

AusNet Services Deep Dive No.1

Network innovation

Pre-reading pack

1 February 2019



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 - › 1. Potential innovation projects
 - › 2. Developing and managing innovation programs

**Need for industry innovation and
funding support**



The transformation of the energy system

- ▶ An important element of our future plans is our proposed response to the rapidly changing energy system and how to support the new energy solutions being sought by our customers.

- ▶ The rapid transformation of the energy sector is being driven by four inter-related trends, all of which are picking up pace.



Shift towards Distributed Energy Resources (DER)

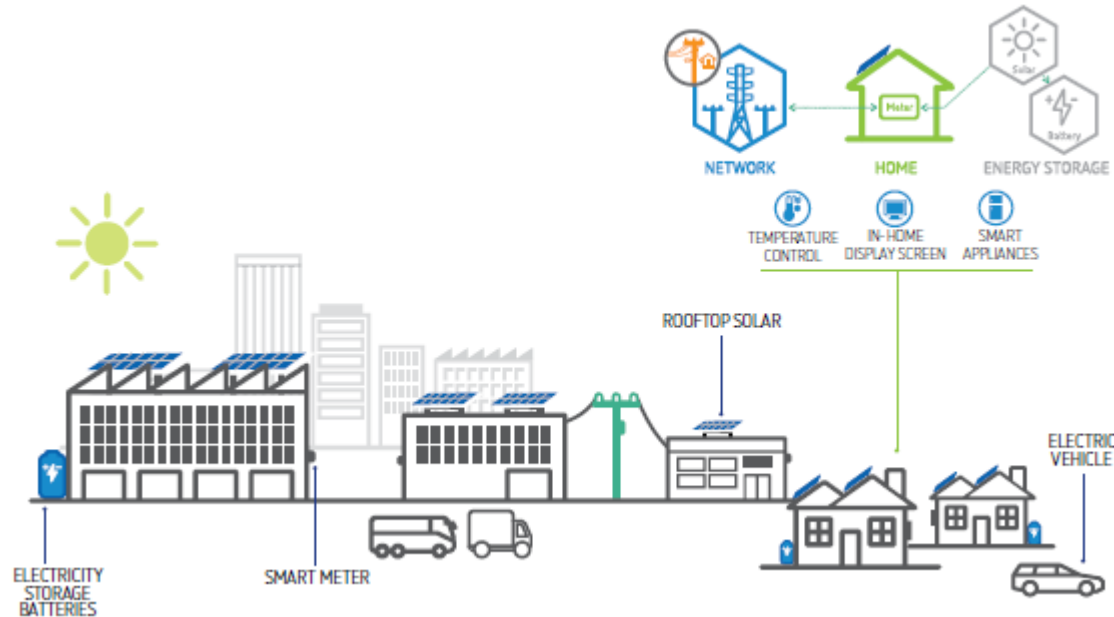
Shift to low carbon and renewable energy sources

Customers seeking control and empowerment

Digital platforms & big data analytics

- ▶ Our Network Innovation program seeks to test and leverage this future environment in order to deliver a future energy system for our customers that is **lower cost**, **reliable** and **flexible** enough to meet diverse customer energy needs.
- ▶ To develop this element of our proposal we sought input from our customers and stakeholders via the Customer Forum. We are also learning from and collaborating with our industry peers and the CSIRO.

The transformation of AusNet Services' distribution network



- Over 100,000 of our customers already have solar installed
- Whole communities are moving to solar e.g. Yackandandah
- Change is gathering pace with customer's adoption of solar generation, batteries, smart appliances, energy management systems and electric vehicles
- Changes the nature of services we need to provide e.g. support for two-way electricity flows

What are our customer's future needs?

