Innovation expenditure

Negotiating position for the Customer Forum

1. Negotiation scope

The innovation expenditure proposal is in scope of the proposed expenditure negotiations between AusNet Services and the Customer Forum. However, it is outside the scope of negotiation that will be oversighted by the Australian Energy Regulator (AER).

AusNet Services is seeking Customer Forum endorsement for $10.8 million ($2018) of innovation expenditure over the 2021-25 period. This amount is separate to the allowance for demand management innovation under the existing Demand Management Incentive Allowance (DMIA), which will be approximately $3.5 million over the 2021-25 period.

AusNet Services has posed the following questions to the Customer Forum:

- Is upfront customer investment in specific innovation projects justified given their expected benefits? These projects span the following broad categories:
    - Projects to enhance management of the low voltage and high voltage network, including exploring optimisation of distributed energy resources in order to reduce long terms network costs to all customers;
    - Trial of Stand Alone Power Systems in remote parts of the network to improve supply reliability, reduce bushfire risk and reduce costs;
    - Leveraging controllable DER to better support the network reduce overall costs and engage DER customers;
    - Data availability to support customer choice and decision making and promote non-network solutions; and
    - Managing the pending impact of electric vehicles in order to reduce network infrastructure costs and improve supply security to all customers.
- How would you rank the individual expenditure items given customer feedback?
    - Should AusNet Services innovate in other areas? Should this be in addition to what we have proposed or instead of?
      [**Please refer** to the separate position note on customer experience that explains the proposed innovations to improve customer experience and interactions with AusNet Services.

2. Technological and customer driven changes require innovation

AusNet Services and all distribution networks are responding to unprecedented changes in our network that are forcing us to innovate to allow us to maintain reliable services and to manage energy costs. These changes are being driven by technological change and changing customer preferences. Customers are embracing new energy technologies, taking control of how they use energy and seeking to reduce emissions. Some of these changes comprise a fundamental reversal in the way the legacy network is utilised. This poses the risk of large costs in renewal and upgrades of network assets unless smarter ways can be found to adapt.

There is general understanding and support for the need for distribution networks to respond to these changes, including through innovation. For example, the Australian Energy Market Commission (AEMC) in their recent review of network regulation made the following comments supporting the need for innovation.

Innovation expenditure

AEMC, Economic Regulatory Framework Review, 26 July 2018

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> The grid of the future is likely to perform a different function. It is expected to become a platform for a broad range of technologies and business models, managing multi-directional energy flows both to and from consumers. NSPs will face new technical and operational challenges in managing this future grid, and will need to undertake different types of investments to maintain quality and reliability and operate the network within safe limits.

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> However, new technologies also offer solutions to these new challenges that DER pose. NSPs will also need to innovate and evolve in order to be able to meet the technical challenges posed by DER and continue to meet quality, reliability and security obligations. These same innovations required to meet these challenges can also offer new opportunities.

Energy Networks Australia (ENA) also point to support from the Finkel Review:[1]

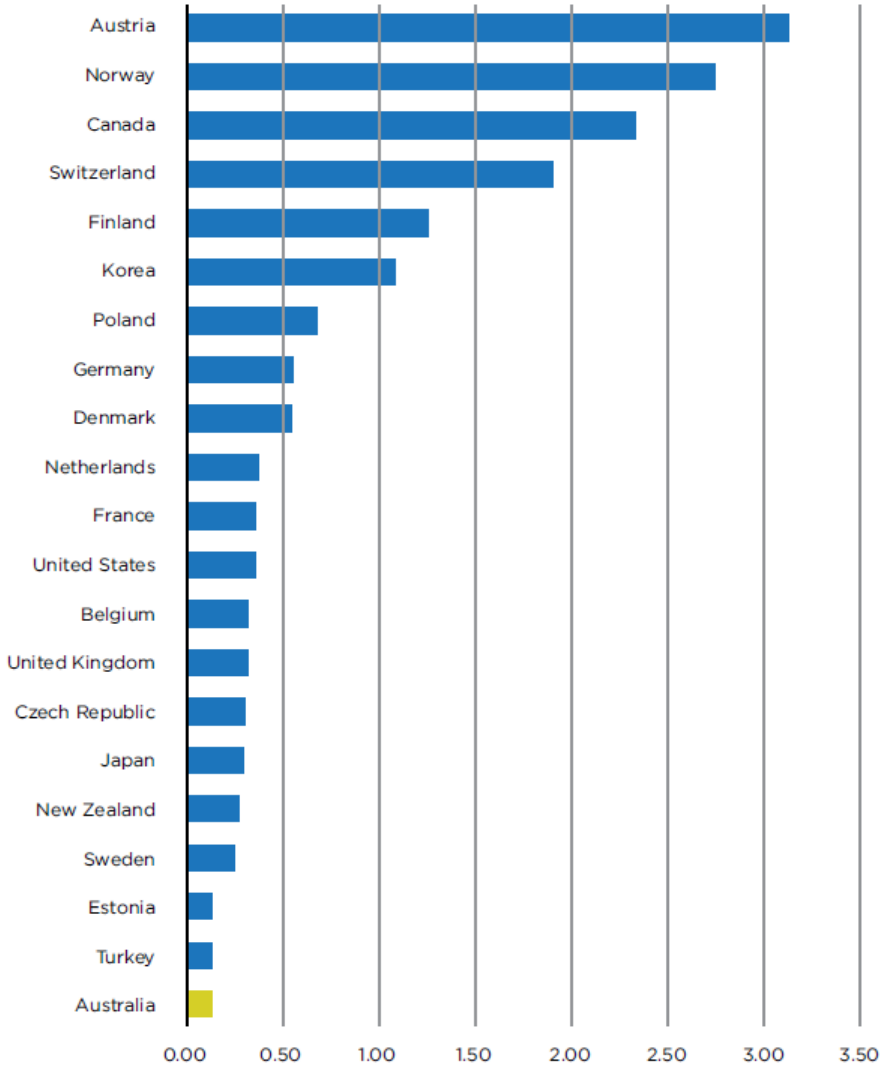
> *"By end-2018, the Australian Energy Market Commission should review and update the regulatory framework to facilitate proof-of-concept testing of innovative approaches and technologies."*[3]
>
> Finkel Review of NEM Security

