

Technology program

Integration of Distributed Energy Resources

PUBLIC

Program Brief

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1 Document Background**1.1 Purpose of this document**

The purpose of this document is to outline a business case for a proposed program of work that will form part of AusNet Services' Technology EDPR submission.

1.2 References

Document	Version	Author
AusNet Services FY19-FY23 Technology Plan	V1.00	AusNet Services

1.3 Document History

Date	Version	Comment	Person
19/11/2019	V11.1	Feedback incorporated	Samantha Scanlon

1.4 Approvals

Position	Date
Technology Leadership Team	

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2 Executive summary

2.1 Program summary

The table below provides a summary of the program discussed in this brief. Additional information is provided throughout the brief.

Table 2-1 Summary table

Key objective(s) of the program	Initiatives to integrate and manage Distributed Energy Resources (DER) efficiently during the next regulatory period, to support increased customer choices in DER connection options and improved economic investment options, and to progress AusNet Services on the path to a digitally optimised utility that can participate in future orchestration business models						
Key benefits to customers	<ul style="list-style-type: none">Enhanced and more efficient network planning, incorporating DER forecastsFaster DER connections, facilitated by clearer hosting capacity limitsPeak demand savings generated by demand response, leading to lower network augmentation costsPreparation for potential orchestration roleGiving customers more options through facilitation of peer to peer trading						
Cost allocation	Electricity Distribution	100%		Electricity Transmission		0%	
	Gas Distribution	0%					
Program type	Recurrent			<input type="checkbox"/>			
	Non-Recurrent			<input checked="" type="checkbox"/>			
	Client Devices			<input type="checkbox"/>			
Program timings	Program duration:			5 years			
	Program start year:	FY2022	Q1 <input checked="" type="checkbox"/>	Q2 <input type="checkbox"/>	Q3 <input type="checkbox"/>	Q4 <input type="checkbox"/>	
Expenditure forecast	(\$m)	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	Total
	CAPEX	\$1.25	\$1.60	\$1.89	\$2.26	\$2.62	\$9.63
	OPEX	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
	Electricity Distribution cost	\$1.25	\$1.60	\$1.89	\$2.26	\$2.62	\$9.63
	Total Program cost	\$1.25	\$1.60	\$1.89	\$2.26	\$2.62	\$9.63
Estimated life of system	We expect the estimated life of the investment to be 5 years. Elements of the solution which are delivered by a subscription service would be perpetual and would be evaluated as part of the project initiation.						
Customer Engagement	<p>As the first DNSP in Australia to trial the New Reg process, we held deep dive workshops with stakeholders, including the Customer Panel, on DER (and ICT). In that engagement we recognised customers’ evolving needs with respect to DER. Material associated with all our deep-dives is available on AusNet Services’ website.</p> <p>A key theme of our engagement with the Customer Forum was the need for us to provide clarity on what we were proposing for ICT and what the expected customer benefits were. We acknowledge this feedback and have taken it into consideration when proposing the most appropriate option for this business case.</p>						

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The electricity sector is undergoing significant transformation driven by customers' increasing requirements around the use of distributed energy resources (DER). As defined by the Australian Energy Market Commission (AEMC), DER includes:

1. Any equipment (smart or passive) co-located with customer load – including combination of behind-the-meter battery; solar PV; electric vehicles; household appliances
2. Any smart energy equipment intended to control load e.g. direct load control pool pumps, Hot water systems, Air-conditioning
3. Larger equipment directly connected to distribution network e.g. solar or wind farm, large battery.

With increasing DER, energy flows on the distribution network are becoming variable and unpredictable. The electricity industry – including networks, regulators and policymakers – are working together to identify the potential future scenarios under high DER penetration, including new services and roles for Distribution Network Service Provider (DNSPs). At present, there is significant uncertainty as to the impacts of DER and the best way to manage a high penetration of DER efficiently, while continuing to provide customers the network services they require and desire.

At present, there are limited responses available to AusNet Services to reduce the risks associated with high DER penetration, or to take advantage of the opportunities that new technology is providing to drive new and better distribution services. In the 2022-26 regulatory period, AusNet Services must invest to evolve its technology in line with the changing market and consumer expectations.

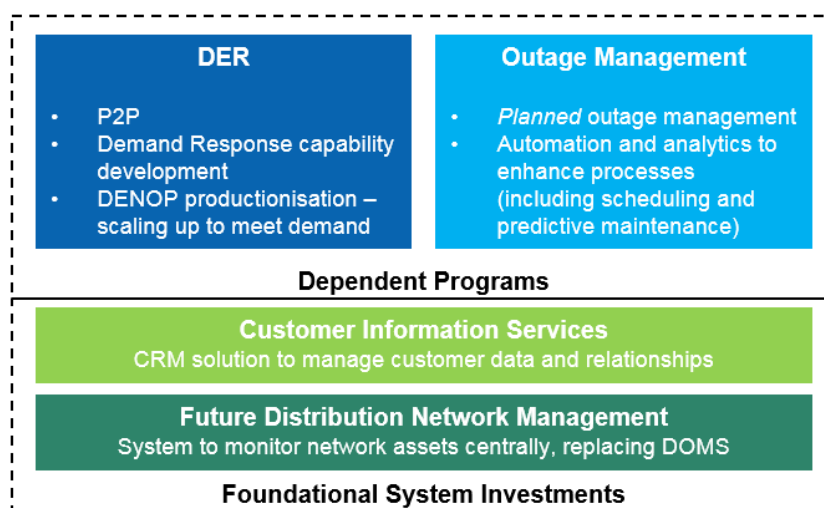
The investments proposed in this program of work include:

- Improvements in **forecasting and modelling capability**, to understand where DER operation is constrained or is causing constraints on the network, which areas pose the highest risk or opportunities for DER, and where future areas of customer DER uptake are likely to occur
- Investments to allow for **improved visibility of the LV network** – including GIS upgrades, implementation of field mobility solutions for managing LV network detail to the energy consumer, and spatial application viewers
- Technology to enable maximum customer DER connection and operation within the limits of the network, to model and **manage the impacts** of changing load, storage and generation in a cost-efficient manner
- Technology to provide customers who have DER with **better price signals** to facilitate efficient use of DER for all and enable peer to peer trading.

AusNet Services is taking a conservative and prudent position on technology investments required to deal with DER – it is not proposing to prepare for all uncertain future business models but needs to be ready to participate and provide data to new entities providing services for customers.

The objectives outlined in this program of work are heavily dependent on investments outlined in both Future Distribution Network Management System (FDNMS) and Customer Information Services briefs. These foundational pieces will ensure network and customer data are captured accurately and consistently across the business. This data will underpin advanced analytics and automation tools, resulting in improved operational efficiency, decision making, and customer relationships.

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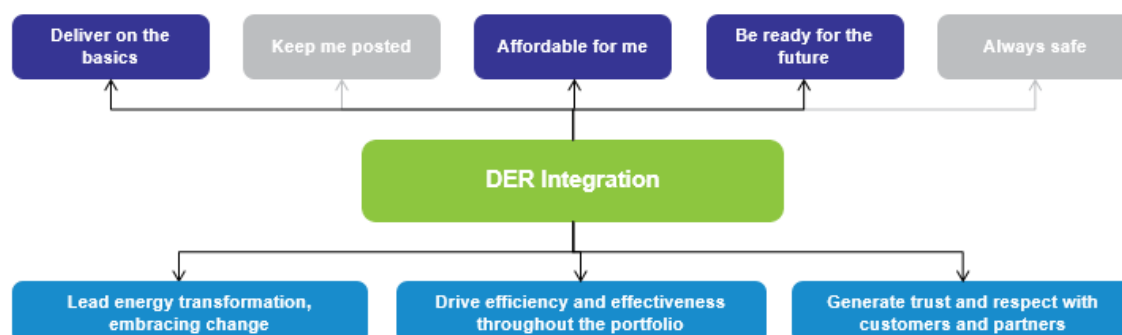


This program of work will deliver significant benefits to customers over the long term. The main areas of benefit include:

- Ability to connect DER to the AusNet Services network efficiently (Be ready for the future)
- Secure, stable power supply (Deliver on the basics, Always safe)

In summary, this program will bring to the customers the following benefits: “deliver on the basics”, “affordable for me” and “be ready for the future”. Mapping of the program with customer outcomes is illustrated in the figure below.

Figure 2-1 Summary of customer and business drivers of this program



Alignment with AER ICT expenditure assessment framework

In accordance with the framework outlined in the AER’s Consultation paper – ICT Expenditure Assessment of May 2019, we have categorised this program as non-recurrent expenditure, on the basis that it relates to ongoing investment in AusNet Services’ network infrastructure.