“Get with the program and you could make it work for you for the next 100 years”
EV Customer, November 2017

Future customers want:



To have a reliable energy supply - if not, show me the alternatives like off-grid and remote area power systems



To decrease costs and make money from generating my own energy



To decrease costs and reduce emissions, show me how to be efficient with my energy/appliances



To share energy with my neighbours/community and be able to buy energy locally at a reasonable price



To have the energy data I need to make my life simple and efficient



To facilitate easy charging solutions in and out of home to power my electric/autonomous vehicle

..but this is only the beginning and expectations will evolve. 6

Long term benefits established by the Electricity Network Transformation Roadmap



▶ **The ENA/CSIRO Electricity Network Transformation Roadmap is a comprehensive assessment of the benefits of encouraging fundamental transformation of the electricity networks sector**

▶ **Key outcomes by 2050 at national level:**

› Lower bills for valued services →

- Total system spend is \$101b lower to 2050
- Saves households \$414pa by 2050
- Network charges 30% lower than 2016

› Fairness & incentives →

- Networks pay over \$2.5b pa for DER services
- Over \$18b in cross subsidies avoided, saving \$600 pa for med size family without DER.

› Safety, Security & Reliability →

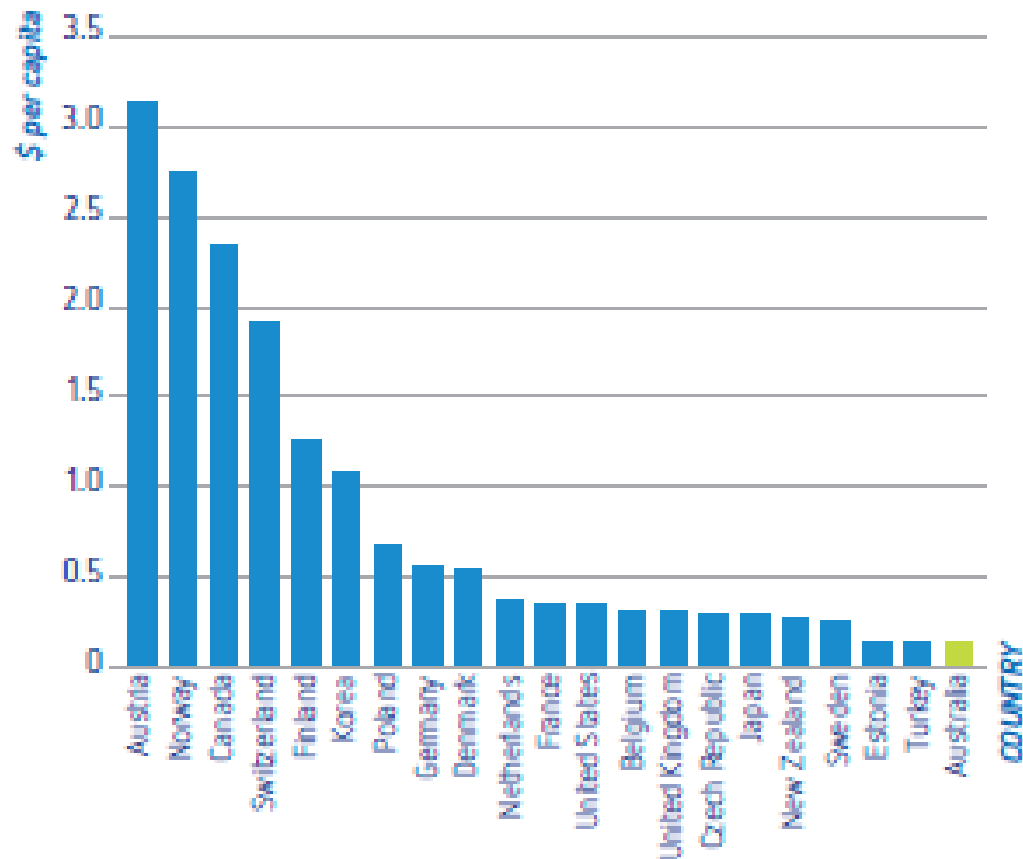
- Real time balancing, reliability and quality of supply at small and large scale, with millions of market participants.

▶ **Transformation can not be achieved without the experimentation & testing of new technologies, techniques, business models and customer offers**

▶ **This is where our network innovation proposal plays a critical role**

Innovation funding is low in international terms

Network R&D funding per capita 2014, USD



Source: IEA and United Nations database, Electricity transmission and distribution R&D funding per capita, USD (2015 prices and PPP), 2014 – as reported by Energy Networks Australia, Network Innovation Discussion Paper, July 2017

Regulatory arrangements lack incentive to fund innovation (other than for demand management)



▶ Australian Energy Regulator

While incentive regulation is important for giving effect to the NEO [National Electricity Objective], we also recognise that R&D can deliver value to consumers in the long term, but produce higher costs in the short term. Bearing this in mind, it is worthwhile acknowledging that regulated monopolies, like distributors, naturally have less of an incentive to conduct R&D than competitive businesses.