Expenditure on innovation by electricity networks, particularly in Australia, have traditionally been very low. Again the ENA points to research by the International Energy Agency (IEA) demonstrating this.

[1] Energy Network Australia (ENA) 2017, *Network Innovation, Discussion Paper*, July, p. 5.

Innovation expenditure

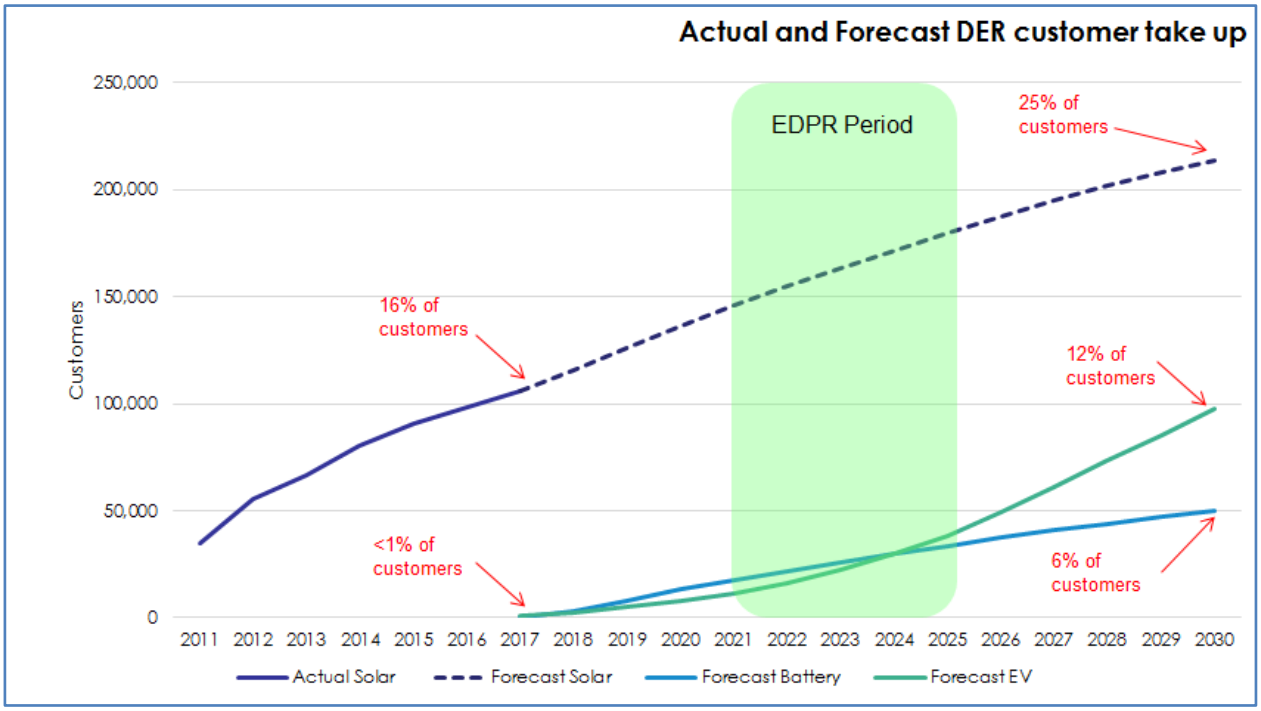
Figure 1: Network R&D funding per capita 2014, USD (2015 prices and PPP)



This is no longer sustainable given the strong evidence of change and drivers for innovation in AusNet Services' distribution network. Victorian customers are also in the unique position of having virtually universal smart metering. This is driving further adoption as this enabling technology is already in place.

