has consistently found that customers support modest innovation to prepare for, and assist, energy system transformation – as long as tangible benefits for customers are delivered, there is no duplication of existing projects and the learnings are shared.</p>

<sup>4</sup> Ibid.

Project 6	DER management platform experimentation
Criteria	Description
	<p>The Customer Forum has previously accepted the case for an innovation allowance and it has concluded that an innovation budget of \$7.5 million based on a modest contribution of approximately \$2 per annum per customer for the regulatory period is reasonable.</p> <p>Our customers expect to be able to export excess solar onto the network and the majority would be very unhappy if this were restricted. There was support for sensible investment to allow solar exports so this valuable energy is not wasted and can reduce cost pressures for all customers. However, a clear understanding of the consequences for the amount of constraints was sought, with and without investment. There was support for sharing of the costs of allowing solar exports, including with government.</p> <p>Specifically, through customer engagement we found that there is strong concern about the possibility that customers' solar exports may need to be limited. For example, research found that 80% of customers would be dissatisfied if restrictions to export DER were in place.</p>
Options and proposed expenditure	<p>There is no “off the shelf” technology available for this work at present.</p> <p>There are two options associated with this proposal – do nothing or proceed with the initiative. Doing nothing would effectively stall our work trialling DENOP in the current period, frustrate customers who want to optimise the value from DER and would not allow the progression of the proposed ARENA project, the DER Marketplace.</p> <p>Our preferred option involves a 3-year work program that targets DENOP development around the DER Marketplace project. We anticipate five major use-cases, each supported by different DENOP integrations over this period, focussing on:</p> <ul style="list-style-type: none"> <li>• Integration to energy markets and enablement of wholesale market access;</li> <li>• Residential demand management programs;</li> <li>• Dynamically managing the network impacts of clustered solar;</li> <li>• Optimising within network boundaries the behaviour of aggregators (including Virtual Power Plants) based on battery storage; and</li> <li>• Integration to customers' DER data and control platforms that are increasingly being offered as an out-of-the-box function by the major manufacturers of solar and battery systems.</li> </ul>

Project 6 DER management platform experimentation	
Criteria	Description
	<p>The DENOP development and integration effort under the DER Marketplace project comprises a period of software integration (through development of Application Programming Interfaces), algorithmic development, lab or acceptance testing, deployment, and operational testing.</p> <p>Our estimated trial cost of \$0.8m (\$2021) will cover software development, labour, testing, and reporting and project management. This project scope does not include budget for any demand side DER or appliance equipment costs as these will be captured by Project 7 which is also delivered under the ARENA DER Marketplace.</p>
Not replicating existing projects	<p>The DENOP is an industry-leading proof-of-concept software platform developed within AusNet Services that enables real-time data flows and controls between the network and customer DER. AusNet Services is recognised amongst network businesses as a leader in this area. The platform will continue to underpin many of our innovation projects involving the management of DER and will be uplifted through progressive development of industry-first capabilities and functions. Outcomes of projects involving DENOP have been well shared amongst industry (e.g. Mooroolbark Mini Grid, UTS Networks Renewed) and future projects will continue to be communicated broadly to ensure that learnings are maximised. Our experience with DENOP will help guide our path towards business as usual implementation of a DER Management System capability. However the rate of change in the DER landscape (both technical, business models and regulatory frameworks) requires a capability for continued agile development and testing where DENOP is perfectly placed to enable.</p>

Project 7	Testing the decentralised power system of the future
Criteria	Description
Initiative description	<p>The Australian Energy Market Operator (AEMO) and ENA's Open Energy Networks working group is tackling the challenge faced by the industry in managing affordable and reliable supply as we transition to a more decentralised and dynamic state. The rationale for the work is that if distributed resources are not managed well, it will result in increased network and system operation costs that will be borne by all electricity system customers.</p> <p>This initiative is a key part of our response to the implementation program that AEMO and ENA have developed in relation to the establishment of a Distribution System Operator (DSO) model for current distribution network businesses. The DSO model envisages a world where customers can opt in to having their DER actively dispatched by a Distribution Market Operator (DMO), in much the same way that large generators are currently dispatched.</p> <p>The inherent complexity and physical boundaries of the distribution network means that DER also needs to be actively coordinated within the distribution network to ensure that customer benefits are realised. The DSO role undertakes this network coordination in concert with the DMO. This would be a significant expansion of our role, which has the potential to deliver significant customer value. The Open Energy Networks process has identified 4 framework options for how this DMO and DSO structure could be put in place. The "Hybrid model" is currently seen as the preferred model, and it is intended to focus on this framework under Project 7.</p> <p>Given that much of the work so far on the DSO has been theoretical, the industry has identified a need to test the model in practice and conduct experimentation that can refine and direct the design of the Open Energy Networks frameworks and provide data for definition of functional requirements of the DMO-DSO construct. To progress this, AusNet Services has partnered with AEMO, Mondo and Melbourne University on a proposed ARENA project called the DER Marketplace. This is a high visibility project within the industry and will generate valuable learnings for the design of the future energy market and the way that customers can interact with it.</p> <p>The project does not seek to define a specific technical or proprietary solution for integrating DER with the energy market, but rather focuses on the framework that underpins the solution. The commercial landscape of technology solutions for managing and integrating DER is fast evolving and this project would provide the commercial market with knowledge regarding the costs and benefits of a DSO framework that can inform their commercial product development.</p>

