Business case: Network visibility

2025-2030 Regulatory Proposal

Supporting document 5.7.6

January 2024

SA Power Networks

Empowering South Australia

Contents

Glossary

Acronym / term	Definition
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
AMI	Advanced Metering Infrastructure
API	Application Programming Interface
Capex	Capital expenditure
CECV	Customer Export Curtailment Value
CER	Customer Energy Resources
CNS	Customer Notification System
DERIWIG	DER Integration Working Group
DNSP	Distribution Network Service Provider
DOE	Dynamic Operating Envelope
DSI	Death or Serious Injury
EG	Embedded Generation
EV	Electric Vehicle
ICT	Information and Communication Technology
LV	Low Voltage
MC	Metering Coordinator
MSATS	Market Settlement and Transfer Solutions
NER	National Electricity Rules
NERR	National Energy Retail Rules
NPV	Net Present Value
Opex	Operating expenditure
PQ	Power Quality
PV	Photovoltaic
QoS	Quality of Supply
RCP	Regulatory Control Period
SMP	Shared Market Protocol
VPP	Virtual Power Plant

1 About this document

1.1 Purpose

This document sets out the business case for our 2025-30 network visibility and modelling program.

1.2 Expenditure category

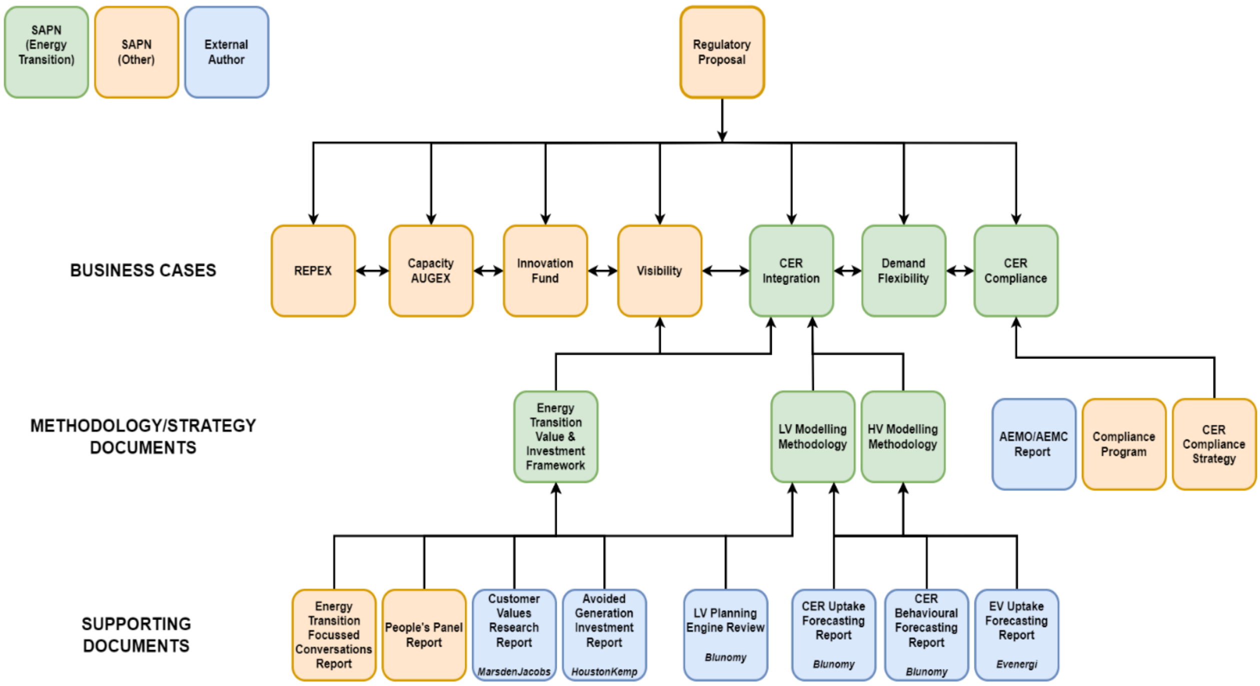
- Non-network ICT capex: non-recurrent - new or expanded capability
- Network Opex

1.3 Related documents

Table 1: Related documents

Title
5.7.3 - CER Compliance - Business case
5.7.4 - CER Integration - Business Case
5.7.5 - Demand Flexibility - Business Case
5.7.15 - CER Integration Strategy - Strategy

Figure 1: Related documents



2 Executive summary

Overview

This document sets out the business case for our 2025-30 network visibility and modelling program. Network visibility is a key capability that underpins numerous operational, safety, Customer Energy Resource (**CER**) integration and network planning functions across the business.

We have established the foundations for our network visibility program in the 2020-25 Regulatory Control Period (RCP) with the deployment of Future Grid COMPASS, a third-party time-series data analytics platform, with an accompanying in-house database. During the period we also rolled out transformer monitors to a targeted subset of our low voltage (**LV**) transformers and we established contracts with two leading Metering Coordinators (**MCs**) to procure a small sample of smart meter data (approximately 25,000 meters) on a trial basis.

At the present time, our visibility of the dynamic state of the network, particularly the LV network, is still limited. Our 2025-30 visibility program builds on the foundations established in the current RCP to significantly enhance this capability, taking advantage of the much greater access to smart meter data we anticipate beyond 2025 due to improvements in access arrangements and the accelerated meter rollout recommended in the Australian Energy Market Commission's (**AEMC's**) Review of the regulatory framework for metering services[1].

This program has a capital cost (**capex**) of **$7.93 million** and an associated opex step change of **$5.96 million** over the 2025-30 RCP[2].

Drivers for change

Policymakers have long recognised that, to continue to plan and operate the distribution network safely, effectively and efficiently in an increasingly dynamic operating environment with high levels of Customer Energy Resources (**CER**), Distribution Network Service Providers (**DNSPs**) need visibility of the performance of their LV networks, particularly with respect to power quality (**PQ**) data such as voltage. Smart meters can provide this visibility, and enabling the use of smart meter data by DNSPs for improved network planning and operations was one of the key drivers for the transition to smart meters in the NEM.

Victorian DNSPs have had access to smart meter data from almost 100% of customer premises for more than eight years since the completion of the Victorian Advanced Metering Infrastructure (AMI) rollout. In this time they have developed numerous new capabilities using this data, enabling a broad range of customer benefits. Unfortunately, this success has not been replicated in other jurisdictions due to the slow pace of the smart meter rollout and issues impeding DNSP access to data under the contestable metering framework that applies outside Victoria. There is now an urgent need for improved network visibility across the rest of the NEM, particularly in high-CER jurisdictions such as South Australia.

The AEMC's Metering Contestability Review, completed in August 2023, aimed to address key shortcomings in the current contestable metering framework, including the failure to achieve the intended benefits of network visibility. This review has proposed changes to the National Electricity Rules (**NER**) and National Energy Retail Rules (**NERR**) to accelerate the pace of the smart meter rollout, with a target of completion by 2030, and to facilitate access by DNSPs to smart meter data. The review proposes that the provision of a 'basic PQ data set' to the DNSP should be included as part of the standard meter reading service for all smart meters. This basic PQ data is to be provided at no direct cost to the DNSP, in contrast to the current situation where DNSPs must negotiate to purchase access to this data on a commercial basis. DNSPs may still enter

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1 AEMC, *Review of the regulatory framework for metering services, final report*, 30 August 2023, accessed at https://www.aemc.gov.au/market-reviews-advice/review-regulatory-framework-metering-services

2 All dollar figures in this business case are in $2022 real.

into commercial arrangements to procure access to other 'non-basic' meter data and services, e.g. near real-time data.

In September 2023, we joined with metering provider Intellihub and energy retailer Alinta Energy to submit a rule change request calling on the AEMC to make the rules recommended in its review. While the final outcome is still subject to the rule change process, we expect, having engaged in the metering review and considering the very extensive stakeholder consultation undertaken and the general consensus in support of the review process, that the proposed rules will be made and that the outcome will be consistent with the AEMC's key recommendations, including the accelerated rollout process and the proposed provision of basic PQ data to DNSPs on a daily basis for 100% of smart meters, commencing from mid-2025.

This will require expenditure in the 2025-30 regulatory control period (**RCP**) to develop the systems to receive, store and process this basic PQ data and to implement the data analytics and business processes to enable the various customer benefits that smart meter data is intended to provide, several of which we have already successfully demonstrated in small-scale trials. Of these, key use-cases include improved network hosting capacity for CER, better voltage management, and the automatic detection of neutral integrity faults. The last of these, neutral integrity fault detection, offers material safety benefits for customers because this is a relatively common class of fault in the wiring to the customer premises that, if undetected, has the potential to lead to an electric shock.

Our proposed work program

The expenditure to support our proposed 2025-30 work program includes the following:

- expenditure to implement a new Application Programming Interface (**API**) and associated infrastructure to receive basic PQ data and other data from MCs at forecast data volumes and in a standard format according to Australian Energy Market Operator (**AEMO**) procedures, replacing the bespoke data transfer arrangements currently in place for our small-scale trials;
- software licencing and cloud hosting costs to scale up our COMPASS data platform to support forecast data volumes for 100% of installed smart meters;
- project costs to implement smart meter data analytics and associated business processes to support key use-cases including improved network hosting capacity, improved voltage management, neutral integrity fault detection and others, building on work undertaken in trials in the current RCP;
- costs to procure a small volume of higher-frequency (non-basic) PQ data on a commercial basis to support specific use-cases;
- costs to enhance the accuracy our LV network model, which underpins the achievement of many of the benefits of improved visibility[3]; and
- cost to remediate existing SCADA monitoring at certain substations where the current equipment cannot properly monitor reverse power flows.

Note that our proposed expenditure does not include costs to procure basic PQ data as we assume that this data will become available at no direct cost from mid-2025, as per the AEMC's recommendations. As this outcome is still subject to a rule change process we have also modelled the case where this data is procured at current market rates. Should it eventuate that the rule change does not include provision of basic PQ data at no cost to the DNSP, our Revised Proposal would need to be amended to ensure that we are provided with a reasonable opportunity to recover our forecast costs.

We also do not propose any further expenditure on LV transformer monitors once we have completed our planned 2020-25 LV transformer monitoring program, as we consider that this sample set of LV transformer monitors, used in combination with forecast volumes of smart meter data, will be sufficient to achieve the network visibility we require.

[3] Noting also that the use of smart meter data also helps improve the accuracy of our network model.

Forecast benefits

The proposed program has forecast quantified net benefits of $58.26 million (15 year NPV) arising from:

- customer safety benefits from automated neutral integrity fault detection, valued in accordance with our Value Framework;
- reduced export curtailment due to more accurate hosting capacity data, used in the calculation of flexible export limits (also referred to as Dynamic Operating Envelopes, or **DOEs**), valued using a variant of the Australian Energy Regulator's (**AER's**) Customer Export Curtailment Value (**CECV**); and
- energy savings arising from improved voltage management (reduction in average network voltage), valued using the methodology in the Victorian Government's 2023 report into network voltage management in Victoria[4].

Our proposed expenditure will also enable several other use-cases that will produce additional customer benefits that we have not quantified in this business case – as we describe later in this case.

Options and Sensitivities

Our proposed program was selected after an options analysis that considered the following other options:

- a base case 'do nothing' option where we continue with our current level of smart meter data, included as a counterfactual to baseline the benefits of the other options; and
- a 'minimum viable' option where we only receive and process a subset of the available smart meter data. This reduces costs but also impacts on the use-cases that can be delivered and hence the benefits that can be realised. Importantly, it excludes most customers from receiving the safety benefits of neutral integrity detection.

We also consider the impact if the AEMC's recommendation that basic PQ data should be made available at no direct cost to the DNSP were not carried through to the final rule change arising from the Metering Contestability Review. In that case we assume we would need to procure access to this data at current market price, which materially increases the costs of the options considered.

Related Work

Our network visibility program has links to the following work programs described elsewhere in our proposal:

- our proposed CER integration program[5]; and
- our proposed CER Compliance program[6]

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4 State of Victoria Department of Energy, Environment and Climate Action, *Voltage Management in Distribution Networks Directions Paper*, June 2023, accessed at https://engage.vic.gov.au/voltage-management-in-distribution-networks-consultation-paper

5 5.7.3 - CER Compliance - Business case

6 5.7.5 - Demand Flexibility - Business Case

3 Background

3.1 The scope of this business case

This business case recommends expenditure in the 2025-30 RCP for our network visibility program. This involves the use of data, primarily from smart meters, to enable or enhance a range of operational, safety, CER integration and network planning functions across the business. The scope of this program also includes the integration of smart meter data with data from our LV transformer monitors, necessary upgrades to SCADA data capture at certain substations and enhancements to our network model.