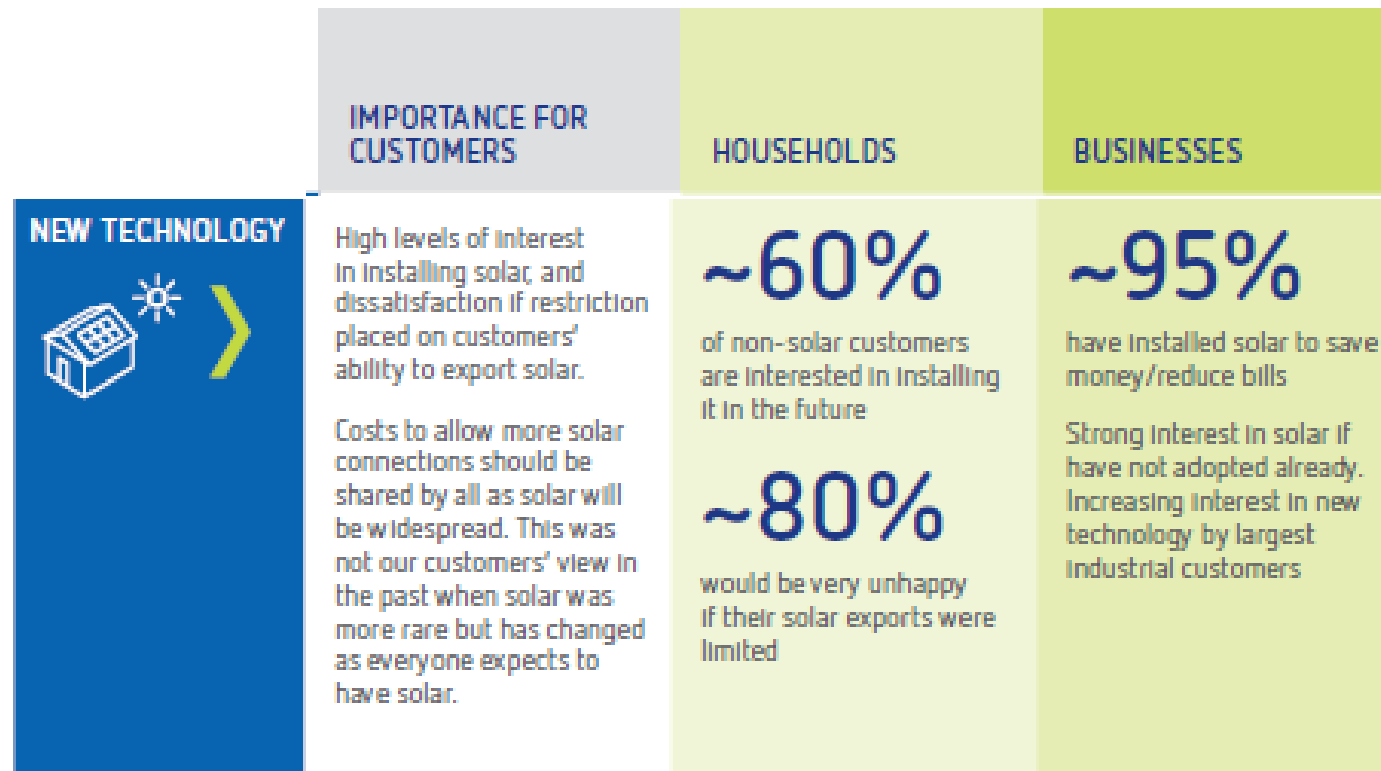
AER 2017, Explanatory statement, Demand management innovation allowance mechanism, Electricity distribution network service providers, December, p. 9

Customer research



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.



