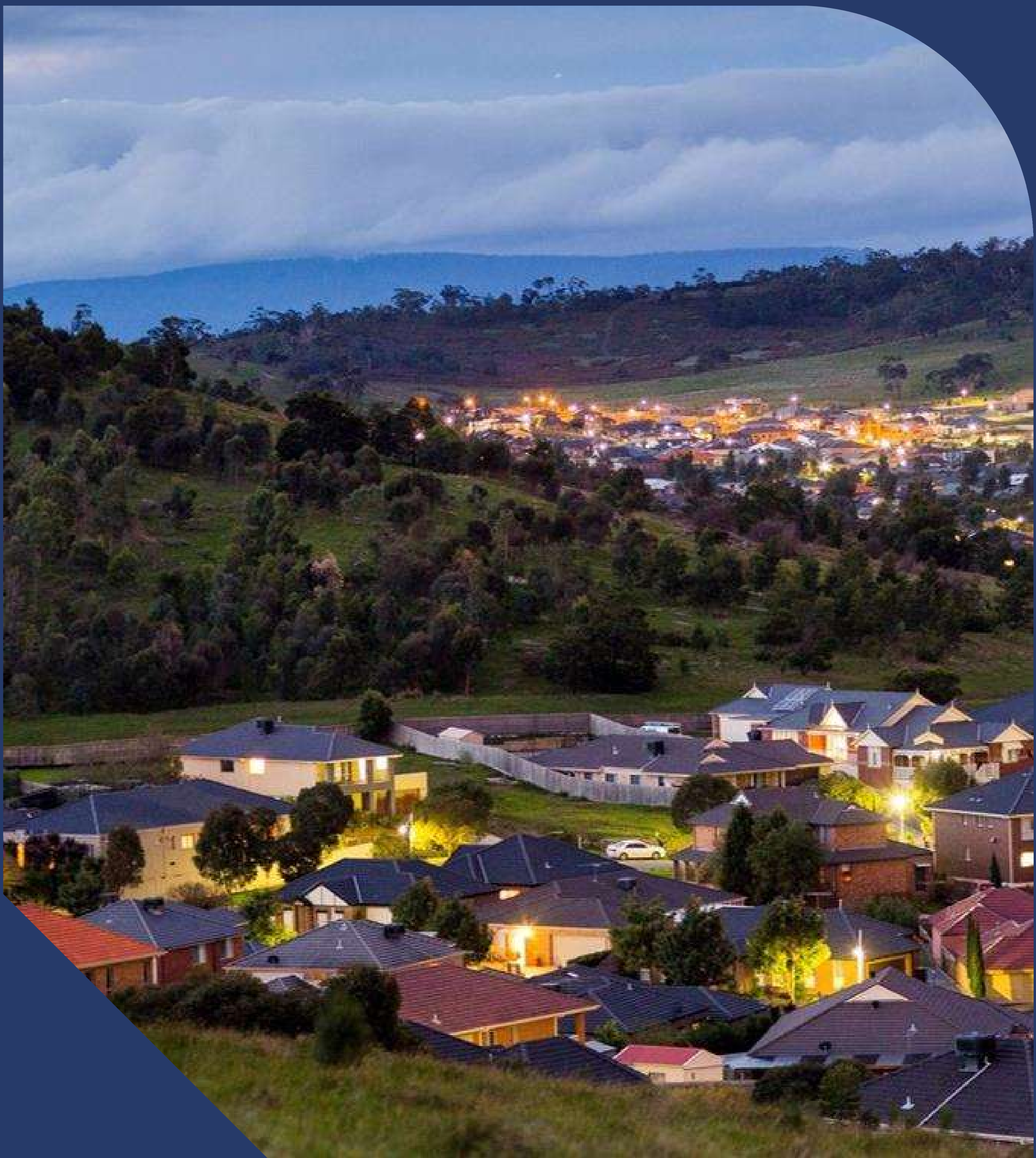
Electricity Distribution Price Review (EDPR 2026-31)

Business case: SAPS

Date: 31 January 2025



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1. Executive summary

The AusNet distribution network supplies electricity to ~809,000 customers across the east of Victoria. Across our network, we are experiencing increasing frequency and size of extreme weather events; the most severe of these events causing multiple prolonged outages for our customers. As a part of enhancing the resilience of the distribution network against climate change, an investigation was conducted to assess the costs and benefits of various non-network programs. This business case outlines our assessment and the preferred investment to proceed with.

This proposal sets out the identified need; some customers have experienced prolonged outages due to extreme weather events and they may be better served by Stand-Alone Power Systems (**SAPS**) compared to traditional network augmentation or like-for-like replacement at the end of asset life. This is due to SAPS being able to provide a dedicated supply that is not as susceptible to extreme weather conditions compared to the grid.

After assessing three options against Business-as-usual (**BAU**) – which we have defined as like-for-like replacement at the end of the asset's life – our assessment identified the delivery of 25 SAPS to individual customers in rural and remote areas as the preferred option that maximises the Net Present Value (**NPV**) of the options assessed. The capital expenditure requirement of the preferred option is $6.02 million over five years (undiscounted, direct, real 2023-24).

The NPV (PV benefits minus PV costs) of the preferred option (relative to BAU) is $4.3 million. While SAPS are already preferred over BAU of like-for-like replacement at the end of asset life, there are other unquantifiable benefits to customers, such as improved power quality. Our analysis adopts the AER's Value of Network Resilience (**VNR**) instead of the AER's standard VCRs to quantify benefits to customers. We have applied the VNR to the AER's 2023 VCRs.