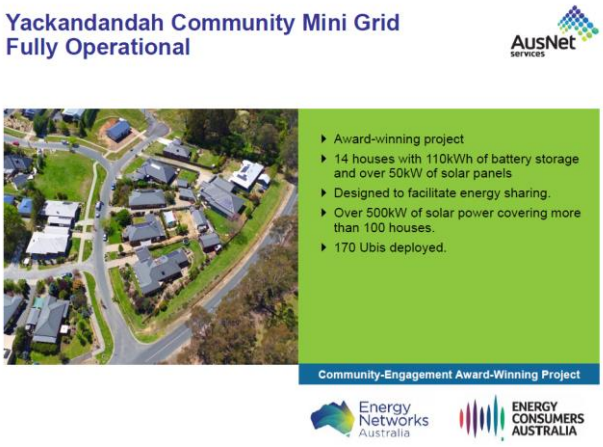
Figure 2 shows growth in the take up of distributed resources including solar PV, batteries and EV based on AEMO's forecasts.

Figure 2: AusNet Services forecasts DER uptake to 2030



Source: AusNet Services. Note the forecasts are aligned to current AEMO forecasts.

This trajectory is not uniform across the network, with pockets of high uptake already pushing the limits of what the network can cope with. Step changes in this trajectory are also possible. AusNet Services are being approached by an increasing number of communities to implementing community-wide energy projects. Recent examples include the Totally Renewable Yackandandah project, the Healesville Community Renewable Energy Project, Totally Renewable Beechworth, Renewable Albury Wodonga, Sustainable Seymour, the Energy Innovation Co-op, Mirboo North Community Energy Hub, Sustainable Sale and the Mallacoota Sustainable Energy Group.



3. AusNet Services' innovation pathway

2021-25 proposed innovation program

The innovation program goes well beyond demand management, supporting the future transformation of our network to improve customer outcomes, particularly in terms of lower bills and improved choice and services.

The majority of the innovation program relates to testing new technologies and approaches that will take the distribution network from a statically managed centralised network to a dynamically managed decentralised network. It is expected that trialling a range of technologies will improve customer outcomes in the long term. Foremost, the aim is to reduce network costs by more efficiently managing the growing amount of distributed energy resources in our network and allowing customers to maximise the value they can achieve from these investments, whilst also providing a benefit to customers overall. The dynamically managed network will also deliver richer, real-time data to make better informed network investment decisions and reduce network costs.

The program will also trial and prepare for customer-specific technologies such as stand-alone power systems that could be used to provide a more reliable, lower cost and safer network service to customers at the edge of the grid. Finally, the program includes early work to prepare for the mass adoption of electric vehicles given that the technology represents a massive increase in network demand, well beyond that of air-conditioning. Network businesses will need to be active in ensuring that increasing volumes of electric vehicles are managed in a way that prevents service quality problems and costs being imposed on the entire customer base (including those that have not adopted electric vehicles).

The need for similar innovation is being seen across all electricity distribution businesses in Australia and internationally. The network businesses in Australia have worked together (with the help of the CSIRO) to identify innovations needed to benefit customers in the rapidly changing energy environment. Our proposed innovation program uses these ideas.

Table 1 lists AusNet Services' proposed innovation projects for the 2021-25 period and provides a description, cost, customer benefits being sought from the project and the degree to which the project may be supported by or aligned with customer support indicated in the customer research.

Innovation expenditure

Table 1: AusNet Services' proposed innovation projects 2021-25

	Project	Description	Cost $M 2018	Customer benefits	Ranking based on customer support
1	Active load balancing	Trial new smart network technology solutions that shift customer loads so that additional solar can be connected without more costly network upgrades being required	$0.75	Reduced costs, customer choice to use energy systems	
2	Advanced voltage regulation	Test and validate network technology solutions for cost-effective way of maintaining customers supply quality	$0.75	Reduced costs, reliable supply	
3	Dynamic DER control	Test a range of dynamic distributed energy control options (pricing, aggregation platforms, Demand Response Enabled Devices, hardware configuration) that will offer best outcomes for customers	$1.0	Reduced costs, increased customer choice to use energy systems and improved returns on behind the meter investments	
4	Leverage solar for network	Explore the value of commercial customers installing solar generation to relieve network congestion, and develop a customer offering to encourage this where it is of mutual benefit	$0.25	Reduced costs, improved returns on behind the meter investments	
5	22kV network monitoring pilot	Demonstration project to test grid sensing and its potential benefits (network fault and loss detection, overloads, dynamic hosting of DER)	$1.59	Reduced costs, improved services to customers	
6	Predictive network “state-estimation”	Develop data analytics that enables the network and customer/controlled DER to be preconfigured to maximise the value of customer DER participation, and also to establish signals to market-facing platforms to co-optimise network and connected distributed energy resources	$0.69	Reduced costs, improved returns on behind the meter investments	
7	Stand-Alone Power Systems (SAPS) pilot	Trial SAPS in remote parts of the network to test their effectiveness and efficiency in avoiding expensive network asset replacement, improving supply reliability, and reducing bushfire risk.	$1.0	Reduced costs, improved safety	
8	Distributed energy network optimisation platform (DENOP) development	Development of the AusNet Services DENOP capability (cloud-based software interfacing with DER systems) to progressively introduce flexible control and dynamic coordination of connected DER in conjunction with network optimisation	$0.75	Reduced costs, increased customer choice to use energy systems and improved returns on behind the meter investments	