Degree of support for innovation

- › **Councils:** A small handful of Local Councils and Community Groups stressed that we need to build a smart distribution network that can accommodate all of the renewable technology that might come onto the network. These participants saw this as being a critical consideration for AusNet Services in the lead up to the 2021-25 regulatory period

- › **Customer Focus Groups:** Experience from the Focus Groups run by NewGate Research was that many participants thought that AusNet Services *'should engage in more R&D activities around new energy technologies'* to provide better customer service
 - Innovation with a long-term payoff is seen as important, but a **supporting rather than a core activity**. This aligns to our modest proposal for innovation expenditure

- › **Attitude and Perception Survey:** Several early adopters considered AusNet Services' engagement and support for distributed energy (including mini-/microgrid initiatives) improved their recognition, trust and satisfaction with the business

Proposed network innovation expenditure and possible projects



Network innovation expenditure

- ▶ To respond efficiently to the pace of change within the electricity sector, we are proposing a modest network innovation expenditure program of **\$7.5 million (\$2020)**

- ▶ AusNet Services suggested a program of \$11.4 million to the Customer Forum
 - › The Customer Forum considered the customer research did not support proposed innovation expenditure on electric vehicle preparation
 - › This would fund innovation related to the needs of a very small number of customers expected to adopt electric vehicles over the 2021-25 period

- ▶ The listing of potential innovation projects and associated costs provided to the Customer Forum is provided at Attachment 1

Potential network innovation projects



How a dynamically managed network will meet customer needs



At its core, our Network Innovation program seeks to test new technologies and techniques that can move us from a **statically managed centralised** network to a **dynamically managed decentralised** network

Customers' future needs

Static management



Dynamic management



To decrease costs and make money from generating my own energy

Increasing solar breaches network limits

- Hard limits/refusals placed on solar connections
- Cost increases to cover large augmentation program

Increasing solar is managed:

- Flexible solar connections that allow dynamic management
- New network devices to compensate
- Lower costs through reduced augmentation



To have a reliable energy supply - if not, show me the alternatives like off-grid and remote area power systems

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

Economic options available to improve supply reliability to remote customers

- Backup supplies & microgrids
- Power quality is maintained
- Application of flexible contracts & new network devices



To share energy with my neighbours /community and be able to buy energy locally at a reasonable price

Current retail model persists

- Limited options to share/trade locally
- Local networks not used efficiently
- Low asset utilisation leads to high prices to customers

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

How a dynamically managed network will meet customer needs



At its core, our Network Innovation program seeks to test new technologies and techniques that can move us from a **statically managed centralised** network to a **dynamically managed decentralised** network

Customers' future needs

Static management



Dynamic management



To facilitate easy charging solutions in and out of home to power my electric/autonomous vehicle

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

Greater numbers of EVs able to be hosted:

- Augmentation is more efficient and reduces prices for all customers
- EV customers can extract value from EV charging flexibility options



To decrease costs and reduce emissions, show me how to be efficient with my energy/appliances

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

Customers can make use of network insights about usage patterns:

- Customers provided with tips and tools to improve efficiency
- Customers have more options and ability to join demand response programs



To have the energy data I need to make my life simple and efficient

Energy data is difficult to access and interpret by customers:

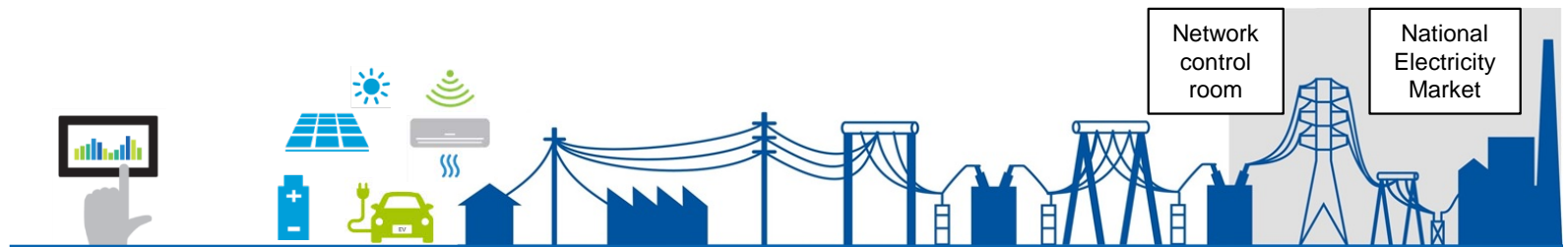
- Customers not able to make use of data to reduce costs
- Fewer service options and less automation available to customers from retailers & DER providers