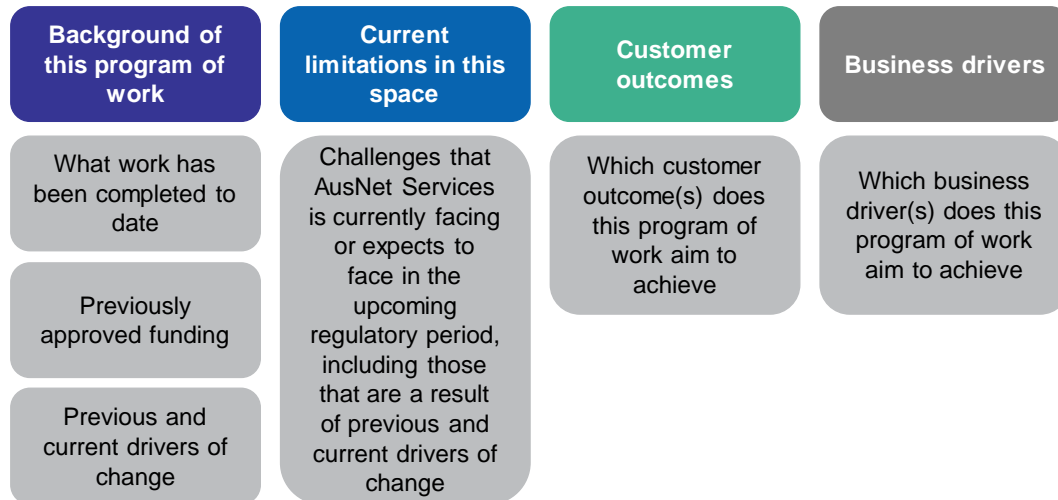
We have also undertaken NPV analysis in support of the project and have developed a detailed business case in support of the chosen option.

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3 Context

The DER Program of work for the next regulatory period is will enable AusNet Services to evolve its Technology in line with the changing market and consumer expectations. It includes Technology driven initiatives that address specific limitations in AusNet Services' capability to integrate DER and participate in future business models. It aligns with other business investments in innovation, reflecting the technology cost components of specific initiatives.

Figure 3-1 Key areas of the context to be discussed



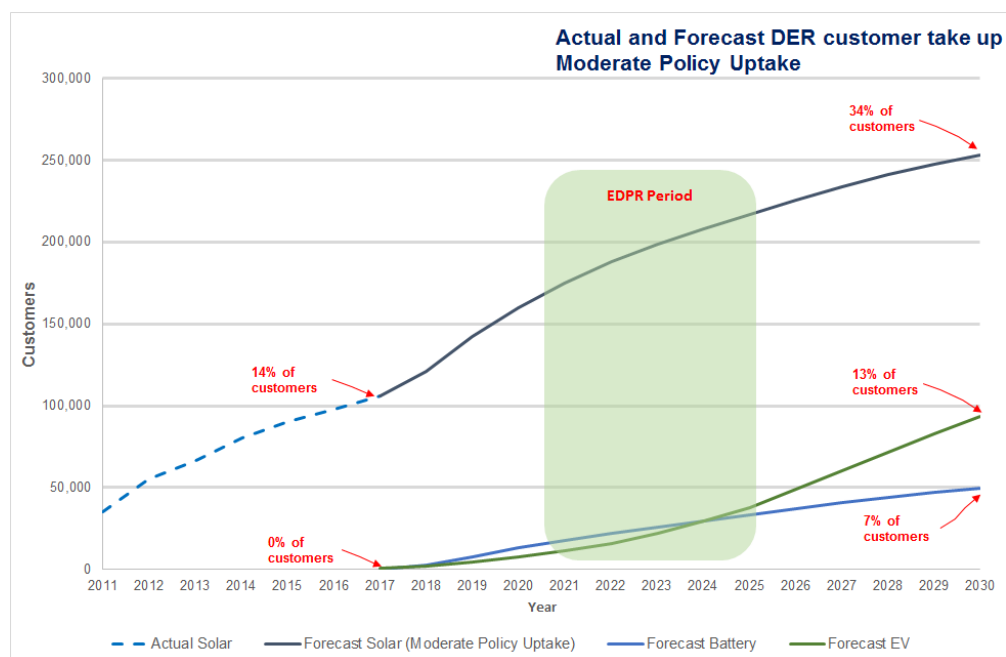
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3.1 Background

Over the past decade, Australian consumers have heavily invested in rooftop solar PV. The Australian Energy Market Operator (AEMO) forecasts this trend will continue for the foreseeable future, and in addition, storage solutions (mostly household batteries) have entered the market and are expected to be adopted enthusiastically as the economic payback periods improve with scale driven cost reductions.

The following diagram presents AusNet Services' forecast of solar PV uptake.

Figure 3-2 AusNet Services' forecast of solar PV uptake



DER technology costs, performance and policy changes could escalate DER uptake, requiring more rapid implementation and adaption.

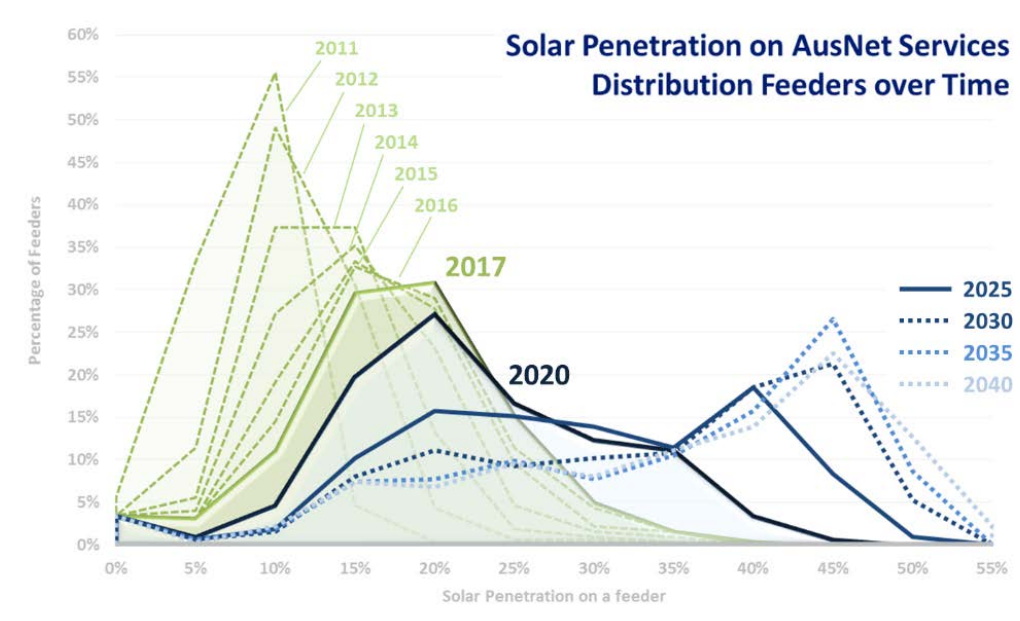
AusNet Services estimates that half of our distribution feeders will have greater than 30% solar penetration by 2025 (from 7% today) and may require some form of control or mitigation to mitigate solar impact to other connected customers. We note any requirement for control or mitigation is highly dependent¹ on type of network and location of DER installed along the

¹ Problems arising from hosting additional DER depends on the nature of the network. For example, weak parts of the network may run into problems at 20% solar penetration, whereas stronger parts may be able to host more than 60%. We note that it is the overall kW capacity of DER installed that drives network issues, not % penetration, so size and location of installed systems are very important.

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feeder. This is outlined in the following figure.

Figure 3-3 AusNet Services' solar penetration on a feeder



DER integration creates a number of risks that AusNet Services must be prepared to manage in the next regulatory period. Unmanaged DER poses the following risks:

- DER customers can face reduced PV generation (and lost feed-in tariff income) due to inverter tripping, or alternatively reduced PV generation due to conservative network policies;
- Other connected customers may face reduced quality of supply due to voltage dips;
- Some customers' electrical equipment may be damaged from over voltage;
- Customers who invest in electric vehicles for home charging may face overnight charging issues;
- AusNet Services' network may breach the distribution code due to voltage levels exceeding or deviating from the required limits; and
- AusNet Services' assets, including conductors and transformers, may face damage from thermal overload, resulting in higher costs for consumers.

To manage the above risks, DNSPs, including AusNet Services, currently utilise 'blunt' or static approaches, the most common being application of static export limits to new connection applications. Today, these static export limits apply to <1% of AusNet Services customers, but will grow as penetration increases. These limits constrain the energy output from individual DERs but help prevent impact to other connected customers.

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Preparing for a more efficient and optimal integration of DER at the forecast levels will require investment in technology in the next regulatory period.

In the current regulatory period, AusNet Services has undertaken limited investment in the business-wide integration of DER, focusing on technology trials and improving the customer connection process for DER. As the scale of DER connections and its impact on network operations is increasing, the need for investments to improve DER integration across the network is also increasing.

In the longer-term, as DER technologies grow in penetration and sophistication, and new third party business models emerge, the potential role is emerging for distribution networks to act as 'orchestrators' of distribution power flows. Orchestration can release additional value from customer DER investments from facilitating and integrating access to other buyers within the wider energy market (including AEMO as system operator) and other customers.

At present, the future role of distribution network operators is uncertain and yet to be clarified, within a decentralised, digitised energy system. Regardless, AusNet Services needs to undertake 'no-regrets' investment in technology to meet customer expectations and prepare the foundation to facilitate and integrate emerging business models and markets.