Project 7	
Testing the decentralised power system of the future	
Criteria	Description
Improved service to customers	Currently, distributors control and maintain the distribution network. Under the DSO model, the operator will take a more active role in managing local electricity generation and use. Specifically, the DSOs will securely operate and develop an active distribution system comprising networks, demand, generation and other flexible distributed energy resources. DSOs will enable customers to have competitive access to markets and the optimal use of DER on distribution networks. In addition, DSOs will enable customers to be both producers and consumers, by providing customer access, customer choice and improved customer service. Ultimately the DSO model is seen to provide a better value and more efficient network service.
Driven by customer needs and expectations	<p>This initiative aims to allow the network to be operated most efficiently in a high DER environment, minimising costs to customers and enabling customers to optimise the value from DER. It is about unlocking value. Our customers expect that we develop this capability.</p> <p>It has been estimated that expanding renewable generation will reduce wholesale prices at the rate of around \$0.09/MWh, per one MWh of additional wind generation. For solar – almost all of which has so far been on household roofs –the wholesale price reduction is a rate of around \$0.26/MWh, per one MWh of additional solar production.<sup>5</sup></p>
Involves collaboration	As part of the DER marketplace ARENA proposal, this project will be highly collaborative. The project itself is a partnership with AEMO, Mondo, the University of Melbourne and a cross section of customers in our North-East network region. The knowledge sharing framework that is being proposed includes not only broad knowledge sharing across industry but includes a targeted DNSP forum to which all DNSPs in Australia are invited to participate. AusNet Services has secured letters of support from all Australian DNSPs for this project.
Solves a specific issue	This initiative directly addresses the issue of there being only limited practical experience and data regarding the technical, economic and customer experience of a DSO model that can feed into the design of the future energy system. The learnings will be foundational in shaping the ongoing design of the energy system under the Open Energy Networks process.

<sup>5</sup> Ibid.

Project 7	Testing the decentralised power system of the future
Criteria	Description
Customers are willing to pay	<p>Customer research conducted with a variety of customers and their advocates and conducted in a variety of ways has consistently found that customers support modest innovation to prepare for, and assist, energy system transformation – as long as tangible benefits for customers are delivered, there is no duplication of existing projects and the learnings are shared.</p> <p>The Customer Forum has previously accepted the case for an innovation allowance and it has concluded that an innovation budget of \$7.5 million based on a modest contribution of approximately \$2 per annum per customer for the regulatory period is reasonable.</p> <p>Our customers expect to be able to export excess solar onto the network and the majority would be very unhappy if this were restricted. There was support for sensible investment to allow solar exports so this valuable energy is not wasted and can reduce cost pressures for all customers. However, a clear understanding of the consequences for the amount of constraints was sought, with and without investment. There was support for sharing of the costs of allowing solar exports, including with government.</p> <p>Specifically, through customer engagement we found that there is strong concern about the possibility that customers' solar exports may need to be limited. For example, research found that 80% of customers would be dissatisfied if restrictions to export DER were in place.</p> <p>We also recognise that 'control' is a key issue for our customers. Specifically, through customer engagement we found that there was also a strong preference for voluntary rather than automated demand response programs, again emphasising the desire of our customers to retain control. This project is focused on giving customers options where they can choose how much they or the network has.</p>
Options and proposed expenditure	<p>The DSO model has the potential to deliver significant benefits to customers by integrating DER activities and creating value through optimisation and choice. It is a new operating model that needs to be developed and tested. As such, it does not have an alternative – apart from 'do nothing', which would be an imprudent course of action given the widely expressed view 'that industry wide collaboration is essential to deliver the most efficient pathway to facilitate this transition.'</p>