Customers can easily access, package and transfer energy data

- More customers are able to find better deals and reduce costs
- Retailers & other service providers can provide better service options with data automation

Capabilities and innovation required to move to a dynamically managed network

► Our Network Innovation program comprises an integrated set of initiatives across the entire electricity network supply chain, aimed at developing new capabilities



CAPABILITIES REQUIRED

Ability to interpret and deliver useful data to customers and service providers

Ability to connect customers quickly and provide flexible service options

Ability to interact with customers for flexible loads and flexible generation

Ability smooth out and manage power flows with new network devices and reduce costs

Ability to fill the network data gap between smart meters and the high voltage network

Ability to control and optimise the flexible network and flexible customers with predictive capability

Ability to integrate customer flexibility into the National Electricity Market and maximise customer returns

OUR INNOVATION INITIATIVES

- Market facing data and information platform trial
- Customised energy efficiency advice

- Automated customer DER connection portal
- Leverage solar for network benefit
- Stand-Along Power Systems pilot
- Community energy resilience project

- Study into DER Management System integration
- Dynamic DER control testing
- EV Network impact and EV clustering demonstration
- Explore Vehicle-to-Grid opportunities

- Active load balancing using new network devices
- Advanced voltage regulation
- Direct Current trial for rural networks (Single Wire Earth Return)

- 22kV network monitoring pilot
- Virtual 22kV monitoring through analytics

- Development of functions within the 'Distributed Energy Network Optimisation Platform'
- Predictive network "state-estimation"
- Predictive analytics to leverage DER fleets for abnormal weather events

- 'Distribution System Operator' pilot project

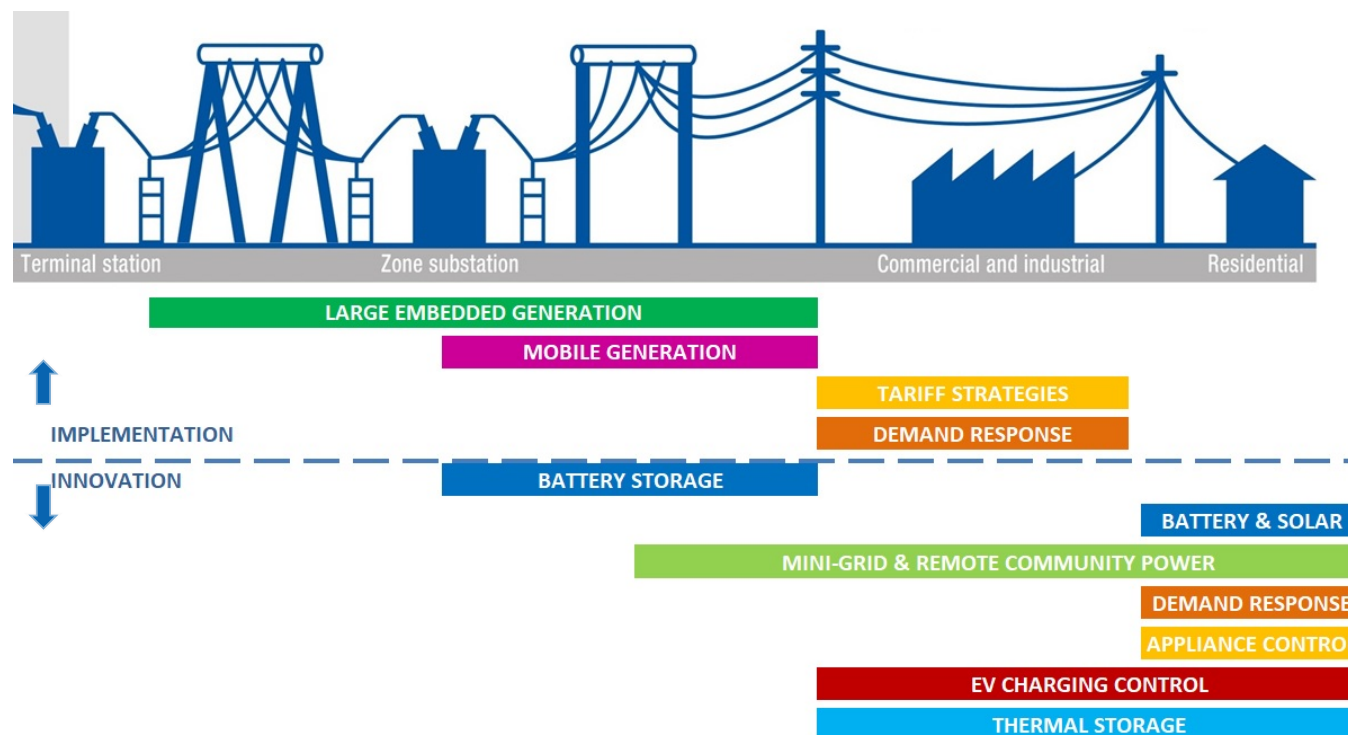
• Black = in current program
• Grey = potential additional initiative