3.2 Current limitations

Within the context of DER integration, AusNet Services expects that the following business capabilities will require Technology developments and enhancements within the next regulatory period:

Distribution planning

- Improved forecasting, particularly integrating DER export data (for historical outputs and forecasts based on the operating schedules of connected DER)
- Increased sensing and data processing associated with network operating state, power quality, load and DER export at the sub-transmission level, and at limited points for constrained HV and LV network areas
- Increased data capture and validation for increased resolution of the LV network where key information is currently not captured (i.e. connection from the pole to the premise)
- Network modelling at sub-transmission points, and for constrained HV and LV networks.

Procuring for network optimisation:

- Increased procurement of demand management capacity and transaction volumes for load-driven constraints.

Network operation:

- Development of dynamic technical envelope evaluation for DER integration (e.g. hosting capacity) for most locations
- Increased network management capability to execute dynamic network strategies (key focus areas on voltage control, phase shifting and dynamic DER management, including customers and grid batteries).

Orchestration

- Information exchange between AusNet Services and third parties (for example, Distributed Energy Resource Management System (DERMS) provider or aggregators) to allow for dynamic DER management and signalling.

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3.3 Objective(s)

Under the proposed program of work, by June 2026 AusNet Services is aiming to:

- more accurately forecast DER uptake and better understand the impact of DER on its network and existing connected customers;
- provide a better customer service by efficiently and accurately responding and evaluating DER customer connections;
- support increased customer choices in DER connection options and improved economic investment options;
- more accurately monitor and evaluate constraints arising from network and DER operations;
- for areas of the network with high penetration of DER, optimise and coordinate network and DER operations to operate the distribution system more closely to its allowable physical limits;
- be able to provide price signals and incentives to customers reflecting the cost of connecting and managing DER during periods of peak network constraint; and
- will be able to efficiently support interaction and data exchange with third parties seeking to aggregate customers' DER and facilitate peer-to-peer trading.

3.4 Customer outcomes

Through customer research carried out by AusNet Services, a succinct list of key customer values and priorities was identified. These customer outcomes are:

- delivering basic services – “deliver on the basics”
- keeping customers informed – “keep me posted”
- affordable services – “affordable for me”
- adaptability – “be ready for the future”
- safety – “always safe”.

This research has been further validated through the ICT deep drive presented to the customer forum. Additional information on each of these customer outcomes is provided in the overarching Technology EDPR submission FY2022-2026.

All expenditure programs identified and proposed by AusNet Services have regard to the customer outcomes and can be directly linked to at least one of these five outcomes.

We consider that this program of work is most relevant to “**deliver on the basics**” as investments in improving analysis and modelling of DER impacts will improve the efficiency and effectiveness of AusNet Services' long term planning and enable it to continue to provide reliable power supply. It is also relevant to “**affordable for me**” as it includes a prudent level of investment in technologies to support DER integration and “**be ready for the future**”, as DER integration is focused on adapting to external technological and customer driven changes, and will further explore this in the discussions of each of the options.

Specifically, for DER, AusNet Services plan to deliver the following customer outcomes in the 2022-26 regulatory period:

1. Transparency of renewable hosting capacity to customers and market
2. Improve connections process for most locations, resulting in high customer satisfaction
3. More accurately integrate DER uptake and impact into distribution planning, resulting in better capital investment decisions, and in the long-term, reduced costs for customers;
4. Network highly optimised and increasingly dynamic – with view to:

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- a. Reduce restrictions on customer's DER connections, and hence, increase economic output for customers and wider markets, and
 - b. Minimise scale of network investment demands for greater DER exports, with reduced costs for customers;
5. Increase utilisation of demand management to reduce load-driven capital costs for customers.

It is to be noted that the broader technology platform to support future "market" related activities within the envisaged Distribution System Operator (DSO) role is excluded from our investments at this stage, as it is as yet uncertain as to the level of DNSP related functionality that will be required in the future market framework.

3.5 Business drivers

In the face of significant industry disruption resulting in a period of substantial uncertainty and increasing complexity across the industry, AusNet Services has selected three key business drivers that set the direction for the business.

These business drivers are:

- Lead energy transformation, embracing change
- Drive efficiency and effectiveness throughout the portfolio
- Generate trust and respect with customers and partners.

All expenditure programs identified and proposed by AusNet Services have regard to the business drivers and are directly linked to at least one of these initiatives.

This program of work will be most relevant to the first driver – 'Lead energy transformation, embracing change', as it responds to the ongoing energy sector transformation, and will further explore this in the discussions of each of the options.

At the end of the 2022-26 regulatory period, AusNet Services needs to be able to:

1. **Enable DER participation in line with network hosting capacity** – at present, due to limitations on its LV monitoring and network information, AusNet Services is necessarily taking a conservative view on level of DER that can be connected to the network. This affects customers through limitations on solar capacity and exports, and timeframes for DER connection.
2. **Manage DER efficiently** – AusNet Services needs to better manage its network around connected DER, to avoid the impacts of fluctuation in voltage. Better DER management will in turn enable AusNet Services to facilitate an efficient level of DER.

To deliver these outcomes, AusNet Services needs to:

1. **Plan for DER.** Use informed forecasts to understand where DER operation is constrained or is causing constraints on the network, which areas pose the highest risk or opportunity for DER, and where future areas of high risk or opportunity are likely to occur. This includes having contemporary (i.e. up to date, if not near real-time) visibility of the LV network at areas where DER is causing constraints.
2. **Facilitate demand response.** Provide customers (including DER customers) with targeted incentives to facilitate more efficient use of the network and DER for all.

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3. **Better manage DER operationally.** Use technology and information to forecast, monitor and respond to the impacts of changing load, storage and generation, optimally managing the flow of power, and the interaction between network/non-network assets.
4. **Prepare for future market requirements.** While AusNet Services considers that it is unlikely that a full DSO model will be implemented by June 2026, it is prudent to prepare for emergence of market platforms and framework that require AusNet Services to take an orchestration role. AusNet Services must have the enabling capabilities to participate in and contribute to orchestration.

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4 Options

4.1 Overview

This section provides an overview of a select number of options which may feasibly alleviate the current limitations. Each option represents a combination of Technology initiatives that work towards the customer outcomes that are sought by the business described in the previous section.

The objective of this program is to integrate and manage DER efficiently during the next regulatory period, to progress AusNet Services on the path to a digitally optimised utility that can participate in future orchestration business models.

As described in the context and drivers' sections above, the increasing penetration of DER is already having an impact on AusNet Services' ability to efficiently deliver reliable, safe power for customers. As such, 'Do Nothing' is not an acceptable option for addressing DER over the next regulatory period.

Table 4-1 Brief overview of the options

Brief overview of each of the options	
Option 1	Analyse – Improve modelling capability (Forecasting and HV LV modelling) and consolidate information (GIS and Spatial network views) to enable more efficient connections and planning
Option 2 (Recommended)	Analyse and respond – Invest in Technology to enhance AusNet Services' capability to integrate DER and facilitate developing markets
Option 3	Analyse, respond and lead – Further invest in technology to enhance DER outcomes – more demand response, greater customer take up of minigrid and peer to peer trading opportunities

The principle difference between the three options for this program are the degree to which business processes that we are currently developing in pilot schemes are automated. Option 1 establishes core capability for forecasting HV LV modelling and spatial network impacts which are the minimum capabilities required to enable DER integration across the network. Option 3 assumes a high degree of centralised automation. Options 1 and 2 both assume that un-automated activities will be carried out locally rather than through centralised tools.

4.2 Option #1 Analyse

At a minimum, AusNet Services must invest to improve its modelling capabilities to better understand and anticipate DER. It also needs to complete and enhance the recent upgrades of some key software programs that will enable more informed and efficient network planning, incorporating the data needed to analyse the impact of DER and manage customer expectations.

The following sections outline the activities that would be carried out under Option 1.

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Enhanced demand forecasting

Currently, AusNet Services forecasts battery and electric vehicle uptake on our network by localising the AEMO forecasts. Industry indicators suggest there will be significant uptake post-mid 2026 but improving technology, reducing costs and government intervention may see this earlier.

Under Option 1, AusNet Services would invest in improvements to its forecasting models to integrate the anticipated DER uptake into its demand forecasting.

HV LV Modelling

Environmental concerns, technology advancement and government incentives have been a driving force that has empowered customers to participate in the way their electricity is produced and consumed. This new paradigm challenges the traditional network hierarchy and places an emphasis on the low voltage network and how it can affect the upstream network as customers produce and consume electricity. Distribution businesses must understand the customers' ability to control how and when they use electricity and take the opportunity to leverage this control in order to optimise the distribution network in the future.

Network modelling is the key to understanding this new environment. Traditionally the most effort in modelling the network has occurred at the higher voltage levels, with little to no analysis being done on the low voltage network. If this is to continue, technical issues will arise that will frustrate customers and negatively influence their network experience. Conversely proactive approach that advances network modelling will open doors to overcome technical challenges and create opportunities for the network to add value to the customer, community and its business (Refer to Appendix 2 Conceptual Scope for further information)

In the current period, AusNet Services has carried out a trial of network modelling using Siemens PSS Sincal © modelling platform, which is used by the Network Planning team and supported by the Technology division. The modelling trial was undertaken for one of its most DER-constrained feeders (HPK21 – Hampton Park).

PSS Sincal is a tool used by Network Planning to perform power flow and fault level studies using models of the physical network, synthesised load data, and estimated real and reactive power for embedded generation.