This business case considers different options for the scope of this program. Different levels of visibility lead to different outcomes for the use cases outlined in this business case. Our preferred option aligns with the expected outcomes of the rule changes proposed by the AEMC in its 2023 review of the contestable metering market[7], including that DNSPs should:

- receive basic PQ data from every smart meter;
- accommodate an accelerated smart meter rollout with a target of 100% completion by 2030; and
- use smart meter data to improve efficiency and deliver customer benefits, including the key safety benefit of automatically detecting neutral integrity faults.

Our network visibility program has links to the following work programs described elsewhere in our proposal:

- our proposed CER integration program[8]; and
- our proposed CER Compliance program[9].

Note that, in relation to smart meters, the scope of the expenditure proposed in this business case is limited to expenditure related to the use of smart meter data, primarily PQ data, for the network visibility use-cases detailed herein. This business case does not include other costs expected to be incurred by the business arising from the AEMC's metering review such as administrative costs associated with our role in facilitating the proposed accelerated rollout process, impacts on our market data and billing systems from the accelerated rollout, and so on. Those costs are considered unavoidable if the recommendations of the AEMC review are implemented and are considered elsewhere in our Regulatory Proposal.

The scope does not include any further expenditure on LV transformer monitors. Once we have completed our planned 2020-25 LV transformer monitoring program, we consider that this sample set of LV transformer monitors, used in combination with forecast volumes of smart meter data, will be sufficient to achieve the network visibility we require.

3.2 Drivers for change

As the energy system transitions, the behaviour and performance of the system, in particular the distribution network, are becoming increasingly driven by the behaviour of CER such as rooftop solar, batteries, virtual power plants (**VPPs**) and the emerging class of smart, flexible and price-responsive loads such as smart electric vehicle (**EV**) chargers and smart home appliances. Energy flows in the distribution network as a result have become much more complex and dynamic than what the network was originally designed to accommodate, and this complexity will continue to increase through 2025-30.

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7 AEMC, *Review of the regulatory framework for metering services, final report*, 30 August 2023, accessed at https://www.aemc.gov.au/market-reviews-advice/review-regulatory-framework-metering-services

8 5.7.3 - CER Compliance - Business case

9 5.7.5 - Demand Flexibility - Business Case

Policymakers have long recognised that, to continue to plan and operate the distribution network safely, effectively and efficiently in this much more dynamic operating environment, DNSPs need visibility of the performance of their LV networks, particularly with respect to PQ data such as voltage. Smart meters can provide this visibility, and enabling the use of smart meter data by DNSPs for improved network planning and operations was one of the key drivers for the transition to smart meters in the NEM.

Unfortunately, other than in Victoria, the network visibility benefits of smart meters have yet to be realised. This has been due to the slow pace of the smart meter rollout and issues impeding DNSP access to data under the contestable metering framework that applies outside Victoria. There is now an urgent need for improved network visibility across the rest of the NEM, particularly in high-CER jurisdictions such as South Australia.

The AEMC's comprehensive Metering Contestability Review, completed in August 2023, aimed to address key shortcomings in the current contestable metering framework, including the failure to achieve the intended benefits of network visibility. This review has proposed changes to the NER and NERR to accelerate the pace of the smart meter rollout, with a target of completion by 2030, and to facilitate access by DNSPs to smart meter data. The review proposes that the provision of a 'basic PQ data set' to the DNSP should be included as part of the standard meter reading service for all smart meters. This basic PQ data is to be provided at no direct cost to the DNSP, in contrast to the current situation where DNSPs must negotiate to purchase access to this data on a commercial basis. DNSPs may still enter into commercial arrangements to procure access to other 'non-basic' meter data and services, e.g. near real-time data.

In making its recommendations the AEMC set out some of the customer benefits that it expects DNSPs to deliver once the proposed changes are made:

> *"Better information can improve efficiency of operation, use and planning of networks. This can reduce costs and unlock greater CER hosting capacity — allowing customers increased export limits. Smart meters also create indirect system-wide benefits to households via DNSPs, retailers and AEMO.*
>
> *"Further, the data and information provided by smart meters can also allow DNSPs to improve their management of customer outages. Smart meters can also offer a dependable and uniform pathway for near-real-time data delivery and control services. Finally, smart meters can improve safety outcomes — such as through detection of neutral integrity failures, which can cause hazardous voltages to be present in accessible areas, and detection of over or under voltages, which can cause equipment failure."*[10]

In September 2023, we joined with metering provider Intellihub and energy retailer Alinta Energy to submit a rule change request calling on the AEMC to make the rules recommended in its review, and it is our expectation that these rule changes will be made by mid 2024.

3.3 Our performance to date

We have established the foundations for our network visibility program in the 2020-25 RCP with the development of our network visibility and analytics platform. This is based on Future Grid COMPASS, a third-party time-series data analytics product, with an accompanying in-house database and various interfaces, reports and analytic functions.

During the current period we also rolled out transformer monitors to a targeted subset of our low voltage (LV) transformers and we have established contracts with two leading MCs for the procurement of a small sample of smart meter data (approximately 25,000 meters) on a trial basis.

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[10] AEMC, *Review of the regulatory framework for metering services, final report*, 30 August 2023, accessed at https://www.aemc.gov.au/market-reviews-advice/review-regulatory-framework-metering-services

3.3.1 The visibility and analytics platform

The aim of the visibility and analytics platform is to provide a single system that can store and analyse time-series data from a variety of sources, including PQ data from smart meters, data received from CER devices and transformer monitor data. The platform comprises the following components:

- the Future Grid COMPASS time-series data platform;
- supporting IT infrastructure for the COMPASS platform including the Microsoft Azure PostgreSQL database and Azure Kubernetes Service; and
- data science tools to leverage data in the PostgreSQL database, enabling us to build proof-of-concept analyses and reports using Azure Databricks and Power BI.

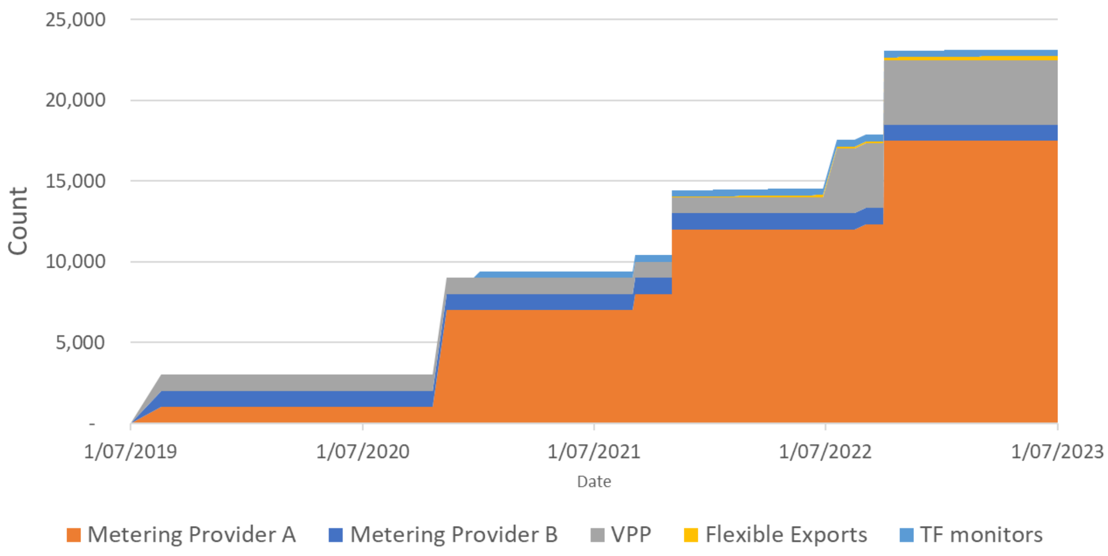
Development of the visibility and analytics platform started in 2019. Since then, the number of data sources has progressively increased and the platform has supported a series of trials of different network operations and planning functions. While the system currently only processes data from around 25,000 end points, it is designed to scale efficiently to support the > 1 million end points we expect to integrate by 2030 with the accelerated smart meter rollout.

3.3.2 Data sources

Since the platform was established in 2019 we have progressively added more data points and data sources over time, as shown in Figure 2 below. These data sources include:

- smart meter PQ data streams from two metering providers;
- PQ data streams from the sites in our Advanced VPP Grid Integration Project[11];
- PQ data streams for Flexible Exports sites;
- interval energy data streams for all smart meters in the SAPN network (through MSATS); and
- PQ data streams from LV transformer monitors.

Figure 2 – PQ data streams by source as at July 2023



[11] Our award-winning Advanced VPP Grid Integration project was an ARENA-funded trial involving a 1,000 customer VPP (since expanded to 4,000 customers) in South Australia. See https://arena.gov.au/projects/advanced-vpp-grid-integration/

3.3.3 Use cases

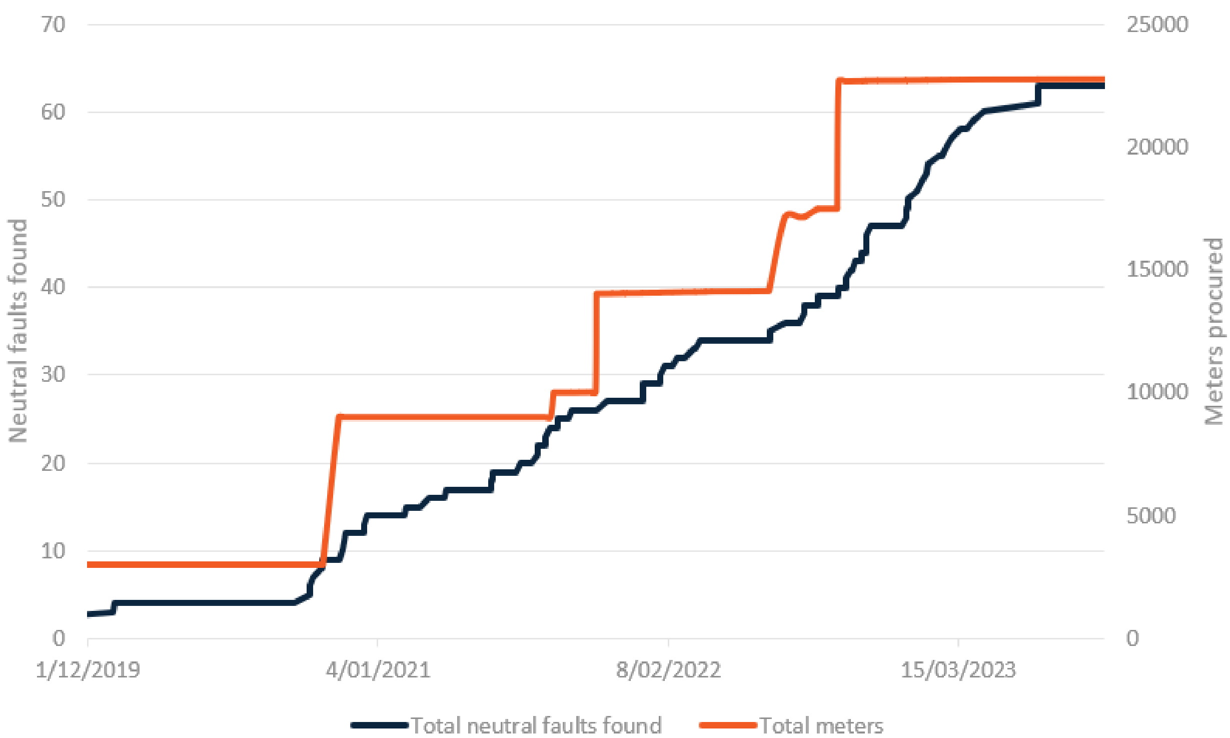
We have used the visibility and analytics platform to trial several different business use-cases, detailed below.