**Demand management innovation
(already funded unlike broader
network innovation)**



Demand Management Program

- ▶ A suite of demand management and non-network solutions is being tested and deployed across much of the network
- ▶ Previously the focus was on managing peak demand growth with large scale solutions
- ▶ The focus for innovation under Demand Management Innovation Allowance (which will be approximately \$3.5 million in total over 2021-25) is now shifting to customer-side techniques and addressing the management of solar/DER uptake as well as peak demand



Possible initiatives under the 2021-25 Demand Management Innovation Allowance



▶ **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**

Thermal storage 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 may be more cost effective than electrical storage.

Questions for consultation



Questions for consultation

► What is your view on

- › The size of the intended network innovation expenditure program (is it too modest, too large)?
- › The potential innovation focus areas we have identified – do you agree with these?
- › Whether preparing for electric vehicles should be an innovation focus area in the 2021-25 period
- › Whether there are other innovation focus areas that the advocates would suggest

Attachment 1: Potential 2021-25 innovation projects



Potential innovation projects provide to the Customer Forum



	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	Blue
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	Blue
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	Blue
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	Blue
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	Blue
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-optimize network and connected distributed energy resources	\$0.69	Reduced costs, improved returns on behind the meter investments	Blue
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	Red
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	Blue

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

Potential innovation projects provide to the Customer Forum



	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	Blue
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	Blue
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	Blue
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	Red
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	Red
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	Green
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	Green
	Total		\$10.83		

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

Attachment 2: Developing and managing innovation programs



Innovation in regulated energy networks

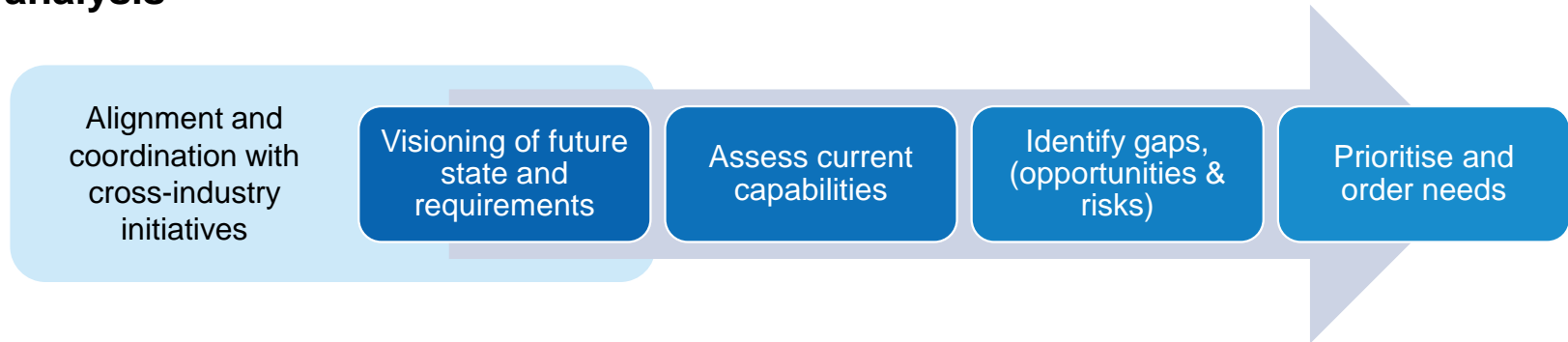
- ▶ **There are broadly two types of innovation expenditure**
 - › **Operational innovation:** Aimed at efficiency improvements, short term payback to customers, internally funded
 - › **Strategic innovation:** Aimed at supporting transformational change, longer term payback to customers, requires regulatory funding