The models of the physical network are currently derived from the GIS (this required some assumptions to be made where data resolution does not exist), and the load data is approximated using a process known as "load manipulation" whereby modified nameplate ratings of transformers are manually manipulated up or down using SCADA derived feeder segment currents to perform successive load flow calculations until the SINCAL model produces a result similar to the reported SCADA derived values. A worst case scenario, in terms of load, is then used to identify areas of the network that are at risk of voltage or overload issues. Fault level studies, which are relatively independent of load, are also undertaken to help inform decisions about protection settings.

There are some significant limitations in the current processes:

- The SINCAL models used only cover the HV network. The LV network, and a continuous model of the HV and LV network has not been modelled. Decisions around design of the LV network are taken using rule of thumb methods, or calculation tools that are based on incorrect assumptions and/or are difficult to use.
- AMI data is not being used as an input to the models – this represents a high opportunity cost given the potential value of this data and the cost of obtaining it. The missed opportunities include:

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- Time based load flow studies are not being performed, meaning diurnal views of network operating states are not available.
- The time taken to produce a baseline model could be reduced – significantly lowering the amount of manual effort performed by engineering staff.
- Load diversity is not being modelled. This will increasingly result in overly conservative decisions being made in some cases, causing network overbuild, or underestimations being made in other cases due to lack of appreciation of diurnal load pattern changes, leading to under-investment in the network assets.

The findings from this trial are summarised below:

- The outputs produced by the model were compared with measured values from the SCADA and AMI systems, and found to be consistent over multiple time periods. The HVLV load flow modelling approach would provide a solid basis for scenario based predictive analytics. Further analysis of the model outputs is needed to understand sensitivity factors and to produce statistically rigorous measures of the modelling efficacy.
- Models were developed with differing penetrations of rooftop solar, electric vehicles and batteries. The models and modelling software provided:
 - Insights into the impact of high DER penetration in the LV and HV networks,
 - Data about load and generation at risk, and
 - The tools and means to explore remediation through asset augmentation, load/generation shifting and power factor manipulation.
- Benefits that would be realised if the approach was scaled up include:
 - The solution would provide accurate predictions of constraints and power quality issues under various DER uptake scenarios, over the entire network, and would provide the tools needed to help develop and defend remediation measures.
 - Planning would become less reactive and more pro-active.
 - Traditional functions for assessing new customer connections and network planning would also benefit significantly from the solution.

For the 2022-26 regulatory control period, AusNet Services plans to extend its learnings from the trial and develop a 'full network normal model' in PSS Sincal. This will enable AusNet Services to better plan, integrate and manage the impact of DER. It will enable 'what if' analysis for solar and inverter output.

This work will include activities to improve AusNet Services' GIS data quality. At present there are gaps in the data which prevent full analysis.

Alignment to objectives

We do not consider that option 1 achieves all the intended objectives of this program of work, as shown in the table below.

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Table 4-2 Objectives analysis of option 1

Objective		Comments
Be able to more accurately forecast DER uptake and better understand the impact of DER on the network; provide a better customer service by efficiently and accurately responding and evaluating DER customer connections; support increased customer choices in DER connection options and improved economic investment options	✓	This option includes investments to enable improved forecasting and analysis of DER impacts, which will enable more DER connections and facilitate increased customer choices
More accurately monitor and evaluate constraints arising from network and DER operations; For areas of the network with high penetration of DER, optimise and coordinate network and DER operations to operate the distribution system more closely to its allowable physical limits – resulting in efficiencies	✗	N/A
Facilitate price signals and incentives to customers reflecting the cost of connecting and managing DER during periods of peak network constraint	✗	N/A
Efficiently support interaction and data exchange with third parties seeking to aggregate customers' DER and facilitate peer-to-peer trading.	✗	N/A

Costs

Table 4-3 Costs of option 1

(\$m)	FY2022	FY2023	FY2024	FY2025	FY2026	Total
Capex	\$0.58	\$0.74	\$0.88	\$1.04	\$1.21	\$4.45
Opex	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Electricity distribution cost	\$0.58	\$0.74	\$0.88	\$1.04	\$1.21	\$4.45
Total program cost	\$0.58	\$0.74	\$0.88	\$1.04	\$1.21	\$4.45

Benefits

The benefits of investing in improvements to AusNet Services' forecasting and HV LV modelling capability are predominately associated with the effectiveness of network planning. It is not possible to quantify specific benefits associated with long term planning efficiency, however, as a guide, estimates can be made as to the avoided costs associated with planning processes, should time savings be made (in an increasingly complex operating environment).

Improving the quality of LV network data through the modelling tasks included in this option will reduce the complexity of the DER connection process. This will result in faster DER connections and reduce the amount of time that customers with installed DER are waiting for connection to enable the export of excess power, and enable the payment of feed in tariffs.

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It is not possible to accurately identify the DER connection time savings that would be made available as a direct result of the investment in modelling improvements. However, should the investments result in connections occurring earlier than otherwise, it would result in additional feed-in tariff revenue for the additional connected days. AusNet Services forecasts that 32,000 customers will seek solar connection to its network over the 2022-26 regulatory period.

Risks

There are a number of risks associated with this particular option, as highlighted in the table below. Based on the consequence and likelihood of each risk, we have rated each of the individual risks blue, green, yellow, orange or red (order of severity). See Attachment 1 – Risk level matrix for additional information on this rating system.

Table 4-4 Risks of option 1

	Risks	Consequence	Likelihood	Risk rating
R1.1	DER take-up continues to exceed forecasts	Level 3: Customers are unable to connect DER due to uncertain network impacts, resulting in significant negative media and customer dissatisfaction	Almost certain	B
R1.2	AusNet Services has limited ability to integrate with Peer to Peer platforms as they emerge over the	Level 1: Low customer satisfaction, localised customer complaints	Possible	E

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	Risks	Consequence	Likelihood	Risk rating
	FY2022-26 period			
R1.3	No DER demand response pricing tools developed by AusNet Services.	Level 1: Lost opportunity for more efficient investment Higher cost network	Almost certain	C
R1.4	AusNet Services is unable to productionise Distributed Energy Network Optimisation Platform (DENOP) DENOP does not facilitate interaction with third party providers (i.e. the market moves faster than AusNet Services' capability)	Level 2: Inability to monitor and evaluate system constraints to accommodate DER Inability to optimise network using dynamic strategies involving network and DER operations. Loss of investments	Possible	D

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	Risks	Consequence	Likelihood	Risk rating
		made to date Lost opportunity to participate in orchestration Higher cost network		
R1.5	Customers (and other stakeholders) perceive the investments in DER integration as inefficiently high	Level 2: Low customer satisfaction, poor public perception of AusNet Services (some media response)	Unlikely	D

As we have identified that this option would result in a number of risks we consider that overall this option is rated high risk.

Alignment to customer related drivers of expenditure

As discussed in Section 3.4, five key customer outcomes have been identified through discussions with customers. The table below highlights the how this option will achieve these outcomes. Where we consider that a customer outcome is not directly achievable by the option or irrelevant, 'N/A' is applied.

Table 4-5 Customer related drivers of option 1

Customer outcome	How this program achieves this
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Deliver on the basics	The investments in improving analysis and modelling of DER impacts will improve the efficiency and effectiveness of AusNet Services' long term planning and enable it to continue to provide reliable power supply.
Keep me posted	N/A
Affordable for me	N/A
Be ready for the future	N/A
Always safe	N/A

In relation to affordability of this option, while this option involves minimal investment during the 2022-26 regulatory period, it would result in higher overall network costs in the longer term as opportunities for improved efficiency are missed. This option does not adequately prepare AusNet Services for a future with high DER penetration.

Alignment to business related drivers of expenditure

As discussed in Section 3.5, there are three business drivers that AusNet Services has identified and is focussing on over the next regulatory period. The table below highlights how this option will input into the initiatives where relevant. Where we consider that a business driver is not directly relevant to the option, 'N/A' is applied.

Program Brief**Table 4-6 Business related drivers of option 1**

Business drivers	How this program achieves this
Lead energy transformation, embracing change	Partial achievement - This option includes some investment to advance aspects of DER integration and enable some transformation. To be a leader in energy transformation requires a higher level of investment.
Drive efficiency and effectiveness throughout the portfolio	The investments in analysis and modelling will improve the efficiency and effectiveness of AusNet Services' long-term planning. However, this option misses' opportunities to further develop efficiencies driven by the emerging markets and technologies underpinning dynamic grid management.
Generate trust and respect with customers and partners	N/A - This option will not progress AusNet Services sufficiently towards greater trust and respect with customers and partners, because it will not enable efficient DER integration and would continue the conservative approach to DER hosting capacity constraints.

This option will not allow AusNet Services to position itself as leading energy transformation, as it does not provide sufficient investment in DER implementation and readiness for the impacts of high DER penetration.

This option will not progress AusNet Services towards greater trust and respect with customers and partners, as it results in insufficient investment in DER integration.

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4.3 Option #2 Analyse and respond (RECOMMENDED)

Option 2 extends the investments outlined for Option 1 to include activities to not only improve modelling and forecasting capability, but to actively manage the impacts of changing load, storage and generation, managing the flow of power and the interaction between network and non-network assets efficiently, to avoid damage. It also includes Technology investments to enable customers who have DER with **better price signals** to facilitate more efficient use of DER for all.