Note: Red =high; Blue = medium; Green = Low

Innovation expenditure

	Project	Description	Cost $M 2018	Customer benefit	Ranking based on customer support
9	Distributed Energy Management Systems Integration	Conduct a study of Distributed Energy Management Systems to discover best practice for application within the AusNet Services network	$0.25	Reduced costs, increased customer choice to use energy systems and improved returns on behind the meter investments	
10	Distributed System Operator trial	Develop a real-world trial of a preferred Distributed System Operator (DSO) design option to test its cost-effectiveness and to inform future applications	$0.7	Reduced costs, increased customer choice to use energy systems and improved returns on behind the meter investments	
11	Predictive analytics to leverage DER fleets for abnormal weather events	Research techniques and develop a short-term predictive analytics capability to respond to abnormal weather events using controlled DER and network management functions	$0.3	Improved reliability, improved returns on behind the meter investments	
12	Automated customer DER connection portal development	Early development of an automated and personalised DER customer connection portal that accesses required data sets and performs the necessary computations to provide specific customer guidance and approvals	$0.5	Reduced costs, increased customer choice to use energy systems and improved returns on behind the meter investments	
13	Market facing data and information platform trial	Development of a data platform to provide information to customers and service providers to customers to fully exploit their DER	$0.8	Increased customer choice to use energy systems and improved returns on behind the meter investments	
14	EV Network impact and EV clustering demonstration	Conduct a detailed EV network impact study, modelling, and EV clustering demonstration trial that tests response to tariffs and charging management solutions	$1.0	Reduced costs and improved reliability by managing EV uptake	
15	Explore Vehicle2Grid opportunities to manage congestion	Conduct a trial of Vehicle2Grid energy exchange to understand customer and network benefits, technology capability, and the commercial models that may be required in future	$0.5	Reduced costs and improved reliability by managing EV uptake	
	Total		**$10.83**		

Note: Red =high; Blue = medium; Green = Low

Innovation expenditure

Building on our current innovation activities

The network innovation program builds on the small amount of internally funded strategic innovation within the business, externally funded initiatives (such as via ARENA) as well as select DMIA funded projects where learnings have been more broad than just demand management.

The DMIA was developed at a time when network peak demand was growing rapidly due to airconditioning uptake, and regulators identified the value in encouraging DNSPs to innovate new demand management solutions. Since that time, significant customer and technology driven energy transformation has begun to occur that overlaps with, but is far broader than issues of peak demand. Managing this broader transformation relies on a network Innovation program that expands on and complements the DMIA.

Innovation projects progressed across the previous five years, and the respective paths forward include:

- Development of a 20MW portfolio of commercial and industrial demand management customers after development of a business model, experimentation of customer offerings and live trial of an initial customer. This program has since been productionised and embedded as a manual process into the Network Planning and Control Room operations. Further innovation is proposed to increase automation of the portfolio operation which will reduce manual effort, increase efficiency and better integrate the portfolio with network needs. This project has had initial scoping work undertaken, and is proposed to be trialled in 2021-25 leveraging DMIA funding.

- Residential battery storage. An initial technology focussed trial of 10 solar-battery customers was conducted with DMIA funding in 2013. The learnings from this project fed into the wide-ranging Mooroolbark Mini Grid project in 2016 (also DMIA funded) and subsequently the Networks Renewed project (ARENA funded) that focusses on managing the uptake of solar. Further work to unlock the full customer and network value of residential storage is proposed and includes both development of the control and optimisation methods (Network Innovation funded), demand management technology protocols (DMIA funded) and a commercial scale pilot project that seeks to test the commercial model at scale in conjunction with other energy sector partners such as retailers (DMIA funded). The learnings from Mooroolbark will also accelerate our work on Stand-Alone Power Systems (SAPS) (Network Innovation funded) given the overlap of key technology elements.

- Grid scale battery storage. Our initial trial of large scale energy storage was initiated in 2012 (co-funded from DMIA and internally) and the facility is now being enhanced and transitioned into the business-as-usual environment as part of a project to relocate it to a remote location where it can provide increased customer supply reliability. The project has also provided us the technical knowledge to collaborate with third-party proposals around network support from large-scale storage. Implementing these collaborative projects will require innovation to develop efficient methods to integrate the battery operations into the network operational environment (Network Innovation funded) and prove a viable commercial model for engaging third party storage for demand management services (DMIA funded).