Neutral integrity fault detection

Since 2019, we have been trialling automated neutral integrity fault detection using the limited sample of smart meter data available, using the 'Loss of Neutral' detection algorithms built into the COMPASS platform. By analysing the data we have been able to proactively identify potential issues where a customer's neutral connection may be broken or damaged at the service point. This approach enables us to investigate customer service points when we become aware of an issue, rather than relying on reactive responses to customer reports of shocks. The graph in Figure 3 below illustrates the number of sites investigated during the trial as an increasing number of data points became available in the visibility and analytics platform.

The trial has successfully demonstrated the customer safety benefits of automated neutral integrity fault detection. Since the trial started, we detected and responded to more than 60 customer neutral integrity faults, each representing a potential safety risk, none of which would have been detected otherwise.

Figure 3 – Neutral faults found vs. total meters in the visibility platform



A fault cause analysis undertaken after the first 12 months of the trial identified the following causes of neutral integrity faults: failure of a neutral lug or link in a pole-top junction box or pit (nine cases); neutral cable fault (five cases); bird's nest in a pole-top junction box (two cases); failed mains connection point (one case) and corroded conductor (one case). Examples of some of these issues are shown in Figure 4 below.

Figure 4 – Examples of neutral integrity faults

The main limitation of the trial lies in the limited access to data, with fewer than 3% of customer premises able to be monitored using the data we have available today[12]. The rule changes arising from the AEMC's metering review should provide us with access to basic PQ data from all smart meters. This will allow us to activate this capability for around 50% of customers in 2025, growing to near 100% of customers by 2030.

Proactive Voltage Management

As we have had no direct visibility of our LV network in the past, we have historically taken a reactive approach to addressing voltage and other quality of supply (**QoS**) issues arising in the LV network, investigating issues as and when they are reported to our call centre by customers experiencing problems such as lights flickering or solar inverters tripping off.

Using the visibility and analytics platform we have been testing business processes to proactively investigate sites where PQ data indicates that upper or lower voltage limits (as set by AS61000.3.100) are being exceeded. This gives better customer outcomes as it enables us to detect and remediate issues that customers may not be aware of or may not have reported, but which may be reducing the performance of their solar PV systems or even causing damage to their appliances.

CER Compliance

We have developed a CER Compliance Strategy[13] setting out a ten-year work program to improve levels of compliance to CER technical standards and we are currently executing the first phase of this strategy, with a focus on improving the CER application, commissioning and close-out process to increase compliance at the time of installation.

A key element of the second phase of this strategy, in the 2025-30 RCP, is to leverage increased access to smart meter data and our visibility and analytics platform to detect non-compliant CER installations. So far we have undertaken trials in which we have successfully demonstrated the capability to detect non-compliance to AS4777.2 PQ response curves (Volt-VAr and Volt-Watt) and trip settings using the small sample of smart meter data available today.

Our CER Compliance program is described in more detail in the associated business case[14].

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12 This is limited by the limited penetration of smart meters in South Australia, the limited data available under our trial contracts with metering coordinators, and the fact that not all energy retailers allow access to this data.

13 5.7.2 - Compliance Strategy

14 5.7.3 - CER Compliance - Business case

Closed-loop voltage control

Between November 2019 and April 2021, we undertook a trial of closed-loop voltage control at a single substation (Hope Valley) with funding from the South Australian Government and in partnership with CSIRO[15].

Closed-loop voltage control uses smart meter data in a feedback loop to enable more active and dynamic management of voltage at the substation. This can improve overall power quality for customers and significantly improve CER hosting capacity by reducing daytime voltage rise issues, without risking under-voltage problems at times of high demand.

The trial was successful, and with increased availability of smart meter data across the state from 2025 we intend to develop this beyond the proof-of-concept phase and activate it as a BAU operational capability across other substations in the 2025-30 RCP.

Hosting capacity estimation

Our flexible exports systems and the LV Planning Engine model used to forecast future export capacity constraints[16] both rely on an estimate of hosting capacity for each LV transformer, defined as the amount of reverse power flow that the transformer can accommodate before voltage rise in the downstream LV network causes customer voltages to exceed the upper bound allowed in AS60038[17]. This is important for flexible exports as it determines the available export capacity 'headroom' at any point in time, which is used to calculate the flexible export limits (dynamic operating envelopes) that customers receive.

Without direct visibility of the LV network, these hosting capacities have been estimated on a category basis by modelling a small number of sample networks of each category, such that every transformer of the same category (where there are 15 categories based on the type of construction and size of the LV network, e.g. 'New underground' or 'Medium overhead') is assigned the average hosting capacity for the sample networks in that category. This method is imperfect as there is a degree of variation between different networks within the same category.

Using the visibility and analytics platform we have been trialling methods to infer hosting capacity directly on a per-transformer basis by analysis of smart meter data for customers connected to that transformer. This enables a more accurate assessment of hosting capacity.

With the limited smart meter data available today we are only able to determine a unique hosting capacity value for around 2,200 LV transformers, fewer than 3% of the population, and continue to rely on category averages for the rest[18]. With increased access to smart meter data from 2025 we expect to be able to progressively phase out the use of category averages and transition to a fully data-driven approach to hosting capacity estimation, which will provide a more accurate, unique hosting capacity for each LV transformer.

LV network load forecasting

Load forecasting for distribution transformers in the LV network relies on a combination of targeted sample-based monitoring using temporary loggers and a small population of permanent transformer monitors to monitor load growth over time and analyse trends. We have been trialling the use of smart meter data in combination with data from transformer monitors to improve the accuracy of our load forecasting. While

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15 CSIRO, Final report – Closed-loop Voltage Control Trial, August 201, accessed at https://publications.csiro.au/rpr/download?pid=csiro:EP2021-1894&dsid=DS1, accessed September 2023.

16 Described in detail within the 5.7.4 - CER Integration - Business Case.

17 We are required under the *South Australia Electricity (General) Regulations 2012, version 17.10.2017, regulation 46 (a)* to maintain customer voltage in accordance with AS60038.

18 Further information on this methodology is included in 5.7.4 - CER Integration - Business Case.

this is currently only a small-scale trial, with increased access to smart meter data from 2025 onwards we expect to be able to incorporate this into our standard load forecasting methodology.

A related capability trialled by Victorian DNSPs and Energy Queensland is the use of smart meter data analytics for load disaggregation, that is, the automatic detection of significant loads such as EV chargers by recognising their characteristic load profiles within a customer's overall load profile. We intend to explore the potential of this approach in South Australia, e.g. as a means to improve the accuracy of our CER database.

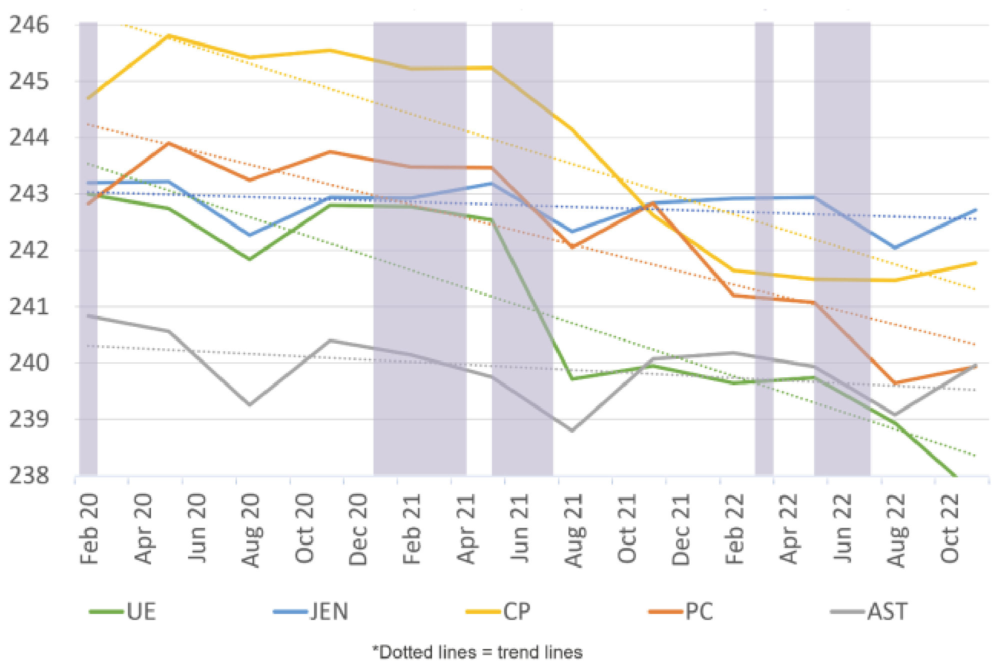
3.4 Industry practice

Victorian DNSPs have had access to smart meter data from almost 100% of customer premises for more than eight years since the completion of the Victorian Advanced Metering Infrastructure (**AMI**) rollout. In this time they have developed numerous new capabilities using this data, enabling a broad range of customer benefits.

All the use-cases that we have trialled on a small scale in South Australia, as described above, have been demonstrated at scale in Victoria. The Victorian DNSPs have also demonstrated many other advanced capabilities enabled by smart meter data including: the automatic detection of other kinds of network fault (e.g. fuse candling); automatic mapping of customers to assets and inference of network topology (e.g. open points) to validate and correct network records; and the provision of Reliability and Emergency Reserve Trader (RERT) services via network voltage management.

One specific initiative of note that has been enabled by the universal visibility of end-customer voltage in Victoria is the work that the Victorian DNSPs have undertaken since 2020 to reduce average voltages in their networks, which has the effect of reducing the amount of energy consumed by many appliances. A recent study undertaken by the Victorian Department of Energy, Environment and Climate Action (DEECA) found that that Victorian DNSPs reduced network voltages by an average of 2.5 V between February 2020 and October 2022, as shown in Figure 5 below, and this has resulted in approximately $7 million in customer savings per annum ongoing in reduced energy costs[19].

Figure 5 – Reduction in average network voltages achieved by Victorian DNSPs between February 2020 and October 2022[20] (source: DEECA)



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19 Department of Energy, Environment and Climate Action, *Voltage Management in Distribution Networks*, Directions Paper, 2023

20 Figure is drawn from Figure 1 in the cited DEECA report. The lines show network-wide average voltages for United Energy (UE), Jemena (JEN), CitiPower (CP), Powercor (PC) and AusNet (AST).

Access to basic PQ data from all smart meters in South Australia from mid-2025 will enable us to pursue similar voltage reduction opportunities here and this is one of the key customer benefits that our 2025-30 visibility program seeks to enable.

Outside Victoria, other DNSPs are pursuing similar 'diverse data' strategies to ourselves and have been undertaking similar pilots and trials to develop the supporting systems required to leverage PQ data from smart meters as it becomes available. Regarding the important use-case of neutral integrity fault detection[21]:

- Ausgrid has also used the Future Grid COMPASS product to trial this capability using a sample set of 20,000 smart meters. Over a 14-month period they detected and remediated 30 dangerous neutral faults;
- Endeavour Energy commenced a neutral integrity fault detection trial in 2021 using another commercial data analytics tool (Gridsight) with a sample of 50,000 smart meters, representing around 5% of their customer base. This trial resulted in the detection of 111 neutral integrity faults and, on this basis, Endeavour has estimated that there is a likely backlog of 1,000+ existing faults on their network that remain undetected and pose a potential safety risk to customers. They also estimate that new faults occur at a rate of around 60 per month; and
- TasNetworks is also using the Future Grid COMPASS software to identify neutral integrity faults on their network. With the accelerated smart meter rollout already underway in Tasmania[22] this system has scaled in the last year from an initial trial set of 20,000 smart meters to more than 100,000. TasNetworks has detected 132 neutral integrity faults to date and estimates a failure rate of around 1 in 2,000 premises per month on their network.

In their recent round of Regulatory Proposals the NSW DNSPs have put forward plans to scale up their use of smart meter data in their next RCPs, citing material opportunities to deliver customer benefits.