In addition to those activities outlined in Option 1, Option 2 also includes activities 4-7, described in detail below.

1. Future Ready Forecasting Model
2. HV LV Modelling (full)
3. GIS Network Data Quality Improvements
- 4. Spatial Application Rationalisation**
- 5. Demand Response Management Enablement**
- 6. Distributed Energy Resource Control/Optimisation (DENOP)**
- 7. Peer to Peer (P2P) trading**

Spatial Application Rationalisation

In the increasingly complex distribution network environment, to facilitate efficient, informed network operations and planning, information is required from multiple data sources.

Spatial Data Management for Electricity (SDMe), a Geographic Information System (GIS) at AusNet Services, is the Network Information Backbone for Electrical Distribution and Transmission. It is used to manage and interrogate Electrical Distribution and Transmission network asset information, where they are, and how they are connected to form the electricity grid. Thousands of employees, contractors and the public access SDMe information and capabilities via several systems/interfaces/reports for all network-related operations, including outage management; works planning/scheduling; asset lifecycle management; customer supply management; designing for an optimised network; and for developing insights.

In the current regulatory period, AusNet Services has invested in a major upgrade of SDMe, following the end of vendor support for its previous version. In the 2022-26 regulatory period, AusNet Services needs to complete the transition to its new SDMe by:

- Uplifting the new SDMe with viewer capabilities utilising information from Application Programming Interfaces, GPAT (lightening detection) and Land Victoria (traffic lights), from SAMs and SAMs OPs
- Decommissioning the old viewers.

These investments will deliver:

- Reduced total cost of ownership of SDMe
- Improved data integrity
- Increased productivity through the ability to use a single system with external data sources easily integrated
- Ability to incorporate additional external data sets to better inform planning and operations.

Demand Response Management Enablement

Demand response management involves providing customers with price signals and rebates that encourage them to use power, and manage their DER exports, at times and in ways that reduce the

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cost of running the network. It can also involve AusNet Services undertaking control of load and generation assets at customer sites, through the development of demand response contracts with customers and remote technologies.

Meeting peak demand poses significant network augmentation costs, and therefore investing to deliver reductions in peak load has the potential to avoid material costs.

While this capability exists for large commercial customers, residential customer demand response incentives have been limited to trials. AusNet Services expects that it will be required to develop demand response capabilities in order to meet the expectations of customers and policy makers (particularly the Victorian Government) over the next regulatory period.

In the FY2022-26 regulatory period, AusNet Services plans to develop its capability for providing demand response incentives for residential customers and customers with DER. There are a number of options for this investment, including:

- Building on existing in-house tools (such as DENOP) to develop the capability for demand response and dispatching control signals
- Purchasing a product to enable demand response capability to be integrated into AusNet Services' network control room
- Outsourcing demand response management to third parties that would contract with customers directly and provide signals to AusNet Services to manage its

This option includes sufficient investment to enable AusNet Services to build on its existing in-house tools to develop the capability for demand response.

Distributed Energy Resource Control/Optimisation (DENOP)

In the current regulatory period, AusNet Services is leading the development of two important, award winning trials incorporating customer-based DER into mini-grids:

1. Yackandandah community mini grid – a partnership between AusNet Services' Commercial Energy Services' product brand Mondo Power, AusNet Services and Totally Renewable Yackandandah (TRY), this trial involved the installation of different combinations of rooftop solar systems, battery storage and Mondo Ubi on 169 homes, as well as extensive network upgrading.
2. The Mooroolbark Mini Grid project involves powering 14 homes in a suburban street with a combination of solar panels, 10kWh storage batteries and the main power grid. Residences are equipped with advanced energy management, communications, monitoring and safety systems. This enables individual participants to capture, store and optimise the use of both solar and grid energy. In addition, all 14 homes can operate as a unified energy system, i.e. a mini grid. Energy can be shared between homes, and the mini grid can interact with the main power grid, as well as operate independently.

In late 2017, our Distributed Energy Network Optimisation Platform (DENOP) was used to control the batteries and share the stored renewable energy among all 14 trial homes in Mooroolbark – even those without solar – while they were “islanded” from the electricity network for almost 24 hours, before successfully switching all homes back to the main power grid.

By combining solar PV, battery storage, smart control and main grid connection, each residential power system participating in the Mooroolbark trial can:

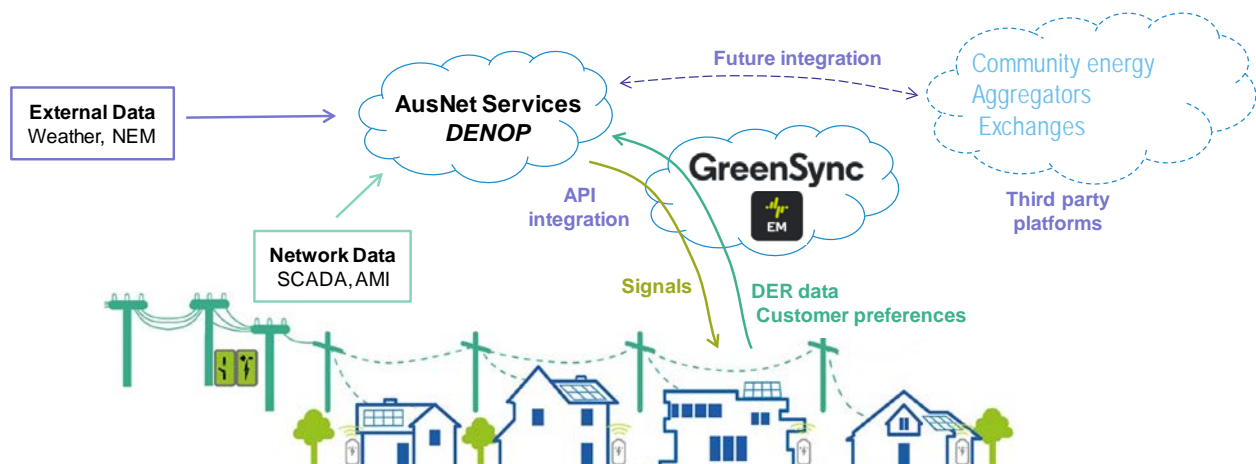
1. Capture solar energy, then allow the participant to use it, rather than grid power, when their solar PV is not generating. (i.e. in the evening).

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2. Take advantage of cheap off-peak electricity rates between 11pm and 7am to recharge the battery cheaply with grid power. This is called 'tariff arbitrage.' It is the first configuration of the power system for the Mooroolbark Mini Grid Trial.
3. Control how much power is exported to the grid, and when it is exported.
4. Continue to power each house if the grid fails. This is called 'islanded' or 'UPS' mode. It is one of the capabilities of the SP Pro battery inverter.
5. Communicate with the mini grid control system. The battery management system includes a communications module that remains in contact with the mini grid control system. So a range of components in the system are being monitored, and can be controlled, to optimise performance and ensure safe operations.
6. Provide the participant with almost real time information on energy usage and power status. The mini grid web portal includes an active power flow diagram that shows; - how much power the solar array is generating, - how much power the house is using, - whether the battery is charging or discharging - - whether the participant is exporting to or importing from the grid.
7. Share energy with other houses in the mini grid. 8. Respond to network requests to manage power consumption, increase or decrease power export and help improve power quality.

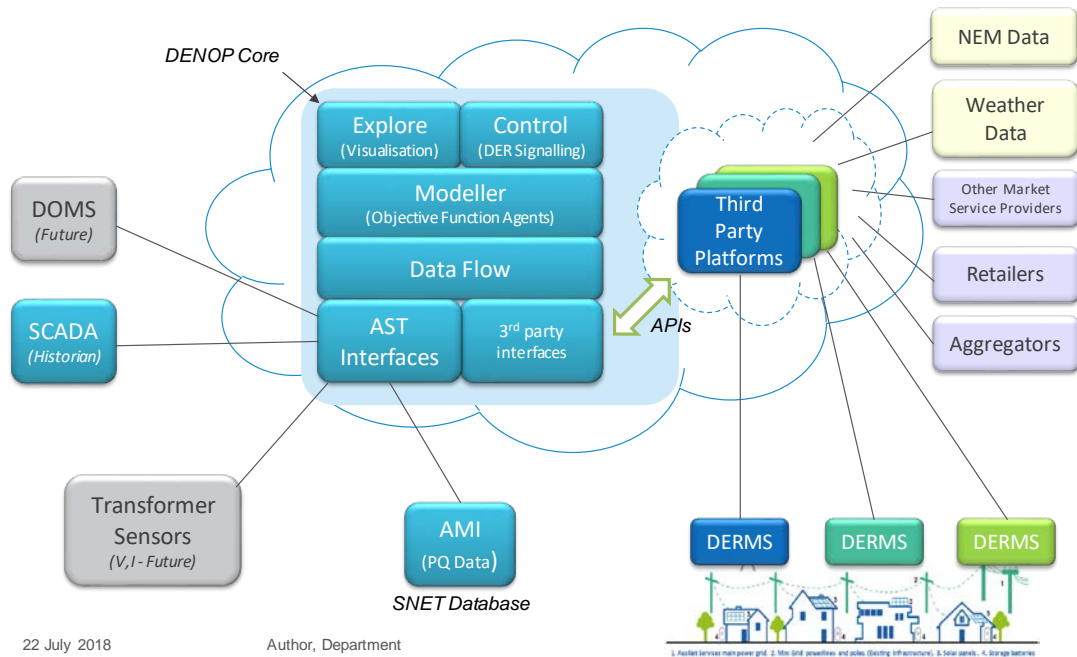
DENOP is a cloud-based software platform which is designed to monitor, control and orchestrate to optimise network operations and services efficiently for all customers. It is designed to cover a diverse portfolio of distributed energy resources and is flexible for integration either directly or via third-party management platforms.