- Solar impact management is emerging as a key customer-driven challenge for networks and many technology-based solutions are potentially available. Our initial innovation experience with solar management was on the Residential Battery Storage Trial and the Mooroolbark Mini Grid (both DMIA funded) and is now the focus of the Networks Renewed project (ARENA funded). In order to productionise solar management techniques, further work is proposed under the Network Innovation program, particularly around load balancing, voltage regulation, DER integration and DENOP development.

- Residential demand management was first tested in 2017 under a proof-of-concept project called Peak Partners (DMIA funded). The focus of the program was on behavioural demand response, but also included air conditioning load control. Both techniques will remain a focus of innovation work under the DMIA with the aim of proving reduced costs, customer acceptance and deployability at scale. Several of the network Innovation funded projects such as network sensing and DENOP development will also facilitate the optimisation of residential demand management operations once rolled into production.

- Network data & analytics. A significant investment has been made in developing analytics capabilities to derive value from our smart meter data. With near-term operational efficiency benefits, this investment has been able to be funded internally. Further work on smart meter data analytics will continue and will be expanded to include more future looking capabilities (leveraging new network sensing devices) and customer focussed applications funded through the Network Innovation program.

- Early work on electric vehicles around 2011 included a partnership with the CSIRO, participation in the Victorian Government EV Trial and preliminary modelling of network impacts. This work was put on hold given the slower than expected uptake in EVs in Australia, but will now be used as a base to refresh our analysis on EV impacts and develop new trials focussed on managing charging load (funded under the Network Innovation program) given the recent advances in the EV market.

New areas of investigation that have not previously been progressed include thermal storage as a means of managing network peak demand (DMIA funded) and the application of direct current (DC) network technology as an alternative to traditional alternating current (AC) networks (Network Innovation funded).

Key projects for the 2021-25 DMIA program are summarised below:

- Residential Demand Response – behavioural techniques. Intended to test the value of customer interaction tools and to prove the economics and efficiency of the program at the scale required to deliver network cost reductions.

- Residential Demand Response – automated load control. Initial focus on air-conditioning load control via industry standard and proprietary communications protocols, but also including battery storage, electric vehicle charging and generic home energy management systems.

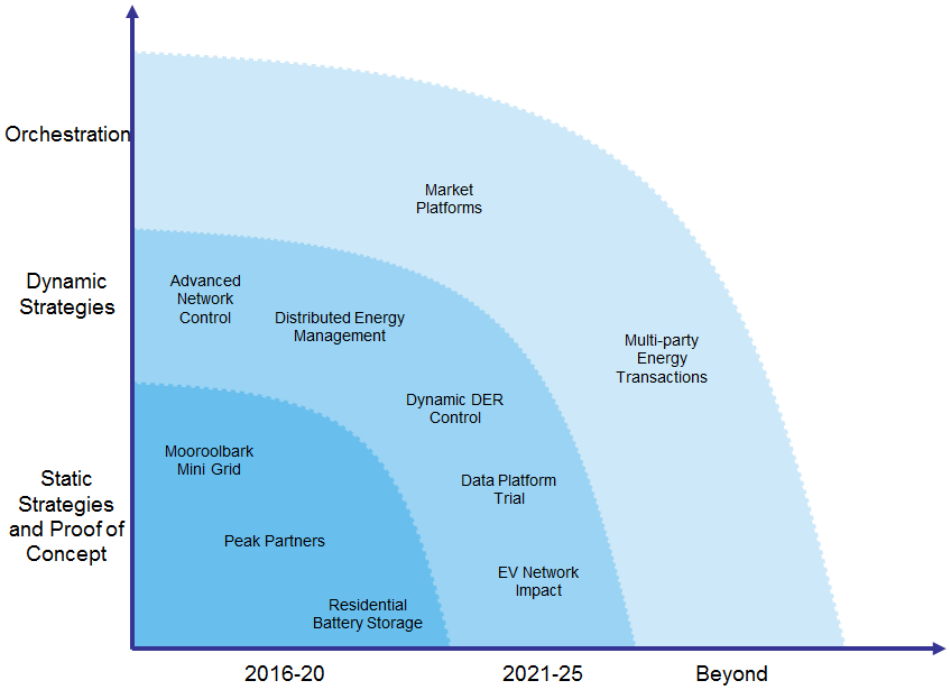
- Integration and automation of demand management programs into Control Room operations. This would identify and test flexible integration solutions that can apply to both commercial customer and residential customer demand response as well as network support from generation and energy storage devices.

- Large scale storage integration. Building on the trial of our own Grid Scale Storage System, this will test and deploy management solutions for third-party storage systems in order to harness network support value. This will harness existing capability within the DENOP and will develop specific functionality for large scale storage systems in order to test the end-to-end commercial solution.

- Thermal storage technology offers an alternative to electrical storage for managing peak network demand that is driven by heating or cooling needs. Particularly at larger scales (such as for commercial cold storage facilities) thermal storage has the potential to be more cost effective than electrical storage.

Figure 3 shows AusNet Services' innovation pathway trailling approaches towards dynamic and orchestrated network operation.