4 The identified need

The AEMC's Review of the regulatory framework for metering services proposes changes to accelerate the uptake of smart meters throughout the NEM and to facilitate universal access to basic PQ data from these meters for DNSPs. The AEMC's final report states:

> *"Smart meters also create indirect, significant system-wide benefits to households – including benefits to DNSPs, retailers and the AEMO. For example, the data and information provided by smart meters allow DNSPs to improve their management of customer outages and, more generally, provide greater visibility of the low voltage (LV) network. Smart meters can offer a dependable and uniform pathway for near-real-time data delivery and control services…*
>
> *"…DNSPs need to operate their networks more dynamically to manage the increasing uptake of CER. Smart meter data enables DNSPs to make better investment and operational decisions that could support more CER connections and potentially delay or remove the need for augmentation. This, in turn, allows for improved utilisation of network assets – which means higher productivity and lower average network costs for all customers."*

The AEMC's recommendations are still subject to a rule change process. However, we expect, having engaged in the metering review and considering the extensive stakeholder consultation undertaken and general consensus in support of the review process, that the proposed rules will be made and the outcome will be consistent with the AEMC's key recommendations, including the accelerated rollout process and the proposed provision of basic PQ data to DNSPs on a daily basis for 100% of smart meters, commencing from mid-2025.

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21 Information is from Energy Networks Australia (ENA) submission to the AEMC's metering review.

22 Tasmania has a Government-led acceleration program in place with a target of 2026 for completion.

This will require expenditure in the 2025-30 RCP to develop the systems to receive, store and process this basic PQ data and to implement the data analytics and business processes to enable the various customer benefits that smart meter data is intended to provide, several of which we have already successfully demonstrated in small-scale trials, as outlined in section 3.3 above. Of these, key use-cases include improved network hosting capacity for CER, better voltage management and the automatic detection of neutral integrity faults.

The last of these, neutral integrity fault detection, offers material safety benefits for customers because this is a relatively common class of fault in the wiring to the customer premises that, if undetected, has the potential to lead to an electric shock. This was recognised by the AEMC and was a key factor in its recommendation to enable universal access to basic PQ data from smart meters for DNSPs at no direct cost. In its final report the AEMC wrote:

> ***"DNSPs are expected to use 'basic' power quality data for detecting loss of neutral***
>
> *"Detecting neutral integrity is a critical use case that requires continuous access to all smart meters in a local network area ... Access to 'basic' PQD under the final recommendation will allow DNSPs to identify and resolve neutral integrity issues – improving consumer safety."*

In making its recommendations, the AEMC sets the expectation that, as meters are rolled out to near 100% of customer premises by 2030, DNSPs will:

- receive, consume and utilise the data provided through the basic PQ data service;
- proactively identify sites that have broken or degraded neutral services; and
- utilise the data to deliver a range of other network use-cases that are expected to deliver customer benefits where it is efficient to do so. The AEMC report lists a number of specific network use-cases that they expect to be enabled through the accelerated rollout and the basic PQ data service, all of which are included in our proposed 2025-30 visibility program.

In considering our response to the recommendations of the AEMC review and in formulating our network visibility strategy more broadly we must have regard to our relevant obligations in the NER and in South Australian regulation.

An overarching obligation in the expenditure objectives in the NER[23] is that we must propose expenditure that we consider is required to meet or manage expected demand for Standard Control Services, including demand for the export service (that is, the provision of export hosting capacity) in a manner that is both prudent and efficient.

A key element of our approach to meeting demand for the export service efficiently is via the use of flexible exports (or DOEs). Our flexible exports connection offer is currently being rolled out across the network and will be available for all new CER customers from late 2024. The AER's DER integration expenditure guidance note[24] identifies the use of DOEs as '*an advanced step in understanding and managing the efficient use of network hosting capacity*'. The guidance note expresses the need for DNSPs to improve their understanding of network hosting capacity in order to enable the operation of DOEs and also to provide customer information on expected export service levels, and states that:

> *"DNSPs with access to AMI [smart meter] data should make use of this data in their assessment of DER hosting capacity, either using network models or econometric models."*

Our proposed use of basic PQ data for these purposes is consistent with this guidance.

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[23] Paraphrased here, based on Clauses 6.5.6(a) and 6.5.7(a) of the NER.

[24] AER, DER integration expenditure guidance note, June 2022, accessed at https://www.aer.gov.au/documents/aer-final-der-integration-expenditure-guidance-note-june-2022.

The NER expenditure objectives also require us to maintain the quality, reliability and security of supply and export services, and the safety of the distribution system. Regarding safety, the *South Australian Electricity (General) Regulations 2012, version 17.10.2017, regulation 47 (1)* also states that '*No circuit in electricity infrastructure may be allowed to remain in service unless every part of the circuit functions in a safe manner*'.

As noted above, the AEMC has recognised that neutral integrity fault detection enabled using basic PQ data from smart meters is an important capability that can contribute to the maintenance of the safety of the distribution system for customers.

Our obligation to maintain quality of supply is also made more explicit in the *South Australia Electricity (General) Regulations 2012, version 17.10.2017, regulation 46 (a)* which requires us to maintain customer voltage in accordance with AS60038. Basic PQ data from smart meters is the key data source that provides the visibility we require to actively identify cases where we are not meeting this obligation and address them, rather than relying on customers to identify voltage issues and report them to us as we have done to date.

Finally, we are guided in our investment decisions by the National Energy Objective (NEO) stated in the National Electricity Law (NEL)[25], which is:

> *"to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to:*
>
> *a. price, quality, safety, reliability and security of supply of electricity; and*
>
> *b. the reliability, safety and security of the national electricity system; and*
>
> *c. the achievement of targets set by a participating jurisdiction—*
>
> *i. for reducing Australia's greenhouse gas emissions; or*
>
> *ii. that are likely to contribute to reducing Australia's greenhouse gas emissions."*

5 Comparison of options

5.1 Meeting the identified need: visibility use-cases in the 2025-30 RCP

This business case considers different investment options to meet the identified need. In these options we propose to develop, to differing degrees, the network visibility use-cases that we have been trialling in the current RCP, as described in section 3.3.3, into production systems and embed them into our standard business processes for network planning and operations. We also propose to implement some additional use-cases that we are not currently trialling in South Australia but which have been demonstrated successfully by other DNSPs, as described earlier in section 3.4. The use-cases we are targeting for our 2025-30 visibility program are:

- **Neutral integrity fault detection**

  While this capability is limited to fewer than 3% of customers in our current trial, the rule changes arising from the AEMC's metering review will allow us to activate this capability for around 50% of customers in 2025, growing to near 100% of customers by 2030. Activating this safety benefit for all customers is one of the most important outcomes we expect from the AEMC's metering review, and the highest priority use-case in our proposed 2025-30 network visibility program.

- **Proactive Voltage Management**

  With greatly increased access to smart meter PQ data from 2025 we have the opportunity to transition from a reactive to a fully proactive approach to QoS management during the 2025-30 RCP.

[25] See https://www.aemc.gov.au/regulation/neo

This will significantly improve our capability to manage quality of supply, enabling issues such as excessive voltages to be detected and addressed before they reach the point where customers are negatively impacted by solar or batter inverters tripping off or appliances malfunctioning.

- **CER Compliance**

  Our trials have established that we can use smart meter data to detect and address non-compliance to AS4777.2, which has benefits in improving hosting capacity, quality of supply and system security. Smart meter data also has the potential to enable us to identify where CER is installed without approvals, if a site is consistently breaching its export limits, or if a site fails to respond correctly to an emergency solar disconnect signal issued under the South Australian Smarter Homes requirements.

  Our CER Compliance program is described in more detail in the associated business case[26].

- **Closed-loop voltage control**

  Increased access to basic PQ data will enable us to develop this beyond the single substation proof-of-concept phase and activate it as a BAU operational capability across other substations in the 2025-30 RCP.

- **Hosting capacity estimation**

  Using smart meter data we can estimate hosting capacity more accurately for each LV transformer. This will lead to improved service levels for customers on a flexible exports connection and reduced solar curtailment. It will also improve the quality of the information we can provide to customers on the performance of their local network and the export service level they can expect to receive.

- **LV network load forecasting**

  Smart meter data will enable us to improve the accuracy of our load forecasting in the LV network, reducing the risk of customer outages due to unexpected capacity exceedances and improving our network planning capability over the long term.

- **Energy conservation through voltage reduction**

  As noted in section 3.4, the Victorian DNSPs have achieved considerable success since 2020 in reducing average network voltage. This has yielded significant customer benefits of more than $7 million per annum in energy savings according to current estimates by the Victorian Government, as well as a corresponding reduction in greenhouse gas emissions. This is only possible with the detailed visibility of customer voltages provided by PQ data from a significant population of smart meters.

  We consider that undertaking this kind of network-wide voltage reduction initiative in South Australia is consistent with the NEO insofar as it promotes the long-term interests of our customers with respect to:

  - price (delivering significant and ongoing savings in energy costs to all consumers of electricity); and
  - the achievement of South Australia's jurisdictional targets for reducing greenhouse gas emissions.

  Given access to basic PQ data from all smart meters and noting the materiality of the potential customer benefits, we intend to pursue this opportunity in South Australia in the 2025-30 RCP.

- **Automatic mapping of customers to assets and inference of network topology**

  Victorian DNSPs have successfully demonstrated that data analytics applied to smart meter data can be used to infer which customers connect to which network asset (e.g. an LV transformer). Many operational functions depend on knowing this (e.g. the calculation of DOEs, the provision of information to customers during planned and unplanned outages, and the scheduling of work

[26] 5.7.3 - CER Compliance - Business case

affecting critical customers such as life-support customers) but network records are not always accurate, particularly for the LV network, or may become inaccurate due to switching occurring in the field. Using smart meter data analytics it is possible to identify errors in network records and correct them, improving customer service levels and outcomes.

We propose to trial this capability in South Australia in the 2025-30 RCP.

- **Network fault detection**

  Victorian DNSPs have also demonstrated that it is possible to detect certain kinds of network fault such as 'fuse candling[27]' by analysing smart meter data, which can potentially enable faults to be found and fixed before they result in customer outages. Increased access to smart meter data after 2025 will allow us to explore the potential opportunity for this kind of analysis in South Australia.

- **Meter wiring issues and energy theft detection**

  Smart meter data can reveal cases where a meter has been bypassed either due to a wiring problem or through a deliberate action. We propose to investigate the potential benefits of this in South Australia in the 2025-30 RCP.

5.2 The options considered

The table below summarises the options considered for our 2025-30 network visibility program.

Table 2: Summary of options considered

Option	Description
Option 0 – Continue as-is (base case)	SA Power Networks currently procures basic PQ data from around 20,000 smart meters out of an installed population of around 350,000 in 2023. Option 0 would see us continue with this current dataset and continue to use smart meter data only to support small-scale trials. This option is included here as a counterfactual to provide a baseline for comparison of the other options. We do not consider it a credible option as it does not align with the intended outcomes of the AEMC's metering review, the expectations of our customers or our strategic direction. It would diminish the value of South Australian customers' investment in smart meters by failing to achieve many of the potential benefits and it would result in worse customer outcomes than the other options being considered.
Option 1 – 100% data	In this option we would receive and process basic PQ data from all smart meters in South Australia as it becomes available from mid-2025, and seek to maximise the customer benefits by developing the use-cases set out in section 5.1. This option also includes a small allowance for the purchase of higher-frequency data (not included in the basic PQ data set) from a small sample (1,000) of smart meters.
Option 2 – 30% data (minimum viable)	In this option we would receive and process basic PQ data only from a 'minimum viable' subset of 30% of smart meters in South Australia. This level of data is sufficient to enable some benefits across all visibility use cases, but has lower forecast benefits than option 1. It also has correspondingly lower costs for data storage and processing. As with option 1, this option also includes a small allowance for the purchase of higher-frequency data for 1,000 meters.

A key assumption in this business case is that the recommendations of the AEMC's metering review are implemented in full, including the recommendation that DNSPs should have access to basic PQ data from all meters at no direct cost from mid-2025 onwards.

If this were not to eventuate and we were required to procure access to basic PQ data at current market prices this would significantly increase the cost of our proposed 2025-30 network visibility program. Given

[27] 'Fuse candling' refers to the progressive failure of a physical fuse in the network where the fuse begins to melt and break down. Using data analytics, Victorian DNSPs have shown it is possible to detect this condition and address it before the fuse fails completely.

the materiality of the cost difference involved, we have included two additional options in the options comparison, Option 1a and Option 2a, which are equivalent to options 1 and 2 respectively but with the added cost of procuring the data.

Should the AEMC's rule change determine that DNSPs must pay to access basic PQ data, we would need to be afforded a fair opportunity to respond to the issue in our Revised Proposal (should one be required) to ensure that it we are able to propose expenditures that we reasonably expect to incur in the 2025-30 RCP in complying with the expenditure objectives of the NER.