The following figure outlines DENOP's role in the mini-grid scenario:



The following figure outlines the DENOP architecture:

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22 July 2018

Author, Department

A future scenario of high DER is likely to involve multiple DER management platforms serving multiple customer types. AusNet Services can gain value and provide better customer outcomes through integration with these platforms to optimise/orchestrate DER operations against network parameters. Without DENOP, AusNet Services would not be in a position to efficiently interact with DER management platforms to facilitate mini-grids during the 2022-26 regulatory period.

While the trials are ongoing (and expanding), and AusNet Services' is continuing to learn from the operation of DENOP, it is clear that the platform will be important in allowing us to facilitate third parties to provide mini-grid trading services to customers during the 2022-26 regulatory period. AusNet Services plans to operationalise DENOP as part of a flexible DER connection offer to customers over the 2022 to 2026 period in parallel with related innovation projects. This will require Technology investments to establish the operational environment to service BAU DENOP applications during the period as well as facilitating further development and expansion of the DENOP platform.

The integration of DENOP into AusNet Services' IT systems is covered under the Future Distribution Network Management System program.

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Peer to Peer trading

As the take up of solar and battery storage systems increase, more customers are interested in peer-to-peer electricity trading (also known as p2p or ptp trading). The system allows consumers to take advantage of other users who produce more energy than they need. Those consumers can sell their excess power for profit. Peer-to-peer solar energy is a logical development in the new economy which sees things such as housing (AirBnB), cars (CarNextDoor) and loans go from person to person rather than a large commercial enterprise to consumer.

Peer to peer trading offers a number of benefits for electricity customers:

- Greater rewards for customers selling excess solar and battery capacity, as compared to the minimum feed in tariffs
- Reduced customer energy costs for those purchasing from peers instead of buying grid energy
- Makes the benefits of solar and batteries more equitable for all (compared to the subsidisation through minimum feed in tariffs)
- Offers price signals that truly reflect the market and will therefore make the whole system more efficient and lower cost.

As peer to peer opportunities among energy customers develop over the next five to seven years, AusNet Services will be required to interact with third parties wishing to facilitate peer to peer trading among our energy customers.

At present, the market structure whereby all of a customer's meter data is billed by the retailer, prevents the development of peer to peer trading. Each customer pays for every unit of energy consumed from the grid through their retailer. However, this requirement is more convention, rather than law or regulation. AusNet Services has the ability to share smart meter data with third parties to facilitate peer to peer trading, before the data is provided to the market and retailers, and then adjust the data to account for any trading among customers.

Peer to peer trading of electricity is likely to work through the following steps:

1. DER customer offers to sell their excess energy via a trading platform, a user friendly digital marketplace. A bid is registered, enabling other participants to see it.
2. Other participant on a trading platform sees there is energy available during the day at a cheaper unit price than their retailer charges. They then bid for this energy via a trading platform.
3. The system matches their bids, subject to the DER customers generating enough energy at the right times and the other participant consuming enough energy at the right times. In the future, customers could choose to fully automate their energy trading.

Importantly, bids are matched after they have actually exported or consumed the energy they've traded. (i.e. 'ex-post'). New meter data, that does not include traded energy, is then provided to retailers. Peer-to-peer trading does not impact the net outcomes in the market.

In the current regulatory period, AusNet Services has amended its terms and conditions in the deemed Metering Coordinator Agreement with retailers related to AMI meters. The new terms and conditions have established the use of final, agreed meter data substitutes for the purpose of peer to peer trading, in accordance with the Metrology Procedures.

In the very early stages of the development of peer to peer markets, meter data can be shared with third parties via email, and simple manual adjustments can be made to accommodate trades and ensure the correct retail bill outcomes. However, as the market develops, and the number and

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complexity of energy trades grows, investments in Technology are required to facilitate efficient accurate meter data transfer.

AusNet Services does not intend to trade in the peer to peer services market. This improvement will allow AusNet Services to facilitate the P2P market and enable the efficiencies it could generate.

Under Option 2, investments in facilitating peer to peer trading would be limited to funding for manual adjustments and simple trading tools. This reflects the uncertainty around when the peer to peer market is likely to develop.

Alignment to objectives

Option 2 includes activities designed to partially address all of the intended objectives of this program of work, as shown in the table below.

Table 4-7 Objectives analysis of option 2

Objective		Comments
Be able to more accurately forecast DER uptake and better understand the impact of DER on the network; provide a better customer service by efficiently and accurately responding and evaluating DER customer connections; support increased customer choices in DER connection options and improved economic investment options	✓	This option includes investments to enable improved forecasting and analysis of DER impacts, which will enable more DER connections and facilitate increased customer choices.
More accurately monitor and evaluate constraints arising	Partial	Investments in DENOP productionisation will assist AusNet Services to

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from network and DER operations; For areas of the network with high penetration of DER, optimise and coordinate network and DER operations to operate the distribution system more closely to its allowable physical limits – resulting in efficiencies		move towards an orchestration capability. Other proposed investments in Distribution Network Management will further advance this objective.
Facilitate price signals and incentives to customers reflecting the cost of connecting and managing DER during periods of peak network constraint	Partial	There is some planned investment in demand response incentives and pricing included in this option, however the level of investment may restrict the number of customers that are targeted for these products and services.
Efficiently support interaction and data exchange with third parties seeking to aggregate customers' DER and facilitate peer-to-peer trading.	Partial	There is some planned investment to progress manual peer to peer trading to enable more efficient data management and transfer.

Program Brief**Costs****Table 4-8 Costs of option 2**

(\$m)	FY2022	FY2023	FY2024	FY2025	FY2026	Total
Capex	\$1.25	\$1.60	\$1.89	\$2.26	\$2.62	\$9.63
Opex	0	0	0	0	0	0
Electricity distribution cost	\$1.25	\$1.60	\$1.89	\$2.26	\$2.62	\$9.63
Total program cost	\$1.25	\$1.60	\$1.89	\$2.26	\$2.62	\$9.63

Benefits

In addition to the unquantified benefits outlined in Option 1 (enhanced network planning and faster DER connections), the investments in Option 2 will deliver additional benefits to customers, including:

- The ability to better integrate customer DER across the AusNet Services network and a reduction in rejected DER connection applications
- Improved customer services and experience
- Reduced risk of damage to customer equipment caused by thermal overload resulting from poorly integrated or visible DER
- Reduced peak demand on the network by introducing technology solutions to orchestrate, manage, and integrate demand response capabilities
- Improved voltage compliance across the network
- Further improvements in the effectiveness of planning and analysis using the data lake – saving time taken in viewing data in multiple systems
- Lower cost of ICT systems through decommissioning the existing spatial viewers, saving approximately \$[C-I-C] over the FY2022-26 regulatory period

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- Peak demand savings generated through the introduction of demand response capabilities (it is not possible to estimate the quantum of savings at this time, as it would require assumptions on the incentive rates and elasticity of demand)
- Avoided penalty payments due to voltage variations.

Preliminary analysis undertaken by AusNet Services suggests that, if the DENOP platform is applied, the number of solar customers (existing and forecast new entrants) who will be constrained, either by not being able to connect, or being constrained in their operation, reduces by over 6,500 by June 2026 on AusNet Services distribution network when compared to the Option 1 option. This equates to a gain of up to 30MW of customer generation at certain times.

The facilitation of efficient data transfer to enable peer to peer trading will result in reduced costs for participants (both AusNet Services, retailers and third party platform providers). An efficient trading process would also make it more likely that the market for peer to peer trading would develop faster, delivering greater opportunities for those with DER to earn a return on their investments and for other participants to make savings by reducing their energy network costs.

Risks

There are risks associated with this particular option, as highlighted in the table below. Based on the consequence and likelihood of each risk, we have rated each of the individual risks blue, green, yellow, orange or red (order of severity). See Attachment 1 – Risk level matrix for additional information on this rating system.