Figure 3: Trials for static, dynamic and orchestrated network



4. Benefits of innovation

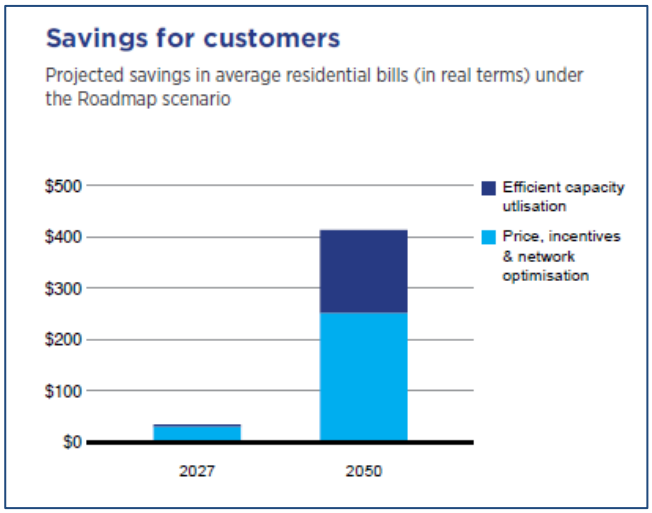
The benefits for network customers of our proposed actions to adapt to this change are potentially large. Also, not taking action to innovate and to adapt is very likely to impose higher costs than would otherwise be the case.

ENA/CSIRO Energy Network Transformation Roadmap (ENTR)

The work that the networks have done with the CSIRO on the ENTR has estimated the benefits of innovation in terms of savings on average residential bills and differences in energy costs with and without innovation.

Figure 4 shows that average residential electricity bills are lower under the Roadmap scenario in both 2027 and 2050 due to reduced network capacity expenditure and more efficient utilisation of the network.

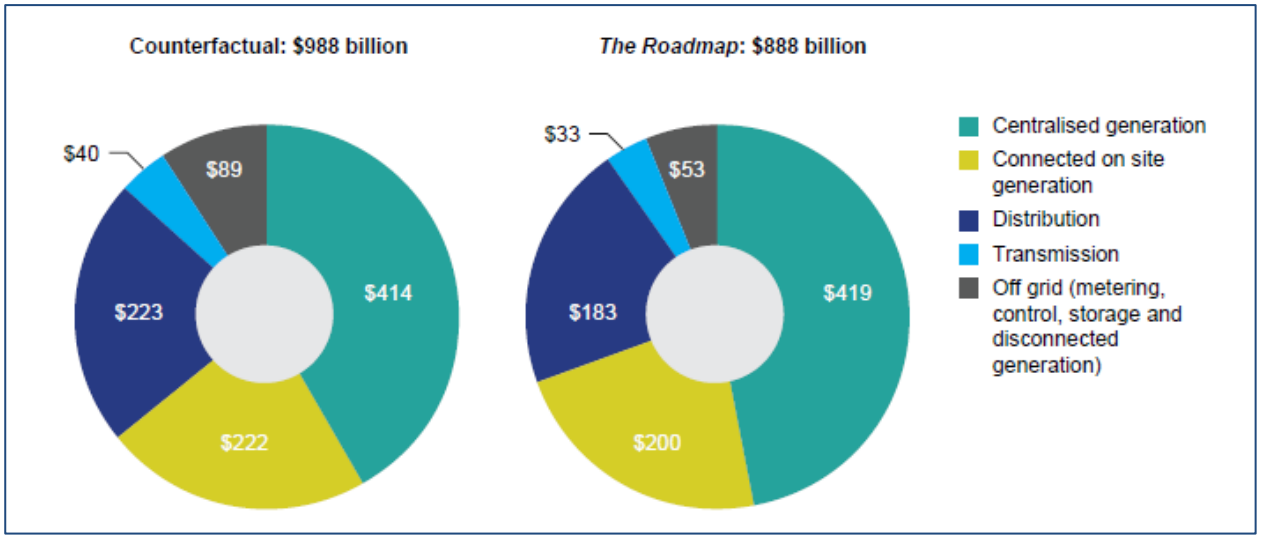
Figure 4: Projected savings in average residential bills (in real terms) under the Roadmap scenario



Source: ENA/CSIRO Energy Network Transformation Roadmap

Figure 5 shows that overall the Roadmap scenario achieves a real $101 billion reduction in cumulative total expenditure, primarily due to efficiencies in the distribution, off grid and connected on site generation sectors

Figure 5: Difference in electricity system expenditure to 2050 (in real terms) under the Roadmap and counterfactual scenarios



Desired customer benefits of AusNet Services' 2021-25 innovation program

Long term benefits AusNet Services is seeking from the innovation program are summarised in Table 2 below. It is hard to determine what the outcomes would be in the absence of the innovation program (the counterfactual). However, it would certainly delay the ability to adjust to and take advantage of the changes in our network. This is very likely to mean higher network costs over the longer team. The likely counterfactual is also described in the table below.