5.3 Comparing options: quantified benefits

To inform the comparison of the options, we undertook a quantitative 15-year Net Present Value (NPV) analysis of costs and benefits over the period from 2025 to 2040. In this analysis we quantified forecast benefits from three of the proposed network visibility use-cases. These are summarised below, and further details on the methodology used to calculate these benefits is included in section 8.2.

Table 3: Summary of quantified benefits

Benefit	Description
Neutral integrity fault detection	The value of automated neutral integrity fault detection arises from the avoided risk of customer harm from electric shocks caused by failed neutral connections. We have quantified this benefit using our Value Framework.
CECV benefits	Flexible export operating envelopes are calculated using an estimate of the hosting capacity for each LV transformer. The accuracy with which we can estimate hosting capacity today is limited by the limited data available. In practice this make it necessary to allow for a margin of error in the calculation of operating envelopes, which means that customers' flexible export limits are generally set lower than they could be if hosting capacity were known to 100% accuracy. This causes a loss of value due to the additional export curtailment involved which we quantify using a variant of the AER's Customer Export Curtailment Value (CECV). As the volume of smart meter PQ data increases in the 2025-30 RCP, our capability to accurately determine LV transformer hosting capacities will increase significantly. This will lead to reduced export curtailment and an increase in CECV value.
Energy conservation from average voltage reduction	Many appliances and other loads consume more energy at higher voltages, so lowering average network voltage results in savings to customers in reduced energy costs. In Victoria, DNSPs have, since 2020, successfully reduced average network voltages by an average of around 3 V, yielding approximately $7 million in savings per annum ongoing to customers in reduced energy costs. Access to basic PQ data from all smart meters in South Australia from mid-2025 will enable us to pursue similar voltage reduction strategies here. We have forecast the potential benefit using the methodology used by the Victorian Department of Energy, Environment and Climate Action (DEECA).

These and other non-quantified benefits are described further in the options comparison below.

5.4 Analysis summary and recommended option

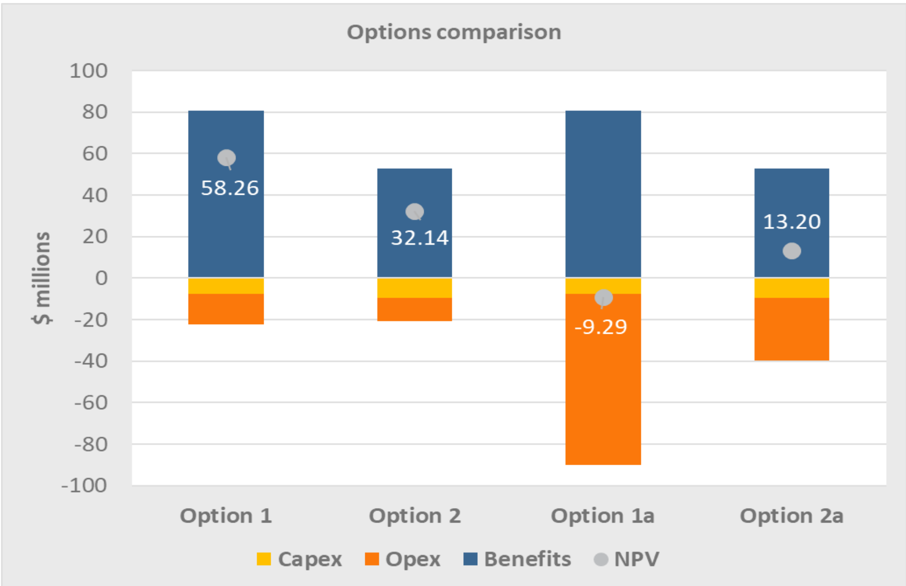
5.4.1 Options assessment results

The table below summarises the results of the comparison of options.

Table 4: Costs, benefits and risks of alternative options relative to the base case over the 15-year period, $m, $ Jun 2022 real. The Option 0 (Base Case) costs have been subtracted from all options.

Option	Costs		Benefits[28]			NPV[29]	Risk Level[30]	Ranking
	Capex[31]	Opex[32]	Neutral integrity	CECV	Voltage reduction			
Option 0 – Base Case	-	-	-	-	-	-	Medium	N/A[33]
Option 1 – 100% data	7.43	15.06	8.98	6.58	65.20	58.26	Low[34]	1
Option 2 – 30% data	9.53	11.27	2.69	4.60	45.64	32.14	Medium	2
Option 1a – 100% data with data purchase	7.43	82.61	8.98	6.58	65.20	-9.29	Low	N/A[35]
Option 1b – 30% data with data purchase	9.53	30.20	2.69	4.60	45.64	13.20	Medium	N/A

Figure 6 – NPV comparison of options



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28 Represents the total capital and operating benefits, including any quantified risk reductions compared to the risk of Option 0 (base case), over the 15-year cash flow period from 1 July 2025 to 30 June 2040 expected across the organisation as a result of implementing the option.

29 Net present value (NPV) of the option over 15-year cash flow period from 1 July 2025 to 30 June 2040, based on discount rate of 4.05%.

30 The overall risk level for each option after the option is implemented.

31 Represents the present value of total capex associated with the option over the 15-year cash flow period from 1 July 2025 to 30 June 2040.

32 Represents the present value of total opex increase associated with the option above the current level of opex, over the 15-year cash flow period from 1 July 2025 to 30 June 2040.

33 The base case is not ranked as it is included as a counterfactual.

34 Risk level adjusted to reflect very low probability event.

35 Options 1a and 2a are not ranked as these are included as sensitivity cases for options 1 and 2 respectively.

Assumptions

- Smart meter uptake rates assume that the AEMC's proposed accelerated rollout proceeds as planned from 2025 to 2030, reaching 95% by 2030 (allowing for 5% shortfall on the AEMC's target of 100% by 2030).
- We assume that basic PQ data will be available at no direct cost from 2025 onwards. Option 1a and Option 2a are included to illustrate the impact on options 1 and 2 respectively if basic PQ data had to be procured, assuming current market pricing. These options would need to be considered in our Revised Proposal should the AEMC rule change determination decide that basic PQ data must be provided on a fee basis to DNSPs.
- Other assumptions are documented below and in sections 8 and 9.

5.4.2 Recommended option

Our recommended option is option 1, receive and utilise basic PQ data from 100% of smart meters.

This option is recommended because:

- it meets the identified need set out in section 4;
- it is estimated to have the highest net positive financial benefits based on the specific benefits that have been quantified;
- it maximises the potential benefits from the other use-cases that we have not quantified in this business case;
- it aligns with the intention of the recommendations of the AEMC metering review that MCs should be required to provide basic PQ data to DNSPs for every installed smarter meter via a standard interface and procedure defined by AEMO. Option 2, in which we only receive and process data from a subset of installed smart meters, in order to reduce data storage and processing costs, would conflict with this intention; and
- it delivers the key safety benefit of neutral integrity fault detection to all customers on an equal, non-discriminatory basis, from the point at which they receive a smart meter. Option 2 is undesirable from a customer safety perspective as it requires us to choose which customers will receive the safety benefit (the ones from whose smart meters we elect to take data) and which will not. The AEMC recognised this issue in the final recommendations of their metering review and it was a key factor in their recommendation that basic PQ data should be made available to DNSPs at no direct cost from all meters.

Noting our assumption that basic PQ data will be available at no direct cost, the above NPV analysis indicates that, in the event that we did have to pay for basic PQ data at market rates then our preferred option would be Option 2a: we would seek to procure data from a subset of meters, not 100%, with a corresponding reduction in benefits.

5.5 Scenario and sensitivity analysis

The following sections further details the options considered and the sensitivity analysis undertaken.

5.5.1 Option 0 – base case

5.5.1.1 Description

Option 0, the base case for this options analysis, assumes that we do not source any additional smart meter data in 2025-30, we do not develop any of the network visibility use-cases proposed in our preferred option, (beyond current small-scale trials) and we do not undertake the SCADA and network model enhancement work proposed under our preferred option.

This option is included here as a counterfactual to provide a baseline for comparison of the other options. We do not consider it a credible option as it does not align with the intended outcomes of the AEMC's metering review, the expectations of our customers or our strategic direction.

5.5.1.2 Costs

There is no new capex under this option and no opex step change. For the purpose of the options analysis in this business case the cost of option 0 has been baselined at zero[36].

5.5.1.3 Risks

Table 5: Risk assessment summary

Risk consequence category	Current risk level[37]	Risk cost[38]
Safety – Harm to a worker, contractor or member of the public	Medium	Current level of risk, baselined at zero for the options comparison
Overall risk level	Medium	

5.6 Option 1

5.6.1 Description

Option 1, our proposed 2025-30 network visibility program, includes the following:

- expenditure to implement a new Shared Market Protocol (**SMP**) server and associated API and infrastructure to receive basic PQ data and other data from MCs at forecast data volumes and in a standard format according to AEMO procedures, replacing the bespoke data transfer arrangements currently in place for our small-scale trials;
- integration of the new SMP server with the COMPASS product and other components of our visibility and analytics platform;
- software licencing and cloud hosting costs to scale up our COMPASS data platform to support forecast data volumes for 100% of installed smart meters;
- project costs to develop and implement smart meter data analytics and associated business processes and reports for the following use-cases[39]:
  - Neutral integrity fault detection;
  - Proactive Voltage Management;
  - Closed-loop voltage control;

36 In practice certain costs included in option 1 and 2 associated with remediating SCADA at substations experiencing reverse power flows may be unavoidable to maintain compliance to regulatory obligations but for the purpose of options comparison we take option 0 to be a 'do nothing' baseline.

37 The level of risk post current controls (ie after considering what we currently do to mitigate the risk).

38 Estimated cost of consequence(s) to SA Power Networks or its customers in an event this risk eventuates over the NPV analysis period.

39 Note that the cost to develop the compliance use-case is not included in this business case as it is included in the separate CER compliance business case.

    - Hosting capacity estimation;
    - LV network load forecasting;
    - Energy conservation through voltage reduction;
    - Automatic mapping of customers to assets and inference of network topology;
    - Network fault detection (trial); and
    - Meter wiring issues and energy theft detection (trial).
- business process change activities to develop and embed new business processes for each of the above in our network planning and operations business functions;
- costs to procure a small volume of near-real-time data from smart meters to support specific use-cases;
- costs to enhance the accuracy our LV network model, which underpins the achievement of many of the benefits of improved visibility[40]; and
- cost to remediate existing SCADA monitoring at certain substations that are forecast to experience reverse power flows at the feeder level in the 2025-30 period, where the current equipment cannot determine the direction of power flow (which can generate incorrect data into our network operations systems, affecting load-flow calculations used in various functions including contingency load/generation shedding).

5.6.2 Costs

The cost of option 1 over the 2025-30 period includes:

- capex to develop the new SMP server, API and data analytics capabilities outlined above ($4.23 million), network model enhancements ($2.64 million) and minor upgrades to local SCADA equipment at 67 substations ($1.06 million); and
- a step change in opex ($5.96 million) arising from:
    - additional software licencing costs to scale up our COMPASS data platform to support forecast data volumes for 100% of installed smart meters;
    - scaling of cloud hosting costs (Microsoft Azure data processing and data storage costs) to support forecast data volumes; and
    - new costs to procure a small sample set of higher-frequency (non-basic) PQ data on a commercial basis. We have allowed for a sample set of 1,000 meters per annum, with the specific meters varying over time. High frequency data is used to target specific applications such as quality of supply investigations.

These costs have been estimated based on actual costs incurred in the current RCP in our network visibility trials, as well as current volume-tiered pricing from our vendors for the COMPASS product, Microsoft Azure hosting and near-real-time smart meter data. Further details on cost inputs are included in section 8.

The costs are summarised in the table below.

[40] Noting also that the use of smart meter data also helps improve the accuracy of our network model.