Project 7	Testing the decentralised power system of the future
Criteria	Description
	<p>AusNet Services is well placed to undertake this project on behalf of DNSPs in that we can leverage our established leading position in innovation around DER issues, operating systems, technologies and processes that can inform the design of the future energy system. In this sense, we are uniquely positioned to contribute to advancing this body of knowledge.</p> <p>The primary purpose of the initiative is to trial the network interactions, operating scenarios and customer experience associated with the Hybrid Model of the AEMO/ENA Open Energy Networks process. The pilot will develop a real-world trial of the Hybrid DMO/DSO framework that integrates industry partners across the supply chain. It would involve:</p> <ul style="list-style-type: none"> <li>• defining the preferred model based on our understanding that we are able to use existing capabilities to support new DSO functions, rather than developing them from new;</li> <li>• mapping the processes and information flows required between stakeholders;</li> <li>• inviting proposals for technology components;</li> <li>• recruiting participants;</li> <li>• implementing the trial; and</li> <li>• analysing results.</li> </ul> <p>At this stage the project would be delivered from early 2020 until mid 2022. The project has grown in scope as a result of ongoing analysis of the complexity of the DSO models developed under the Open Energy Networks process. The ARENA project has been scoped to include further development and testing of our internal proof-of-concept DENOP platform, sufficient to deploy in the initial stages of the project and gather learnings to then move to partnering with a commercial DER Management System provider to deploy in the project in the final stage. The ARENA DER Marketplace project therefore covers the scope of our original Project 6 (DER management platform experimentation), and this Project 7 (Testing the decentralised power system of the future).</p> <p>Factoring in the anticipated level of ARENA funding contribution, our net expenditure across the period from July 2021 to the project end is expected to be \$1.5m for this Project 7, plus the \$0.8m for our Project 6.</p>

Project 7	
Testing the decentralised power system of the future	
Criteria	Description
	Our participation in AEMO and ENA's national initiatives is covered by our expenditure forecasts in our Regulatory Proposal and is not part of this innovation initiative.
Not replicating existing projects	<p>This is a foundational project for the Australian energy sector in seeking to test the real-world application and value of the DMO-DSO frameworks being developed under the ENA-AEMO Open Energy Network process and is the first of its kind. The project is inherently complex and draws on a significant body of experience and research across the industry. AusNet Services has secured the support of all other DNSPs and is setting up both broad knowledge sharing arrangements and specific technical linkages to other related DER management projects (ANU Evolve, UTS Networks Renewed 2) in preparation for this project.</p> <p>The project involves close collaboration, and ultimately a real-time technical integration with AEMO and will be instrumental in guiding the long-term direction of the pathway towards a DMO-DSO framework in Australia, including the definition of what role DNSPs will play. AusNet Services is uniquely placed to lead this project in having both distribution and transmission networks, having taken a leadership position around DER management and having highly regarded experts in the field of market-network interaction and design for DER.</p>



Project 8	
Seamless and tailored DER connections	
Criteria	Description
Initiative description	<p>When a customer applies to through our automated web interface to connect a solar or battery system, we currently rely on existing business rules. Because these rules have been developed as a generic standard to apply across the entire AusNet Services distribution network, there are occasions where connection requests are either unnecessarily refused or curtailed or they are approved even though the connection will cause supply quality issues and therefore reduced solar performance. Either of these cases is a poor customer outcome, and the uptake of solar means that these cases will increase significantly as the capacity of the network to host DER is used up.</p> <p>This project will develop advanced analytical methods that can calculate a site-by-site quantification of the available DER hosting capacity and provide an accurate and real-time assessment to the customer of their application. This will provide direct customer benefits in terms of either allowing additional customer DER to connect (where the business rules were too restrictive), or conversely ensuring that new connections do not create power quality issues so that both the connecting and existing DER operates as intended and provides the customers with the expected level of value from their systems. The project will also reduce costs to customers as it will enable automation of more complex cases that are currently diverted from the automated portal to a manual assessment.</p> <p>In cases where export capacity has been fully utilised, we can offer a new DER customer to connect with either zero export, or with a flexible export arrangement as is being proposed to be developed under Project 3.</p>
Improved service to customers	<p>This initiative will lead to better connection decisions through improved accuracy in our automated process as well as lower costs for customers. Better decision making will either allow additional customer DER to connect or ensure that new connections do not create power quality issues so that both the connecting and existing DER operates as intended and provides the customers with the expected level of value of their systems. Ultimately, it will benefit customers who are being curtailed at present by the business rules, allowing them to reduce energy costs and increase revenue. Reduced network risks would also improve quality of supply for all customers.</p> <p>The project will also reduce costs to customers as it will enable automation of more complex cases that are currently diverted from the automated portal to a manual assessment.</p>