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Table 4-9 Risks of option 2

	Risks	Consequence	Likelihood	Risk rating
R2.1	DER take-up continues to exceed forecasts	Level 3: Customers are unable to connect DER due to uncertain network impacts, resulting in significant negative media and customer dissatisfaction	Possible	C
R2.2	AusNet Services has limited ability to integrate with Peer to Peer platforms as they emerge over the FY2022-26 period	Level 1: Low customer satisfaction, localised customer complaints	Possible	E
R2.3	No DER demand response pricing tools developed by AusNet Services.	Level 1: Lost opportunity for more efficient investment Higher cost network	Possible	E

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	Risks	Consequence	Likelihood	Risk rating
R2.4	<p>AusNet Services is unable to productionise Distributed Energy Network Optimisation Platform (DENOP)</p> <p>DENOP does not facilitate interaction with third party providers (i.e. the market moves faster than AusNet Services' capability)</p>	<p>Level 2: Inability to monitor and evaluate system constraints to accommodate DER</p> <p>Inability to optimise network using dynamic strategies involving network and DER operations.</p> <p>Loss of investments made to date</p> <p>Lost opportunity to participate in orchestration</p> <p>Higher cost network</p>	Possible	D

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	Risks	Consequence	Likelihood	Risk rating
R2.5	Customers (and other stakeholders) perceive the investments in DER integration as inefficiently high	Level 2: Low customer satisfaction, poor public perception of AusNet Services (some media response)	Unlikely	D

As we have identified predominately low risks and one medium risk, we consider that overall, this option is rated medium risk.

Alignment to customer related drivers of expenditure

As discussed in Section 3.4, five key customer outcomes have been identified through discussions with customers. The table below highlights the how this option will achieve these outcomes. Where we consider that a customer outcome is not directly achievable by the option or irrelevant, 'N/A' is applied.

Table 4-10 Customer related drivers of option 2

Customer outcome	How this program achieves this
Deliver on the basics	The investments in improving analysis and modelling of DER impacts will improve the efficiency and effectiveness of AusNet Services' long term planning and enable it to continue to provide reliable power supply.
Keep me posted	N/A
Affordable for me	This option includes a prudent level of investment in technologies to support DER integration ensuring customer price impacts are managed.

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Be ready for the future	This option will enable AusNet Services to prepare for DER integration to meet the current forecasts of DER, and provide customers with a more positive experience in connecting their DER
Always safe	N/A

Alignment to business related drivers of expenditure

As discussed in Section 3.5, there are three business drivers that AusNet Services has identified and is focussing on over the next regulatory period. The table below highlights how this option will input into the initiatives where relevant. Where we consider that a business driver is not directly relevant to the option, 'N/A' is applied.

Table 4-101 Customer related drivers of option 2

Business drivers	How this program achieves this
Lead energy transformation, embracing change	This option will allow AusNet Services to embrace the changes anticipated with a high DER penetration. To be a leader in energy transformation requires a higher level of investment.
Drive efficiency and effectiveness throughout the portfolio	The investments in analysis and modelling will improve the efficiency and effectiveness of AusNet Services' long term planning. Further efficiencies driven by the emerging markets and technologies underpinning dynamic grid management will also drive efficiency and effectiveness.
Generate trust and respect with	This option will progress AusNet Services towards greater trust and respect with customers and partners,

Program Briefcustomers and
partnersby allowing the provision of new
services to incorporate DER.**4.4 Option #3 Analyse, respond and lead**

Option 3 extends the investments outlined for Option 2 to include additional activities to further extend the three most innovative areas of DER integration, to make AusNet Services a leader among its peers.

In addition to those outlined in Options 1 and 2 above, the activities included in Option 3 include:

Demand Response Management Enablement

As discussed above under Option 2, demand response management involves providing customers with price signals and rebates that encourage them to use power, and manage their DER exports, at times and in ways that reduce the cost of running the network. It can also involve AusNet Services undertaking control of load and generation assets at customer sites, through the development of demand response contracts with customers and remote technologies.

This option includes sufficient investment for AusNet Services to procure and implement software to enable demand response capability to be integrated into AusNet Services' network control room.

Distributed Energy Resource Control/Optimisation (DENOP)

As described in Option 2, AusNet Services plans to operationalise DENOP as part of a flexible DER connection offer to customers over the FY2022 to 2026 period. This will require Technology investments to further develop and expand the DENOP platform.

Under Option 3, it is assumed that flexible DER contracts relying on DENOP would be taken up by [C-I-C] AusNet Services customers, which reflects a [C-I-C] percent increase on the customer take up under Option 2.

Peer to Peer trading

Option 3 would significantly extend the investments in peer to peer trading facilitation to enable upgrades of AusNet Services' Meter Data Management System (MDMS) to enable automatic trading to occur.

Alignment to objectives

Option 3 includes activities designed to address all of the intended objectives of this program of work, as shown in the table below.

Table 4-11 Objectives analysis of option 3

Objective		Comments
Be able to more accurately forecast DER	✓	This option includes investments to enable

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uptake and better understand the impact of DER on the network; provide a better customer service by efficiently and accurately responding and evaluating DER customer connections; support increased customer choices in DER connection options and improved economic investment options		improved forecasting and analysis of DER impacts, which will enable more DER connections and facilitate increased customer choices.
More accurately monitor and evaluate constraints arising from network and DER operations; For areas of the network with high penetration of DER, optimise and coordinate network and DER operations to operate the distribution system more closely to its allowable physical limits – resulting in efficiencies	✓	Investments in DENOP productionisation will assist AusNet Services to move towards an orchestration capability building on the proposed investments in Future Distribution Network Management to further advance this objective.
Facilitate price signals and incentives to customers reflecting the cost of connecting and managing DER during	✓	There is some planned investment in demand response incentives and pricing included in this option, the level of

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periods of peak network constraint		investment will enable a high penetration of customers that are targeted for these products and services.
Efficiently support interaction and data exchange with third parties seeking to aggregate customers' DER and facilitate peer-to-peer trading.	✓	There is some planned investment to progress peer to peer trading to enable more efficient data management and transfer, through upgrades to AusNet Services' MDMS.

Costs**Table 4-13 Costs of option 3**

(\$m)	FY2022	FY2023	FY2024	FY2025	FY2026	Total
Capex	\$1.56	\$2.00	\$2.37	\$2.82	\$3.27	\$12.02
Opex	\$0.29	\$0.37	\$0.44	\$0.52	\$0.61	\$2.23
Electricity distribution cost	\$1.80	\$2.40	\$2.80	\$3.30	\$3.90	\$14.25
Total program cost	\$1.80	\$2.40	\$2.80	\$3.30	\$3.90	\$14.25

Benefits

In addition to the benefits outlined in Option 2, the investments in Option 3 will deliver the following additional benefits to customers:

Greater ability to deliver peak demand savings generated through the introduction of more sophisticated demand response capabilities for more customers. It is not possible to estimate the quantum of savings at this time, as it would

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require assumptions on the incentive rates and elasticity of demand.

Preliminary analysis undertaken by AusNet Services suggests that, if the AusNet Services platform is applied, the number of solar customers (existing and forecast new entrants) who will be constrained, either by not being able to connect, or being constrained in their operation, reduces by over 11,000 by June 2026 on AusNet Services distribution network when compared to a no-nothing option. This equates to a gain of up to 50MW of customer generation at certain times.

Further enhancements to efficient data transfer to enable peer to peer trading will result in reduced cost for participants (both AusNet Services, retailers and third-party platform providers). An efficient trading process would also make it more likely that the market for peer to peer trading would develop faster, delivering greater opportunities for those with DER to earn a return on their investments and for other participants to make savings by reducing their energy network costs.

Risks

There are a number of risks associated with this particular option, as highlighted in the table below. Based on the consequence and likelihood of each risk, we have rated each of the individual risks blue, green, yellow, orange or red (order of severity). See Attachment 1 – Risk level matrix for additional information on this rating system.

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Table 4-12 Risks of option 3

	Risks	Consequence	Likelihood	Risk rating
R3.1	DER take-up continues to exceed forecasts	Level 3: Customers are unable to connect DER due to uncertain network impacts, resulting in significant customer dissatisfaction and negative media	Unlikely	D
R3.2	AusNet Services has limited ability to integrate with Peer to Peer platforms as they emerge over the 2022-26 period	Level 1: Low customer satisfaction, localized customer complaints	Unlikely	E
R3.3	No DER demand response pricing tools developed by AusNet Services.	Level 1: Lost opportunity for more efficient investment Higher cost network	Unlikely	E

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	Risks	Consequence	Likelihood	Risk rating
R3.4	<p>AusNet Services is unable to productionise Distributed Energy Network Optimisation Platform (DENOP)</p> <p>DENOP does not facilitate interaction with third party providers (i.e. the market moves faster than AusNet Services' capability)</p>	<p>Level 1: Inability to monitor and evaluate system constraints to accommodate DER</p> <p>Inability to optimise network using dynamic strategies involving network and DER operations.</p> <p>Loss of investments made to date</p> <p>Lost opportunity to participate in orchestration</p> <p>Higher cost network</p>	Possible	E

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	Risks	Consequence	Likelihood	Risk rating
R3.5	Customers (and other stakeholders) perceive the investments in DER integration as inefficiently high	Level 2: Low customer satisfaction, poor public perception of AusNet Services (some media response)	Unlikely	D

As we have identified a number of low risks, we consider that overall, this option is rated low risk.

Alignment to customer related drivers of expenditure

As discussed in Section 3.4, five key customer outcomes have been identified through discussions with customers. The table below highlights the how this option will achieve these outcomes. Where we consider that a customer outcome is not directly achievable by the option or irrelevant, 'N/A' is applied.