Table 6: Option 1 Costs by Cost Type ($m June 2022 Real)

Cost Type	2025-26	2026-27	2027-28	2028-29	2029-30	Total 2025 - 30	2030-31	2031-32	2032-33	2033-34	2034-35	Total 2025-35
Capex	2.82	2.95	0.88	0.71	0.56	7.92	0.00	0.00	0.00	0.00	0.00	**7.92**
Opex	0.92	1.06	1.20	1.34	1.43	5.96	1.43	1.43	1.43	1.43	1.43	**13.13**
TOTAL COST	**3.75**	**4.02**	**2.08**	**2.05**	**1.99**	**13.89**	**1.43**	**1.43**	**1.43**	**1.43**	**1.43**	**21.05**

5.6.3 Risks

Risk consequence category	Current risk level[41] (Option 0)	Residual risk level[42] (Option 1)	Risk cost[43]
Safety – Harm to a worker, contractor or member of the public	Medium	Low	Included in benefits analysis
Overall risk level	Medium	Low	

5.6.4 Quantified benefits

The forecast quantified benefits for option 1 are summarised in the table below.

Table 7: Option 1 Benefits by Expenditure Type ($m June 2022 Real)

Benefit Type	2025-26	2026-27	2027-28	2028-29	2029-30	Total 2025 - 30	Total 2025-40
Capex	0.00	0.00	0.00	0.00	0.00	**0.00**	**0.00**
Opex	0.00	0.00	0.00	0.00	0.00	**0.00**	**0.00**
Customer	1.37	2.67	4.13	5.08	6.08	**19.32**	**114.59**
TOTAL	**1.37**	**2.67**	**4.13**	**5.08**	**6.08**	**19.32**	**114.59**

5.6.5 Unquantified benefits

For the options analysis we quantified benefits for three of the nine network visibility use-cases that we propose to implement under option 1. Section 5.1 outlined the benefits we expect to deliver from the other use-cases, which are summarised below.

Table 8: Summary of unquantified benefits

Use-case	Source of benefit
Proactive Voltage Management	Proactive management of voltage and quality of supply in the LV network, improving overall quality of supply for customers and reducing customer impact of quality of supply issues that arise.
Closed-loop voltage control	Enhanced dynamic range of voltage control at the substation, reducing daytime voltage rise and increasing hosting capacity.
LV network load forecasting	Improved accuracy of load forecasting, reduced risk of outages due to asset overload.

41 The level of risk post current controls (ie after considering what we currently do to mitigate the risk).

42 The level of risk post future controls (ie after considering the effect the investment option).

43 Estimated cost of consequence(s) to SA Power Networks or its customers in an event this risk eventuates over the NPV analysis period.

Use-case	Source of benefit
Automatic mapping of customers to assets and inference of network topology	Improved accuracy of customer outage notifications, reduced administrative costs of life support notifications and improved accuracy of DOE calculations. While we have not included any quantified benefits associated with these capabilities in this business case, some of these potential benefits have been considered as part of the sensitivity analysis in our Customer Notification System (**CNS**) replacement business case[44].
Network fault detection (trial)	Determine potential to implement this as an operational system in the 2030-35 RCP; potential reliability benefits in future.
Meter wiring issues and energy theft detection (trial)	Determine potential to detect these issues and assess whether there is value in pursuing this in the 20230-35 RCP.

5.7 Option 2

5.7.1 Description

Option 2 involves essentially the same work as Option 1 and will develop the same set of network visibility use-cases. The key difference is that in this option we will only request, receive, process and store basic PQ data from a 30% sample of available smart meters.

5.7.2 Costs

This option has lower costs to store and process smart meter data than Option 1 due to reduced costs for COMPASS licensing and Azure hosting, but higher costs for network model enhancement due to the reduced opportunity to use smart meter data to automate validation of some aspects of the network model. The costs of Option 2 are summarised in the table below.

Table 9: Option 2 Costs by Cost Type ($m June 2022 Real)

Cost Type	2025-26	2026-27	2027-28	2028-29	2029-30	Total 2025 - 30	2030-31	2031-32	2032-33	2033-34	2034-35	Total 2025-35
Capex	3.08	3.33	1.35	1.28	1.23	**10.28**	0.00	0.00	0.00	0.00	0.00	**10.28**
Opex	0.59	0.73	0.86	0.98	1.10	**4.26**	1.10	1.10	1.10	1.10	1.10	**9.77**
TOTAL COST	**3.68**	**4.06**	**2.22**	**2.26**	**2.33**	**14.55**	**1.10**	**1.10**	**1.10**	**1.10**	**1.10**	**20.05**

[44] 5.12.19 - Customer Program: Customer Notification System Replacement - Business case

5.7.3 Risks

Risk consequence category	Current risk level (Option 0)	Residual risk level (Option 2)	Risk cost
Safety – Harm to a worker, contractor or member of the public	Medium	Medium	Included in benefits analysis
Overall risk level	Medium	Medium	

5.7.4 Quantified benefits

A 30% sample has been chosen for this option because it is sufficient to enable some benefits from all target use-cases, but the benefits enabled are lower than can be achieved with access to 100% smart meter data. We have estimated the value of the three quantified benefit streams for for option 2 as a percentage of the forecast benefits achieved with access to 100% of smart meter data in option 1, as follows:

Table 10: Forecast benefit value with 30% meter data as a proportion of forecast benefit with 100% meter data

Use-case	Benefit value compared to option 1
Neutral integrity fault detection	30%
Improved hosing capacity estimation (CECV)	70%
Network average voltage reduction benefit	70%

The quantified benefits forecast for option 2 are summarised in the table below.

Table 11: Option 2 Benefits by Expenditure Type ($m June 2022 Real)

Benefit Type	2025-26	2026-27	2027-28	2028-29	2029-30	Total 2025 - 30	Total 2025-40
Capex	0.00	0.00	0.00	0.00	0.00	**0.00**	**0.00**
Opex	0.00	0.00	0.00	0.00	0.00	**0.00**	**0.00**
Customer	0.74	1.62	2.61	3.25	3.91	**12.13**	**75.37**
TOTAL	**0.74**	**1.62**	**2.61**	**3.25**	**3.91**	**12.13**	**75.37**

5.7.5 Unquantified benefits

As well as a reduction in the quantified benefits for the three core use-cases, this option would have reduced benefits for some of the use-cases that have not been quantified, as summarised below.

Table 12: reduced unquantified benefits with 30% meter data compared to 100% meter data

Use-case	Impact on benefit compared to Option 1
Proactive Voltage Management	Some quality of supply issues not able to be identified prior to customer impacts arising.

Use-case	Impact on benefit compared to Option 1
Closed-loop voltage control	30% sample likely to be sufficient to support this use-case with some reduction in efficacy due to reduced accuracy.
LV network load forecasting	Reduced accuracy of load forecasting, minor reduction in benefit
Automatic mapping of customers to assets and inference of network topology (trial)	Significantly reduced benefit; use-case may not be viable with 30% sample.
Network fault detection (trial)	Use-case may not be viable with 30% sample.
Meter wiring issues and energy theft detection (trial)	30% sample would deliver 30% of the benefit of Option 1 for this use-case.

5.8 Options 1a and 2a

As noted in section 5.2, Option 1a and Option 2a are equivalent in scope to options 1 and 2 respectively but with the added cost of procuring basic PQ data from metering providers on a per-meter, per-annum basis at current market rates.

While we assume that basic PQ data will be available in 2025-30 from all smart meters at no direct cost, we have included these options to illustrate the additional costs that would be incurred should this specific recommendation from the AEMC's metering review not be reflected in the final rule change.

The table below shows the additional opex step change associated with this cost component for Option 1a compared to Option 1:

Table 13: Option 1a additional opex compared to option 1 ($m June 2022 Real)

Cost Type	2025-26	2026-27	2027-28	2028-29	2029-30	Total 2025 - 30	2030-31	2031-32	2032-33	2033-34	2034-35	Total 2025-35
Basic PQ data procurement opex (100%)	4.02	4.64	5.26	5.87	6.49	26.28	6.49	6.49	6.49	6.49	6.49	**58.74**

The table below shows the additional opex step change associated with this cost component for Option 2a compared to Option 2:

Table 14: Option 2a additional opex compared to option 2 ($m June 2022 Real)

Cost Type	2025-26	2026-27	2027-28	2028-29	2029-30	Total 2025 - 30	2030-31	2031-32	2032-33	2033-34	2034-35	Total 2030-35
Basic PQ data procurement opex (30%)	1.09	1.27	1.46	1.64	1.83	7.30	1.83	1.83	1.83	1.83	1.83	**16.47**

5.9 Sensitivity analysis

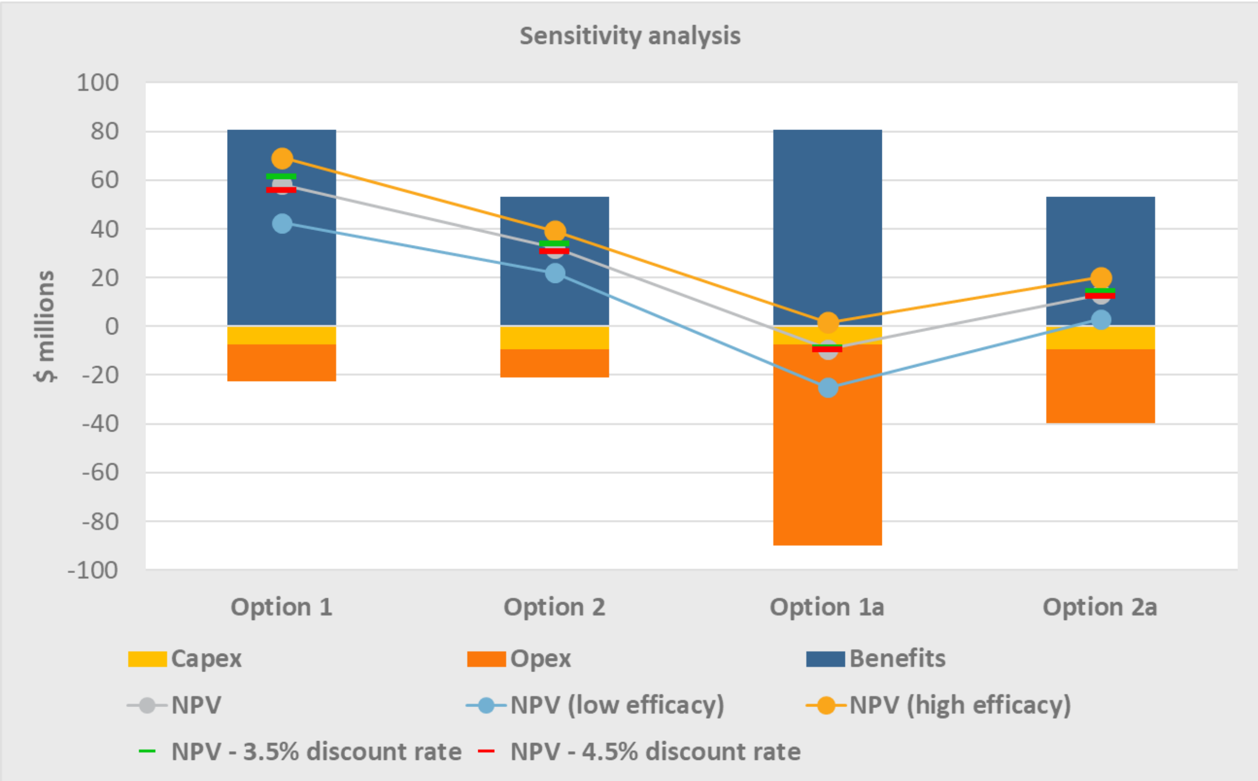
Our benefits forecast relies on assumptions regarding the efficacy of our network visibility program in enabling us to detect neutral integrity faults, improve the accuracy of our network hosting capacity models and improve network voltage management.

To allow for uncertainty in these assumptions we have modelled:

- a 'low efficacy' sensitivity case, reflecting more pessimistic assumptions regarding the impact of the program; and
- a 'high efficacy' sensitivity case, reflecting more optimistic assumptions regarding the impact of the program.

In addition, we have assessed sensitivity to our assumed discount rate of 4.05% by repeating the NPV analysis using a lower discount rate of 3.5% and a higher one of 4.5%. The outcome of the analysis is shown below.

Figure 7 – Sensitivity analysis



Further details of the assumptions and sensitivity cases are included in section 8 and Appendix C.

The outcome of this analysis is that option 1 is preferred over option 2 in all sensitivity cases modelled. The forecast net benefit of option 1 under pessimistic assumptions ('low efficacy') is slightly greater than the forecast net benefit of option 2 under optimistic assumptions ('high efficacy'). This indicates that, assuming there is no direct cost per meter to procure access to basic PQ data, it is more beneficial to receive, process and use data from 100% of meters than from a smaller subset.