- ▶ **This funding proposal focusses on “Strategic Innovation” that aims to deliver long-term customer benefits through reduced costs and/or improved service levels in an environment of transformative change driven by customer choices in energy usage and energy technologies.**

- ▶ **Where do we sit on the innovation spectrum?**
 - › Basic Research: **No** (Universities and research bodies)
 - › **Applied Research: Very occasionally (as a partner to research bodies)**
 - › **Experimental development: Sometimes (if we have capability + market gap)**
 - › **Product & process development: YES (Performance of new approaches)**
 - › **Production and market integration: YES (Business case for new approaches)**

How do we identify our network innovation initiatives?

- ▶ **Map out future requirements to best serve customers and undertake gap analysis**

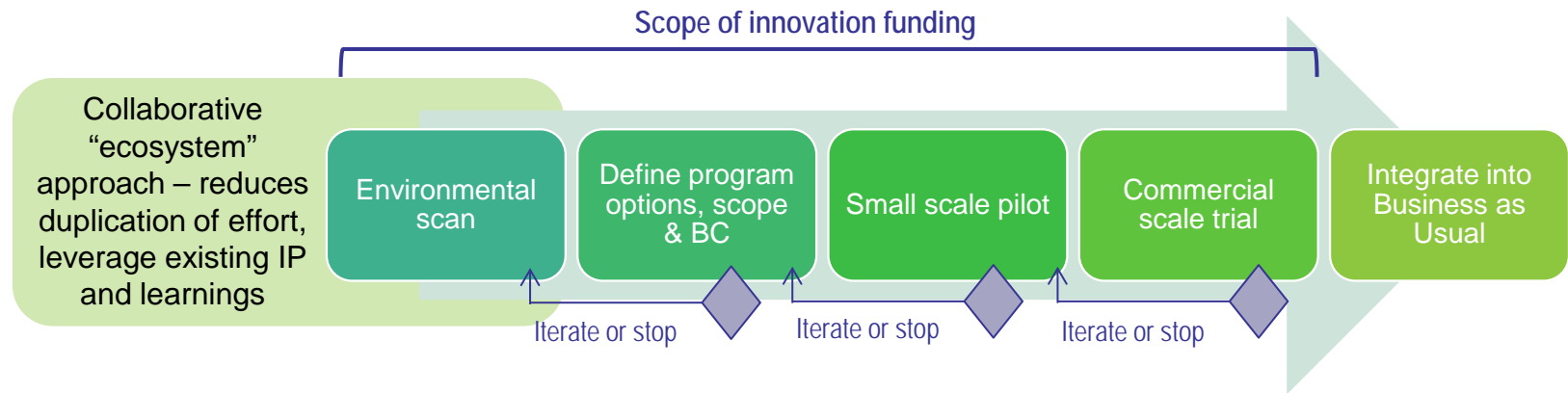


- ▶ **We draw on industry literature, consultancies, customer research and stakeholder collaboration to derive the highest priority innovation initiatives.**
 - › A key reference is the ENA's Electricity Network Transformation Roadmap delivered in collaboration with the CSIRO
- ▶ **At its core, our network innovation program seeks to test new technologies and techniques that can move us from a statically managed centralised network to a dynamically managed decentralised network**

How do we plan and cost our network innovation program?

- ▶ **For identified needs, establish and follow a development roadmap**

- › Different projects will be at different states of development



- ▶ **Matching of bottom-up cost estimates with top-down factors, considering:**

- › Rate of transformation required to align to customer expectations
- › Availability of co-funding such as Government Grants, ARENA, partnerships
- › Bill impact to customers and scale of allowance (e.g DMIA)

- ▶ **The agile nature of innovation means that the overall scale of the portfolio is more important than the specifics of each project**

- › Project priorities are constantly changing (based on external & internal factors)