Table 2: Customer benefits associated with AusNet Services' proposed innovation projects 2021-25

Customer benefit	Contribution of the innovation program	Counterfactual in the absence of innovation
 **Lower network costs**	Systems being trialled are designed to reduce network costs by deferring network investments, improving network asset utilisation, make use of distributed energy resources and providing better and more real-time information for network investment decisions. This is expected to reduce costs.	Less use of distributed resources and higher augmentation costs
 **More opportunity to use and earn a return on solar, batteries, etc**	Systems will test ways of allowing customers to make more use of distributed energy while requiring less network capacity. This includes flexible solar connections that allow dynamic management and new network devices to compensate.	Increasing solar breaches network limits Hard limits/refusals placed on solar connections Inefficient network expenditure to manage solar/DER
 **Reduced bills and emissions**	Customers can make use of network insights about usage patterns: • Customers provided with tips and tools to improve efficiency • Customer have more options and ability to join demand response programs Customers can easily access, package and transfer energy data • More customers are able to find better deals and reduce bills • Retailers & other service providers can provide better service options with data automation	Network insights about customer usage are not leveraged: • Customers less likely to know about inefficient usage or faulty appliances • Few options for customers to engage in demand response programs Energy data is difficult to access and interpret by customers: • Customers not able make use of data to reduce costs • Fewer service options and less automation available to customers from retailers & DER providers
 **Reliable supply**	Power quality is maintained through the application of flexible contracts and new network devices Economic options available to improve supply reliability to remote customers including via stand-alone power systems and micro-grids	Remote customers continue to experience poor supply reliability • Non-networks solutions not available • Increasing DER degrades power quality • Appliances do not function correctly, solar power systems can not export

Customer benefit	Contribution of the innovation program	Counterfactual in the absence of innovation
 **Electricity sharing**	This is not an area of heavy focus, but early stage trialling of ways to enable new models of energy retailing and sharing. New retail models are enabled by data & local control with integration to network: • More options to buy and sell locally with better prices Local energy flows make efficient use of the network • Lower prices to customers	Current retail model persists • Limited options to share/trade locally Local networks not used efficiently • Lower asset utilisation leads to high prices to customers
 **Managing the impact of EVs**	Some preparation and testing is needed to manage the impacts on all customers not just those with EVs : • Augmentation is more efficient and reduces prices for all customers • EV customers can extract value from EV charging flexibility options	Network limits are breached with low numbers of EVs: • Cost increases to all customers to cover early augmentation program • No options for customers to extract value from EV charging flexibility

5. AusNet Services' customer research

The customer research that is relevant to understanding views on the proposed innovation program is provided below. Much of the research does not address views on our innovation and research activities directly. However, there are clearly strong intentions to adopt solar and batteries when possible, which is driving the need for innovation in our network to ensure this is managed cost efficiently and in a customer-centric manner.

Technology trials and innovation was not always seen as a core activities, but an important one that could also build trust. Concern was expressed that innovation activities may be directed at helping wealthy technology first adopters at the expense of remaining customers, including vulnerable customers.

Strong customer intentions to adopt energy technologies

The research has consistently shown that customers would like to adopt distributed energy and other behind the meters technologies. These customer preferences are driving a fundamental transformation in service requirements and network usage that creates a need for AusNet Services to innovate into the future.

Innovation expenditure

Small to Medium Businesses (AusNet Services' Survey)	Households (RMIT Survey)
• Widespread interest in adopting solar and battery technology	• If households didn't already have rooftop solar, most wanted to install it. • Renters and financially constrained households wanted a way to proceed with solar PV
Residential and SME (Quantum Survey)	**Residential and SME (New Gate Research)**
• Of those without solar, 58% of residential and 57% of SME customers were interested in installing solar panels in the future. • 55% of residential and 48% of SMEs interested in getting battery storage in the future • Interest in investing in electric vehicles was limited	• Over half of the non-solar customers would probably or definitely install solar in the next few years. Many felt that eventually all customers would have solar • Strong awareness & interest in batteries to solve the intermittency issues of solar • Many felt that electric vehicles would not be popular in the short to medium term

Insights into the degree of support for research activity

Small to Medium Businesses (AusNet Services' Survey)	Households (RMIT Survey)
• A small handful of more progressive Local Councils and Community Groups stressed the point that we need to build a smart distribution network that can accommodate all of the renewable technology that might come onto the network in the near future. These participants saw this as being a critical consideration for AusNet Services in the lead up to the 2021-25 regulatory period.	• No direct information
Residential and SME (Quantum Survey)	**Residential and SME (New Gate Research)**
• Several early adopters considered AusNet Services' engagement and support for distributed energy (including mini-/microgrid initiatives) improved recognition, trust and satisfaction with the business	• Innovation with a long-term payoff is seen as important, but should be a supporting rather than a core activity. • Many participants thought that AusNet Services 'should engage in more R&D activities around new energy technologies' to provide better customer service. • However, concern remains about how this is paid for, similar to DER integration. There may be a feeling that AusNet Services or the government should be meeting the innovation costs rather than imposing them on AusNet Services' customers • Spending on electric vehicles was not seen as an imminent issue worth investing in

Concern about paying for new technology/needs of wealthy customers

There is a concern about all customers having to pay for meeting the needs of wealthy customers as they pioneer the adoption of new technologies, including air conditioning, solar PV and batteries and electric vehicles. However, as these technologies become more mainstream there is concern to ensure that the technologies are facilitated and costs shared in a fair way.