In the case of options 1a and 2a the situation is reversed; if we assume that we must procure basic PQ data at current market rates then option 1a only has forecast positive net benefits under the more optimistic sensitivity case whereas option 2a has forecast positive net benefits under all scenarios.

Noting that this cost/benefit analysis is limited insofar as we have only sought to quantify benefits from three of the many benefit streams arising from greater network visibility, should it eventuate that we do not receive access to basic PQ data at no direct cost, further work would be required to determine whether there is a positive business case for procuring data from 100% of smart meters or whether we would only procure data from a subset.

6 How the recommended option aligns with the views of our customers and industry stakeholders

In developing our proposed 2025-30 network visibility program we considered the views, expectations and preferences of industry stakeholders and customers in our engagement with them over the last 18 months.

We have been active participants in the AEMC's review of the contestable metering framework, including as members of the industry working group convened to review data access arrangements for DNSPs. Through this process we collectively examined the use-cases and customer benefits enabled by access to basic PQ data, drawing on input from the Victorian DNSPs and learnings from their AMI[45] programs. While some stakeholders did not support the AEMC's proposal that basic PQ data should be made available at no direct cost to DNSPs, there was strong support from customer advocates for this.

Among all stakeholders, there was broad agreement that:

- DNSPs need visibility of their LV networks in order to efficiently plan and operate their networks through the energy transition and to efficiently integrate forecast levels of CER;
- smart meters were always intended as the primary tool in the NEM to enable this visibility at least cost to customers (since every customer requires a meter, and every smart meter can provide this data); and
- customers deserve access to the full range of benefits that their smart meters can provide.

The three key use-cases for which we quantified future benefits in this business case, neutral integrity fault detection, improving our understanding of network hosting capacity and the reduction of average network voltage are those that align most with the recurring themes raised in our engagement with our customers and with other industry stakeholders through forums like our DER Integration Working Group (**DERIWG**)[46]:

- customers expect a safe and reliable network, and strongly value fairness, equity and non-discrimination in the way that we deliver our network services;
- the AER, policymakers and customer advocates expect that as we transition from static export limits to flexible exports (dynamic operating envelopes) we will (a) seek to maximise access to available network capacity and not curtail exports more than necessary, and (b) be transparent and provide customers with information on the hosting capacity of their local network and the service levels they can expect. This principles are set out clearly in the AER's draft interim export limit guidance note[47]. Our performance in both of these areas is improved when we have a more accurate understanding of hosting capacity in the LV network; and
- The cost of energy and reducing carbon emissions are key concerns raised repeatedly by customers in our engagement with them. The recent progress made in reducing network voltages in Victoria has shown that there is a significant opportunity to deliver energy cost savings to customers and reduce greenhouse gas emissions through similar actions in South Australia.

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45 Advanced Metering Infrastructure.

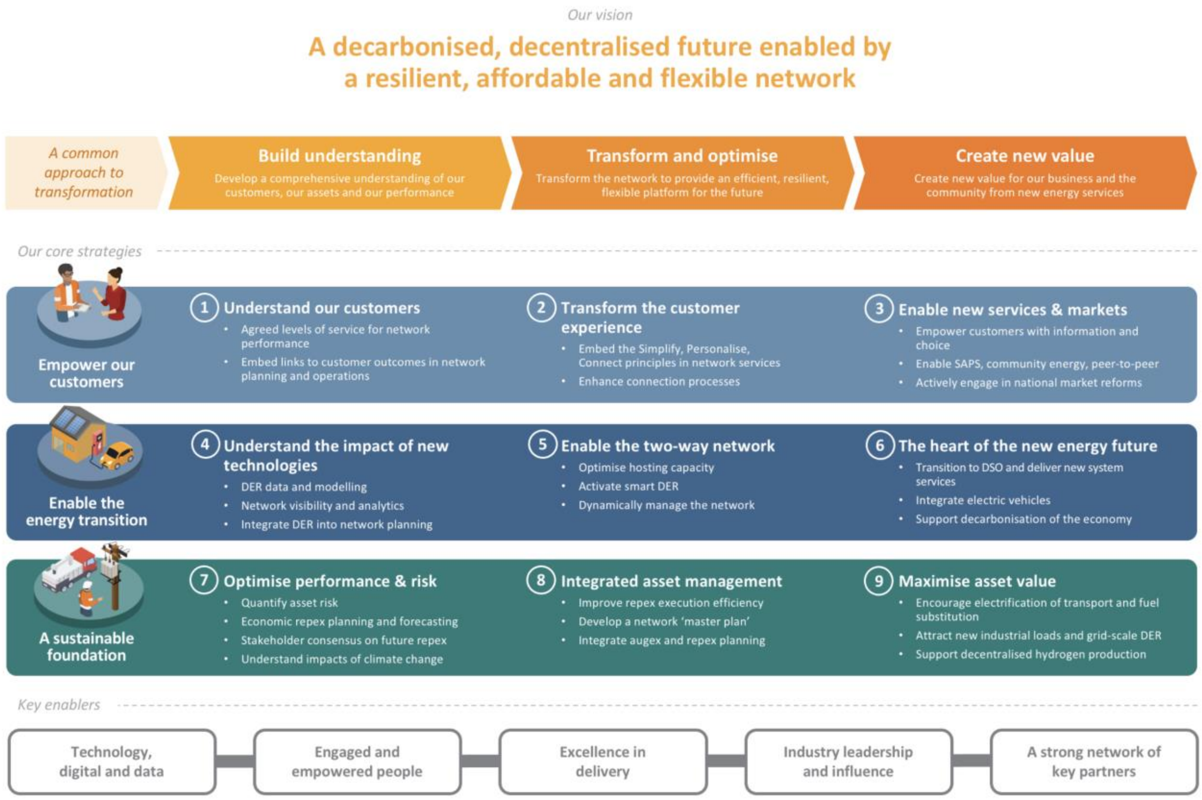
46 Our DERIWG is a national forum of DER/CER industry stakeholders that we convene to seek industry input on our approach to CER integration.

47 AER, *Interim export limit guidance note – for consultation*, November 2023,accessed at: https://www.aer.gov.au/documents/draft-export-limit-interim-guidance-note-november-2023

7 Alignment with our vision and strategy

Our Network Strategy[48] is shown in Figure 8 below.

Figure 8 – SA Power Networks' Network Strategy



Our proposed 2025-30 network visibility program aligns with and supports the following core strategies within our overall Network Strategy:

Strategy 4: Understand the impact of new technologies

- **Improve DER records through electronic registration and data analytics**
- **Implement a network visibility and analytics platform**
- **Model the Low Voltage (LV) network**
- Enhance network planning capabilities to consider minimum demands, reverse power flows and DER operating scenarios

Strategy 5: Enable the two-way network

- **Enhance DER integration, from passive measures like technical standards and tariffs, to flexible exports and active integration of smart DER**
- Lead positive reform in network access and pricing regulation
- Coordinate management of DER for system security
- **Actively manage voltage across the network**

Strategy 6: Network at the heart of the new energy future

- Transition to DSO and actively integrate with VPPs and aggregators
- Integrate electric vehicles
- **Investment in hosting capacity enhancements**
- Leverage our network assets and capabilities to deliver new services to system-level markets

[48] 5.7.1 Network Strategy

- **Support decarbonisation of the economy**

8 Reasonableness of cost and benefit estimates

Our methodologies for estimating costs and benefits are summarised in the tables below.

8.1 Costs

Table 15: Basis of cost estimates

Cost item	Basis of estimate
Meter PQ data storage and processing costs	OPEX cost forecasts are based on actual costs incurred to date for meter data processing and storage for the following PQ data sources in our pilot program: • 25,000 smart meters; • 7,638 customer inverters (VPP sites and flexible exports solar inverters); and • 500 transformer monitors. Costs include data processing and storage for all the above data sources. Data volume forecasts are based on current per-meter data volume (basic PQ data only) and an observed average of 1.19 PQ data streams per meter. OPEX forecast includes forecast licensing costs for the Future Grid COMPASS time-series data platform, based on vendor volume-tiered pricing, plus Microsoft Azure cloud hosting costs, based on current pricing. All costs are step change only, with current (revealed year) OPEX baseline removed.
Meter data procurement costs	In our core options, basic PQ data is assumed to be available for all meters from July 2025 at no direct cost, in line with final recommendations of the AEMC's metering review. As this outcome is still subject to a rule change, we have also modelled the case where basic PQ data must be procured. For these cases, per-meter data procurement costs are based on current market pricing from two leading metering coordinators for basic PQ data. In all cases we have included an allowance for the procurement of higher frequency (near real time) meter data from a small sample set of 1,000 meters to support specific use-cases such as QoS investigations, with costs again based on current market rates for this kind of data.
Data analytics: algorithm development	CAPEX costs to develop and implement new data analytics algorithms to support the use-cases outlined in this business case have been estimated based on actual effort involved in pilots, trials and preliminary investigations undertaken in the current period, including: • closed-loop voltage control trial; • neutral integrity fault detection pilot; • LV network hosting capacity analysis for LV Planning Engine; • Transformer reverse power flow estimation trial; • Volt-VAR compliance detection investigation; and • Transformer tap setting inference investigation. For proposed 2025-30 use-cases where no analysis has yet been done, estimates are based on forecast complexity, based on similarity to work already done and informed by learnings from the Victorian networks' AMI data analysis projects.
Data analytics: business process change	CAPEX costs for business process development and change management have been estimated based on the learnings from the pilots, trials and preliminary investigations undertaken in the current RCP, as listed above.
Top-down challenge	After individual cost items had been estimated as above, the overall program cost was subject to internal top-down review to consider the staging of work over time and potential program-level synergies and

Cost item	Basis of estimate
	efficiency gains in common activities such as change management and project management. This activity resulted in a small reduction to the original bottom-up cost estimates.

8.2 Benefits

Table 16: Basis of benefit estimates

Benefit item	Basis of estimate
Neutral integrity fault detection	The value of automated neutral integrity fault detection arises from the avoided risk of customer harm from electric shocks caused by failed neutral connections. The estimated future value has been quantified based on: • Forecast number of neutral integrity fault detections in each year from the start of the 2025-30 RCP, extrapolated from the detection rates observed so far in our neutral integrity fault detection pilot, which uses a small subset of smart meter data from less than 3% of premises; • Likelihood of death or serious injury from an undetected neutral integrity fault, based on Ofgem data; and • Consequence value of death or serious injury in accordance with our Value Framework. Further details of this methodology are included in Appendix B.
CECV benefits	Flexible export operating envelopes are calculated using an estimate of the hosting capacity (maximum reverse power flow possible while remaining within voltage limits) for each LV transformer. In most cases today these hosting capacity values are estimates based on category averages derived from a limited sample of available smart meter data. They are, therefore, subject to a degree of estimation error, observable in the standard deviation of each category dataset. In practice, it is necessary to account for this by including a buffer in the calculation of operating envelopes, to mitigate the risk of the true capacity limit of an asset being breached due to an estimation error. This means that customers' flexible export limits are generally set lower than they would be if hosting capacity were known to 100% accuracy, which causes a loss of CECV value due to the additional export curtailment involved. As the volume of smart meter PQ data increases in the 2025-30 RCP, our capability to accurately determine LV transformer hosting capacities will increase progressively. This will enable the LV network to be operated closer to its true export capacity, with a corresponding increase in CECV value unlocked, than if we did not have access to more smart meter data and had to continue to rely on current estimates. This benefit has been estimated using a with/without analysis undertaken using our LV Planning Engine to calculate the estimated CECV benefit associated with the incremental reduction in export curtailment we expect to be able to achieve through improved visibility. It is important to note that this analysis is based on our forecast of the level of export curtailment before making the investments in additional export capacity proposed in our CER integration business case. This ensures that there is no double-counting of benefits: the CECV value attributed to the network visibility program in this business case is not included in the CECV values associated with the network capacity upgrade options considered in the CER integration business case. Rather, all the options for network investment considered in the CER integration business case start from a baseline that assumes that our 2025-30 visibility program will go ahead, and the accuracy of our hosting capacity estimates will improve over time accordingly. This also means that the CECV benefit attributed to our network visibility program is independent of the level of investment in additional export capacity (i.e. independent of which investment option of those considered in the CER integration business case is chosen). Details of the LV Planning Engine can be found in our CER Integration business case49.