Table 4-15 Customer related drivers of option 3

Customer outcome	How this program achieves this
Deliver on the basics	The investments in improving analysis and modelling of DER impacts will improve the efficiency and effectiveness of AusNet Services' long term planning and enable it to continue to provide reliable power supply. Implementing this option would mean AusNet Services can anticipate and better prepare for peak energy demands.
Keep me posted	N/A

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Affordable for me	This option includes investments that are considered higher than a prudent level of investment in technologies to support DER integration, resulting in higher customer prices.
Be ready for the future	This option will enable AusNet Services to prepare for DER integration to exceed the current forecasts of DER take-up and provide customers with a more positive experience in connecting their DER.
Always safe	N/A

Alignment to business related drivers of expenditure

As discussed in Section 3.5, there are three business drivers that AusNet Services has identified and is focussing on over the next regulatory period. The table below highlights how this option will input into the initiatives where relevant. Where we consider that a business driver is not directly relevant to the option, 'N/A' is applied.

Table 4-16 Business related drivers of option 3

Business drivers	How this program achieves this
Lead energy transformation, embracing change	This option will allow AusNet Services to embrace the changes anticipated with a high DER penetration and lead energy transformation in readiness for DSO.
Drive efficiency and effectiveness throughout the portfolio	The investments in analysis and modelling will improve the efficiency and effectiveness of AusNet Services' long term planning. Further efficiencies driven by the emerging markets and technologies underpinning dynamic grid management will also drive efficiency and effectiveness.

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Generate trust and respect with customers and partners	This option will progress AusNet Services towards greater trust and respect with customers and partners, by allowing the provision of new services to incorporate DER.
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5 Assessment and recommended option

5.1 Assessment of the options

To identify a recommended option for this program of work, we have selected a number of criteria to assess each of the options. We consider that these criteria represent a comprehensive view of each option, in achieving AusNet Services' business and customer objectives as well as requirements of the AER in ensuring that any expenditure is both prudent and efficient.

The table below summarises our assessment of each of the options against the criteria.

Table 5-1 Summary table of the assessment of the options

	Option 1	Option 2	Option 3
Alignment to objective	Does not achieve all objectives	Partial achievement of objectives	Fully achieves all objectives
Costs	\$4.45M	\$9.63M	\$14.25M
Overall risk rating	High	Medium	Low
Alignment to customer related drivers of expenditure	Low alignment (1/5)	Medium alignment (3/5)	Medium alignment (3/5)
Alignment to business related drivers of expenditure	Low alignment (1/3)	High alignment (3/3)	High alignment (3/3)

Based on this assessment, Option 2 is the recommended option, as it reflects a prudent level of expenditure that will progress AusNet Services towards its objective of efficient and effective DER integration, also achieving alignment with the desired business and customer outcomes.

Option 1 does not achieve the objectives for this program of work and is also high risk despite its lower cost.

[C-I-C]

NPV analysis

As defined in the AER Consultation Paper – ICT Assessment Approach, the AER is refining its approach to ICT assessment, requiring a disaggregation of ICT expenditure into recurrent and non-recurrent ICT expenditure.

As this program includes 100% non-recurrent expenditure, Table 5-2, below shows the NPV analysis for this program, further demonstrating the cost effectiveness of Option 2, the recommended option.

Program Brief**Table 5-2 NPV analysis (\$FY21m)**

	Costs (NPV)	Benefit (NPV)	Net benefit (NPV)
Option 1	\$3.79	\$4.42	\$0.63
Option 2	\$10.96	\$15.82	\$4.86
Option 3	\$16.24	\$16.51	\$0.27

We have captured four primary benefits for this program:

- Reduction in constrained DER
- Reduction in peak demand for electricity
- Reduction in penalties / payments
- Reduction in complaint costs.

We consider that all options of this program will reduce the constraints on DER integration. These will be driven by improvements in forecasting and modelling capabilities, improved visibility of the LV network and enhanced tools to manage the impacts of changeable demand and supply. Option 2 is likely to reduce the constraints on DER and is estimated to result in a cumulative reduction of 100% over the 22-28 period. Option 3 will reduce constraints by 106% and both of these reductions relates to a cost reduction of \$[C-I-C] m and \$[C-I-C] m respectively across the 22-28 period.

We also consider that all options of this program will reduce the peak demand for electricity and therefore result in avoided network augmentation costs. We estimate that Option 1 will result in avoided network augmentation costs by 33%, resulting in a reduction of \$[C-I-C]m across the 22-28 period, as it includes investment in a future ready forecasting model HV/LV modelling and also GIS network data quality improvements, and AusNet Services will be able to better forecast where network augmentation is required. We estimate that Option 2 will result in more avoided network augmentation costs, of \$[C-I-C]m across the 22-28 period, as it also includes special application rationalisation, demand response management enablement, DENOP and Peer to Peer trading. [C-I-C].

We have also identified some non-quantifiable benefits associated with this program, relating to customers' FIT. As more customers will be able to connect their DER to AusNet Services' network, particularly with Option 2 and Option 3, they will be able to take advantage of those FIT's from retailers.

Based on our NPV analysis, Option 2 has the largest positive NPV and therefore is our recommended option.

5.2 Recommended option

As outlined above, the recommended program of work for DER integration over the 2022-26 period reflects a prudent level of expenditure on initiatives that are designed to progress AusNet Services towards being able to manage DER efficiently and participate in future orchestration

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business models. It involves investment in the following activities:

- Future Ready Forecasting Model - Enhancement of current Demand Forecasting model, including automation, additional data inputs and inclusion of DER uptake forecast
- HV LV Modelling (full) - Development of a full HV to LV network load flow model and analytical capability for entire network to enable better planning. This includes the extension of HPK21 trial in current regulatory period, using PSS Sincal.
- GIS Network Data Quality Improvements - Work to improve the quality of data in the GIS, to overcome current limitations of SDMe. This will feed into the HV to LV Model.
- Spatial Application Rationalisation – Work to rationalise existing SAMS & SAMS OPS spatial applications into the SDMe Network Viewer, and repoint downstream interfaces from SAMS & SAMS OPS to SDMe or the Data Lake
- Demand Response Management Enablement - Productionise demand response incentives for residential and DER customers, including payment structures and innovative tariff options.
- Distributed Energy Resource Control/Optimisation (DENOP) - Work to expand and productionise the DENOP platform under trial in the current period
- P2P trading - Activities to facilitate AusNet Services providing meter data to third party trading platforms. This investment includes funding to enable manual data

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transfer to and from retailers, with data collected and sent via email.

The profile of expenditure is increasing over the FY2022-26 period in line with AusNet Services' projected take up of DER, as the capability requirement develops with the market for DER services.

The risks associated with the delivery of this program are outlined in the following table (referring to the Risk Matrix in Attachment 1) and a mitigation approach is described for each one.

Table 5-3 Option 2 risks and mitigation actions

	Risk	Consequence	Likelihood	Risk rating	Mitigation
R2.1	DER take-up continues to exceed forecasts	Level 3: Customers are unable to connect DER due to uncertain network impacts, resulting in significant negative media and customer dissatisfaction	Possible	C	Improve forecasting capabilities as part of this program – continually improve forecasting and reporting on DER take up
R2.2	AusNet Services has limited ability to integrate with Peer to	Level 1: Low customer satisfaction, localised customer complaints	Possible	E	Monitor the development of the Peer to Peer market and adapt

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	Peer platforms as they emerge over the FY2022-26 period				approach described in this program, reallocate funding, as requirements emerge.
R2.3	No DER demand response pricing tools developed by AusNet Services.	Level 1: Lost opportunity for more efficient investment Higher cost network	Possible	E	Monitor the development of demand response pricing in the market (retail and other network areas), adapt approach as opportunities emerge.
R2.4	AusNet Services is unable to produce Distributed Energy Network Optimisation	Level 2: Inability to monitor and evaluate system constraints to accommodate DER	Possible	D	Maintain connectivity with the market – ensure tool development takes account of developing

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	<p>n Platform (DENOP)</p> <p>DENOP does not facilitate interaction with third party providers (i.e. the market moves faster than AusNet Services' capability)</p>	<p>Inability to optimise network using dynamic strategies involving network and DER operations.</p> <p>Loss of investments made to date</p> <p>Lost opportunity to participate in orchestration</p> <p>Higher cost network</p>			market requirements.
R2.5	Customers (and other stakeholders) perceive the investments in DER integration as inefficiently high	Level 2: Low customer satisfaction, poor public perception of AusNet Services (some media response)	Unlikely	D	Maintain connectivity with the market – ensure tool development takes account of developing market

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					requirement S.
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Table 5-4 Confirmation of scope of recommended option

In scope	Out of scope	Dependencies
Initiatives listed in Recommended option.	Change management costs	Future Distribution Network Management (ADMS)
		Customer Information Management Program

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6 Attachment 1 – Risk level matrix

The figure below shows the risk level matrix to which we have assessed each of risks within the options. Risks of highest concern are rated red, whereas those of lowest concern are rated blue.

Figure 6-1

		Consequence				
		1	2	3	4	5
L i k e l i h o o d	Almost Certain	C	C	B	A	A
	Likely	D	C	B	B	A
	Possible	E	D	C	B	A
	Unlikely	E	D	D	C	B
	Rare	E	E	D	C	C

Consequence Rating	
5	Catastrophic
4	Major
3	Moderate
2	Minor
1	Insignificant

Overall Risk Rating	
A	Extreme
B	High
C	Medium
D	Low
E	Very Low

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