As present there is little value placed on connecting customers with electric vehicles to the network.

Previous customer engagement work had also highlighted the view that:

> 'Innovation should aim to benefit all customers, not just those that adopt new technologies themselves'

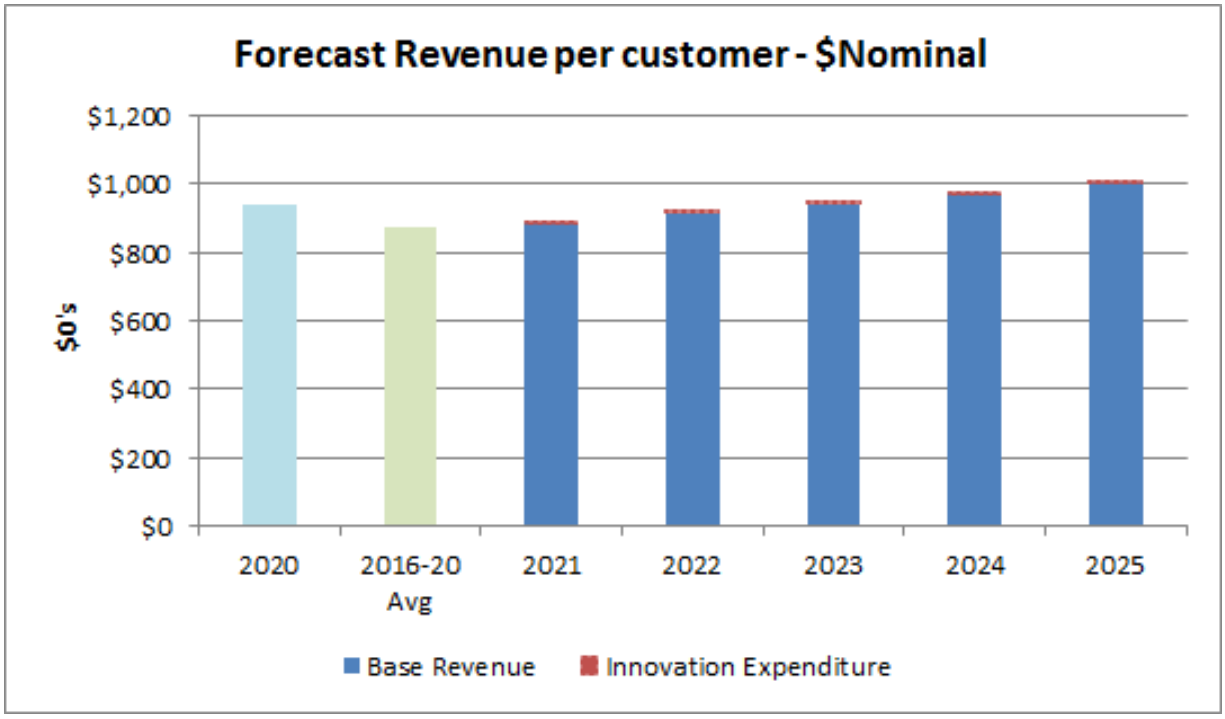
AusNet Services note that it appears to be not well understood that a failure to manage new customer driven technologies generally results in increased costs to all customers, rather than only causing costs to the technology-adopting customers. Taking electric vehicles as an example, failure to manage the huge increase in network demand from EVs risks inefficient network investment that would cause cost increases to all customers. Conversely, developing and putting in places mechanisms to manage EV charging load can actually increase network asset utilisation over time and therefore result in a more economically efficient network and lower costs to all customers.

This situation highlights the need for AusNet Services to articulate to customers the challenge of integrating new technologies. This will also require some base education about the trends that we see in industry. Most people don't expect to be driving an electric vehicle in future, but this is likely because they are not aware of the probable future offerings of car manufacturers or statements from many manufacturers and jurisdictions about ceasing the sale of internal combustion vehicles.

6. Bill impact of the proposed innovation expenditure

The proposed innovation expenditure accounts for just over 1% of proposed opex and 0.5% of proposed capex over the 2021-25 period. Reflecting the modest expenditure proposed, the bill impact is also small. As shown in the figure below , in each year of the 2021-25 period the revenue collected for the innovation program (i.e. the cost of the innovation program) accounts for 0.1% of total revenue (or cost) per customer.

Figure 6: Forecast revenue per customer associated with the innovation expenditure (2021-25)



Source: AusNet Services.