[49] 5.7.4 - CER Integration - Business Case

Benefit item	Basis of estimate
Energy conservation from average voltage reduction	Many appliances and other loads consume more energy at higher voltages. The increase in energy consumption for voltages above the Australian reference voltage of 230 V varies according to the nature of the load but can, aggregated over a large number of customers, be significant. Since 2020, Victorian distribution network service providers (**DNSPs**) have been actively working to reduce average network voltages through various initiatives, all of which rely on the near-100% availability of smart meter voltage data in Victoria. A recent study undertaken by the Victorian Department of Energy, Environment and Climate Action (DEECA) found that the decline in average voltages that has been achieved by the Victorian DNSPs since 2020 has resulted in approximately $7 million in savings per annum ongoing in reduced energy costs[50]. Access to basic PQ data from all smart meters in South Australia from mid-2025 will enable us to pursue similar voltage reduction opportunities here. To quantify the potential future benefit to customers we have used the same methodology used in the Victorian study, which estimates the average dollar value in energy saved per customer for each Volt of voltage reduction. We have adapted the methodology to the South Australian context by incorporating the slightly different mix of appliance types in an average South Australian home and using South Australian energy prices. Our central benefit case assumes that with 100% access to smart meter data we could achieve a reduction of 3 V in average network voltage over the five-year RCP from 2025 to 2030, compared to 2023 average voltage levels. This is comparable to the voltage reduction achieved by Powercor (2.9 V) in under three years between February 2020 and October 2022, and lower than the corresponding reduction achieved by CitiPower in the same period (3.8 V). Noting that Powercor's network is more similar to ours than CitiPower's smaller and more urban network we consider a 3 V reduction over five years as realistically achievable in South Australia. Our benefit model assumes a further reduction of 2 V is achievable in 2030-35, with no further reduction beyond that. We consider this is a conservative estimate of future benefits, noting that a total reduction of 5 V over ten years would result in average network voltages that are still above the nominal 230 V standard. To allow for uncertainty in the future efficacy of our voltage reduction activities, however, we have also modelled a range of sensitivities, described in appendix C.

9 Reasonableness of input assumptions

The table below provides a summary of other input assumption not included in section 8 above.

Table 17: Basis of key input assumptions

Input assumption	Basis

Smart meter uptake forecasts	Our forecasts for smart meter uptake in South Australia were prepared by consultant Blunomy (formerly Enea) taking into consideration:
	• Actual current penetration of smart meters;
	• Current and forecast replacement rates arising from new solar and other CER installs, meter failures and customer-requested replacements;
	• The AEMC's proposed accelerated rollout program assumed to commence in July 2025 which has:
	  o a target of 100% completion by end 2030; and
	  o a target to achieve a roughly linear growth profile from 2025-30
	• We have assumed that 95% completion by 2030 is realistically achievable based on the AEMC target of 100%, drawing on experience from the Victorian AMI rollout.

[50] Department of Energy, Environment and Climate Action, *Voltage Management in Distribution Networks*, Directions Paper, 2023

CECV model input assumptions	Forecast CECV benefits from more accurate hosting capacities are calculated using our LV Planning Engine model. This relies on various input assumptions based on AEMO's August 2022 ESOO forecasts for South Australia, as well as analysis of existing smart meter data. This modelling activity has been supported by independent advice from external consultants Blunomy (formerly Enea) and EVenergi. Further details are included in the CER integration business case.

A. Appendix A - Risk assessment

				Current risk (Option 0)			Residual risk (Option 1)			Residual risk (Option 2)		
ID	**Risk scenario**	**Consequence description**	**Consequence category**	**Consequence**	**Likelihood**	**Risk Level**	**Consequence**	**Likelihood**	**Risk Level**	**Consequence**	**Likelihood**	**Risk Level**
1	Failure to detect neutral integrity fault	Risk of electric shock to customer potentially resulting in injury or even death	**Safety** - Harm to a worker, contractor or member of the public	5	1	Medium	5	1	Low*	5	<1	Medium
			Overall Risk Level[51]			Medium			Low*			Medium

*Risk level adjusted to reflect very low probability event

[51] For each option, the overall risk level is the highest of the individual risk levels.

B. Appendix B – Neutral integrity fault detection: benefits analysis

Our approach to quantifying the forecast benefits of neutral integrity fault detection is based on our Value Framework[52]. The Value Framework prescribes the consequence value for safety risks across a severity scale, with five values ranging from Minimal to Catastrophic. The first four severity levels use the disability weighted value of life approach while the minimal severity level uses an OHS cost approach. The OHS cost approach is used because the value of life approach is too coarse to apply to low severity injuries. The values are presented in the table below.

Table 18: Value Framework Risk Values

Scale	Description	Value Metric Assumption	Calculation assumption	Value (2020/21)
Minimal	Low level injury/symptoms requiring first aid only	Minor injury requiring limited treatment. Valued using SafeWork Australia short term absence cost.	OHS Cost (Short term absence)	$4,876
Minor	Non-permanent injuries/work related illnesses requiring medical treatment	Temporary injury that limits the victim's quality of life for 1 year. Valued using VSLY multiplied by the weighting for a minor injury (e.g. nerve damage, sprain, dislocation).	VSLY * 0.07	$15,190
Moderate	Significant non-permanent injury/work related illnesses requiring emergency surgery or hospitalisation for more than 7 days	Temporary injury that limits the victim's quality of life for 1 year. Valued using VSLY multiplied by the weighting for a bone fracture of a major bone (e.g. femur, pelvis).	VSLY * 0.25	$54,250
Major	Permanent injury/work related illnesses to one or more persons	Severe injury that permanently reduces the victim's quality of life. Valued using VSL multiplied by the weighting for an arm/leg amputation.	VSL * 0.3	$1,500,000
Catastrophic	One or more fatalities. Multiple significant permanent injuries/work related illnesses	Fatality or severe injury that prevents the victim from working for the rest of their life. Valued using VSL.	VSL * 1	$5,000,000

The above risk values are weighted by a Disproportionality Factor (DF) reflecting the extent to which our business would invest in order to avoid causing harm to customers and the community. The DF for a Catastrophic event is chosen as 6 and for Minimal it is 3.2, as shown in the below table.

52 SA Power Networks, *SAPN Value Framework v1.0, March 2022.*

Table 19: Disproportionality factor

Safety Category	Disproportionality factor (DF)
Minimal	3.2
Minor	3.9
Moderate	4.6
Major	5.3
Catastrophic	6

To apply these risk values we need to take into consideration the likelihood of the risk – in this case a fault or failure of the neutral connection to the premises – and the probability that the occurrence of the risk will lead to the consequence, i.e. the likelihood that a faulty neutral will result in a death or injury.

We have a strong safety record and fortunately has had very few significant safety consequences, so we cannot produce a reasonable estimate of the probability of consequence from our own records. Instead we have adopted the UK Office of Gas and Electricity Markets (OFGEM)[53] probability of consequence due to an asset failure. As OFGEM's categorisation does not specifically include the customer service line, we take their pole failure category as the closest equivalent. These probabilities are presented in Table 20.

Table 20: OFGEM Likelihood of Failure Leading to a Safety Event

Lost Time Accident	Death or Serious Injury to Public	Death or Serious Injury to Staff
0.000816	0.00003264	0.00001632

OFGEM's 'Death or Serious Injury' probabilities are considered to span across the 'Catastrophic' and 'Major' categories in the SA Power Networks Value Framework. Similarly, OFGEM's 'Lost Time Accident' probabilities are considered to span across the 'Moderate', 'Minor' and 'Minimal' SA Power Networks categories.

Table 21 Mapping OFGEM to Value Framework Categories

OFGEM Category	SAPN Category
Death & Serious Injury	Catastrophic
	Major
Lost Time Accident	Moderate
	Minor
	Minimal

OFGEM's Death & Serious Injury (**DSI**) category is weighted in financial terms with $1,810,495 assigned to DSI and $1,745,000 assigned to Death. The DSI likelihood of consequence is therefore divided with 60% assigned to SA Power Networks' Major Category and 40% assigned to the Catastrophic category.

[53] Office of Gas and Electricity Markets UK, *DNO Common Network Asset Indices Methodology OFGEM*, April 2021.

Table 22: OFGEM LOC to SAPN Categories

% of OFGEMs DSI Likelihood of Consequence (LOC)	SAPN Categories
60%	Major
40%	Catastrophic

OFGEMs Lost Time Accident (LTA) category is similarly mapped to SA Power Networks' categories, weighted so that the less serious events are more likely, consistent with safety management practice.

% of OFGEMs LTA LOC	SAPN Categories
17%	Moderate
39%	Minor
44%	Minimal

The total Likelihood of Consequence for each Scale of Consequence is calculated in the following table:

Table 23: Total Likelihood of SA Power Networks' Scales of Consequence

Scale	OFGEM Likelihood of LTA	OFGEM Likelihood of DSI	Distribution of OFGEM Likelihood to SAPN Scale of Consequence	Total Likelihood
Minimal	0.000816		0.17	0.00013872
Minor	0.000816		0.39	0.00031824
Moderate	0.000816		0.44	0.00035904
Major		0.00003264	0.6	0.000019584
Catastrophic		0.00003264	0.4	0.000013056

For SA Power Networks, it is estimated that there are **1,419** service failures that have a consequence each year. These include unplanned outages and/or electric shocks.

The following methodology is used to calculate the risk value for each consequence level:

$$Risk\ value = Value \cdot DF \cdot Likelihood \cdot Failure\_rate$$

Where:

- Risk value = The total risk value of a scale of consequence to SA Power Networks (e.g. Catastrophic, Major etc.)
- Value = Value of the scale of consequence in the SA Power Networks Value Framework
- DF = Disproportionality Factor of scale of consequence as in Table 19

- Likelihood = Likelihood of scale of consequence as in Table 23
- Failure_rate = 1,419 events per year

This translates to the following table for all customers in the SA Power Networks network:

Table 24: Total annual risk value for shocks from service failures

Scale of Consequence	Risk Value
Minimal	$7,949
Minor	$26,752
Moderate	$49,122
Major	$220,928
Catastrophic	$555,794
Total	$860,546

We have forecast smart meter numbers through the 2025-2030 period, assuming that the AEMC's proposed accelerated rollout proceeds as intended from 2025. As meter numbers increase, this increases the number of smart meters available to detect broken neutral faults at customer sites. The total meters for each year is translated to a proportion of the Total Risk Value in Table 24 to give the forecast annual value of avoided risk due to neutral integrity detection.

Table 25: Total risk value by meter penetration

FY	Meters	Percentage of total	Value by year
2026	551,608	63%	$541,465
2027	632,872	72%	$621,235
2028	714,136	81%	$701,006
2029	795,401	91%	$780,776
2030	876,665	100%	$860,546
Total			$3,505,030

C. Appendix C – Sensitivity cases

Our NPV analysis considers how sensitive the NPV of our proposed work program is to variations in key input assumptions. The sensitivity analysis includes low-efficacy and high-efficacy sensitivity cases for the three quantified benefits, as well as testing sensitivity to different assumed discount rates. These are shown in the table below.

Table 26: Sensitivity cases

	Option 1 / 1a			Option 2 / 2a		
Input	**Central**	**Low**	**High**	**Central**	**Low**	**High**
Neutral integrity likelihood of consequence (percentage of central case)	100%	80%	120%	100%	80%	120%
Hosting capacity estimation accuracy benefit (percentage of central case)	100%	80%	120%	100%	80%	120%
Network voltage reduction efficacy - average voltage reduction achieved by 2030 (Volts)	3	2.5	3.5	3	2.5	3.5
Network voltage reduction efficacy - average voltage reduction achieved by 2035 (Volts)	5	4	5.5	5	4	5.5
Discount rate for NPV analysis	4.05%	3.50%	4.50%	4.05%	3.50%	4.05%

Figure 9 below shows the forecast achievable level of average voltage reduction in the 2023-30 RCP and the 2030-35 RCP under our central, low efficacy and high efficacy sensitivities. Our 15-year NPV analysis assumes no further benefit in average voltage reduction from 2035 onwards.

Figure 9 – Average voltage reduction relative to 2023 average network voltage