Project 8	
Seamless and tailored DER connections	
Criteria	Description
Driven by customer needs and expectations	<p>Customers expect us to connect the optimal amount of solar to maximise distributed generation within economic and safety constraints. This method will be far more accurate than our current business rules.</p> <p>Customers also want to connect to DER and want us to deliver in a timely and accurate manner – this initiative looks to do this. The successful development of high-speed calculation methodology for solar connection will reduce the time and effort required from customers during the application process.</p>
Involves collaboration	<p>We have a current collaboration with University of Melbourne that will feed into the design of this project, and may extend through delivery. This collaboration is on a project lead by University of Melbourne called “<i>Advanced Planning of PV-Rich Distribution Networks</i>” with funding through ARENA. The scope of the project includes development of an innovative statistical approach to assessment of DER hosting capacity. We are also internally progressing an engineering analysis approach using smart meter data and a modelling approach utilising a detailed load flow model. We intend to compare and contrast the different methods in order to guide the preferred methodology that we develop in this project. The ARENA project requires that extensive knowledge sharing undertaken within industry and University of Melbourne is also sharing research outcomes within academia.</p>
Solves a specific issue	<p>We do not currently have a method to accurately assess DER connections at a highly localised level. This initiative is designed specifically to identify the least cost, least conservative self-service approach to granting DER connections without adversely affecting other network users.</p>
Customers are willing to pay	<p>Customer research conducted with a variety of customers and their advocates and conducted in a variety of ways has consistently found that customers support modest innovation to prepare for, and assist, energy system transformation – as long as tangible benefits for customers are delivered, there is no duplication of existing projects and the learnings are shared.</p> <p>The Customer Forum has previously accepted the case for an innovation allowance and it has concluded that an innovation budget of \$7.5 million based on a modest contribution of approximately \$2 per annum per customer for the regulatory period is reasonable.</p>

Project 8	Seamless and tailored DER connections
Criteria	Description
	<p>Customer research and feedback consistently highlights improved and transparent connection processes are greatly valued. Customer satisfaction surveys and complaints data identified key “pain points” for electricity distribution customers as our solar connection processes, new electricity connection processes and outage management processes. Across the board there is also a desire for improvements in our communications with customers: in terms of convenience, timeliness and accuracy.</p>
Options and proposed expenditure	<p>One option is to continue with the current business rules approach, however this will result in an increasing number of customers receiving an inaccurate assessment that will either overly constrain or refuse the system, or will result in power quality degradation leading to the new customer DER and existing customer DER operating at a reduced level and not providing customers with the expected level of value. This is not a solution that will be accepted by customers.</p> <p>A second option is to refine the business rules by developing a suite of business rules to apply to different network types. This can help improve the accuracy of the assessments by a moderate degree in the short term, but will ultimately suffer the same problems of inaccuracy as DER uptake grows. The cost to undertake the modelling for different network types is likely to be equivalent to the preferred option.</p> <p>The preferred option is to undertake this project and develop an advanced analytical methodology that can be applied to any part of the network to achieve an accurate assessment of DER connection applications and improve customer experience. This will enable a least cost, least conservative self-service approach to granting DER connections without adversely affecting other network users. The proposed expenditure is \$0.5m (\$2021).</p>
Not replicating existing projects	<p>This project will be the first in Australia to link the near real-time status of the network to the DER connection process via an automated web portal. Currently our web-portal for DER connections utilises standardised business rules, or diverts to an internal manual assessment. This project seeks to take the theory around calculating the hosting capacity of the network at individual customer locations based on smart meter data and refine it to the level of accuracy that can enable operational decision making. We are currently collaborating with University of Melbourne on an ARENA project regarding hosting capacity assessment techniques, with reporting being shared with industry, and the proposed linkage to a connection portal will likewise be communicated broadly.</p>

Project 9	
Using our data sets to improve customer services	
Criteria	Description
Initiative description	<p>Energy service providers, DER providers and other third parties would be better able to innovate their service offerings to customers and reduce customer costs if there were an easier method by which they could access the vast energy and network data sets held by DNSPs. Our customers tell us that they want simple, tailored and low cost energy and DER services. In the modern environment of digitalisation and smart technologies such as DER, improved customer service increased choice and lower costs is built on access to, and analysis of, big data by customer-facing service providers. This includes players across the energy supply ecosystem including incumbent retailers, start-up energy businesses, DER providers, community energy groups, environmental groups, non-network solution providers, customer advocate groups and Governments.</p> <p>As a DNSP we regularly receive requests from players in the energy supply ecosystem that are looking to innovate their service offerings for customer benefit and unlock the benefits within the growing population of DER. Currently these queries are treated individually and involve manual processing which creates a constraint on data access.</p> <p>This project aims to develop and test a proof-of-concept for a data management method and digital platform that can reduce this constraint to data access, and open it up to analysis and exploration by third parties to innovate their service offerings and unlock the value of DER for customer benefits, whilst maintaining data privacy and security. Based on our experience of data requests received to date, some of these third parties will be looking to deploy big data techniques to improve and reduce costs in their direct offerings to customers, a large portion of which involves the packaging of DER services. Others will be looking to provide new and alternative services to the DNSP (again often based on DER) that offer to reduce the network costs that are paid by customers.</p> <p>The project has a very strong technology component in designing and implementing a big data platform with open protocols, detailed data definitions and continuous updates. Data is anticipated to include anonymised metering data (including AMI smart meter data), DER device data, network operational data, network planning data and network asset data where privacy, commercial confidentiality and security can be maintained.</p>

Project 9	
Using our data sets to improve customer services	
Criteria	Description
Improved service to customers	This initiative aims to significantly enhance the ability of the energy supply and DER sector to innovate their customer offerings to provide improved service, greater engagement and lower costs. This will be achieved through developing and testing an open data access platform to unlock the vast energy and network data held by DNSPs. Based on trends currently observed in the energy supply sector, we expect that customers will benefit from more tailored retail offerings that match their needs and lower costs, DER offerings that are simplified, more attractive and lower costs, new types of energy engagement programs such as demand response that can return value to customers and lower their energy costs, and provision to DNSPs of more efficient non-network, DER and demand management solutions that can reduce the network costs paid by customers.
Driven by customer needs and expectations	This initiative is a direct response to our customers' stated needs for simple, tailored and low-cost energy and DER services and service provider requests that we enable them to access a wide range of data on-demand to enable improved customer offers to be developed. Customers also expect to gain the maximum value possible from the investment in the AML smart meter roll-out, and this project seeks to enable a very high value use of this data.
Involves collaboration	<p>The genesis for this project concept was collaboration with another DNSP and an energy technology specialist company as part of the ARENA A-Lab incubate process, and we subsequently contributed to the development of a project scope for an "Open Network Data Gateway" initiative. Our preferred collaboration pathway for progressing this project is to engage with the Victorian Government Centre for New Energy Technologies (C4NET) and we have raised this concept in initial discussions.</p> <p>Most Victorian DNSPs and several research organisations are active members of C4NET, whose aim is to promote collaboration around new energy technologies.</p>
Solves a specific issue	This project seeks to address the specific issue of opening up third party access to large volumes of energy and network data that can enable innovation and lower costs for customer offers within the unregulated energy supply ecosystem and unlocking of value offered by the growing population of customer DER. To demonstrate that this issue can be solved the project will develop a proof-of concept for an open data access platform that can seed and accelerate the customer service offerings and customer engagement of the unregulated energy sector.

Project 9	
Using our data sets to improve customer services	
Criteria	Description
Customers are willing to pay	<p>Customer research conducted with a variety of customers and their advocates and conducted in a variety of ways has consistently found that customers support modest innovation to prepare for, and assist, energy system transformation – as long as tangible benefits for customers are delivered, there is no duplication of existing projects and the learnings are shared.</p> <p>The Customer Forum has previously accepted the case for an innovation allowance and it has concluded that an innovation budget of \$7.5 million based on a modest contribution of approximately \$2 per annum per customer for the regulatory period is reasonable.</p>
Options and proposed expenditure	<p>There are no “out of the box” solutions that could be deployed provide an open data access platform of this type.</p> <p>Our proposal involves carrying out a 2 year pilot towards the end of the next regulatory period. The \$0.8m budget (\$2021) to develop a stand-alone application for proof-of-concept is primarily internal development costs – subject matter experts, data scientists, user experience analysts and technical development and implementation staff.</p>
Not replicating existing projects	<p>With the data-rich environment of smart-metering in Victoria, AusNet Service are well placed to lead this project around testing the value of opening up our metering and network data sets for external stakeholders and the broader market via a central platform, whilst maintaining privacy and confidentiality requirements. This concept has been well discussed within industry, requested by energy services providers and has clear value to the broader energy ecosystem, but is yet to be implemented in a real-world trial. This unique project would have a high degree of interest from industry and Government stakeholders.</p>