This business case outlines how we have:

Analysed historical data: The process of evaluating investment feasibility comes through investigating the historical outages experienced by customers on the network and identifying most impacted locations. Historical outages are then trended forward by the addition of a climate change factor. By understanding which network areas are projected to experience more severe and frequent weather conditions in the future, a proactive solution can be designed and delivered.

Assessed various options: Options analysis involves comparing the costs and benefits of feasible and available options. We have assessed three options relative to BAU (like-for-like replacement at the end of the asset's life) and they are the installation of SAPS, undergrounding existing overhead cables and insulating existing overhead conductors. Benefits have been quantified at the customer level; by estimating the expected annual outage (largely based on historical outages and then trending it forward by an annual climate change growth rate) and expected unserved energy for each customer, then multiplying it by the AER's VNR.

Identified the preferred option: The installation of SAPS is our preferred option as it maximizes the NPV of all the options assessed.

Benefits of SAPS for customers are improved performance during outages as the dedicated supply is separate from the grid; customer can remain energised. This allows customers to experience resilience benefits through avoiding major event day outages, as well as day-to-day reliability improvements.

Table 1: Summary of options analysis (Real $m, 2023-24 dollars)

	2026-31 (undiscounted)			Full assessment period relative to BAU (discounted)			Comments
	Capex	Opex	Total cost	Total cost	Total benefits	NPV	
Business-as-usual	C-I-C	C-I-C	C-I-C	C-I-C	$-	C-I-C	This is a like-for-like replacement at the end of the existing asset's life
Option 1 – Stand-alone Power Systems	$6.2	$0.5	$6.7	$2.1 less than BAU	$2.2	$4.3	The installation of 25 SAPS is the preferred option as it maximises the NPV
Option 2 – Undergrounding	C-I-C	C-I-C	C-I-C	C-I-C	$2.2	C-I-C	The replacement of 12.5 km existing overhead cables with undergrounding.
Option 3 – Covered conductors	C-I-C	C-I-C	C-I-C	C-I-C	$2.2	C-I-C	The replacement of 12.5 km existing overhead cables with covered conductor.

Source: AusNet.

2. Background

Extreme weather events on our distribution network

Over the past 5 years, we have experienced 4 major storms and 1 bushfire:

2019-2020 – Black summer bushfires

The black summer bushfires across the 2019-2020 summer resulted in widespread damage across the state and destroyed a significant proportion of our distribution network. Across our network, over 300 power poles were destroyed, over 1,000 kilometres of powerlines were affected, and approximately 60,000 customers experienced outages. Significant remediation works were required to restore supply to customers across the state, and temporary supply was required to enable operation of essential services across remote regions where power was not restored for a significant duration of time.

2021 – June & October storms

Victoria was impacted by severe storms during June and October of 2021, which again caused significant outages. The significant winds during this period caused trees and powerlines to fail, faulting powerlines and resulting in prolonged outages whilst infrastructure was repaired. These events resulted in outages to approximately 249,000 customers during the June 2021 storms and 217,000 customers during the October 2021 storms; some of which lasted multiple days.

2024 – February storm

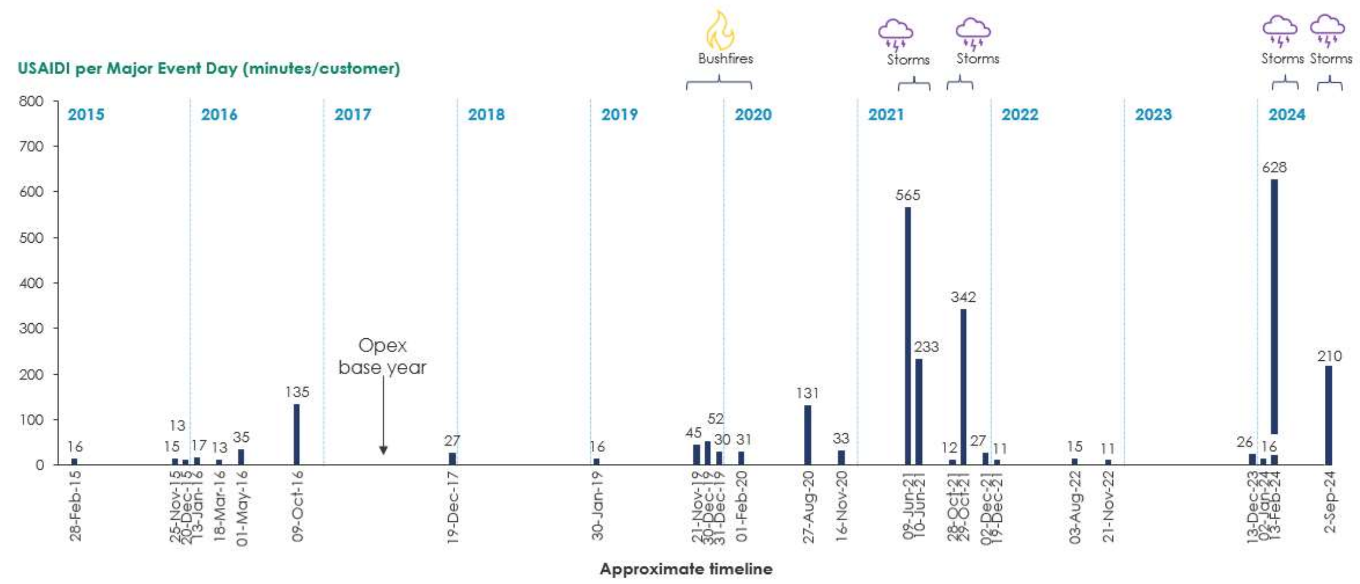
February 2024 storm impacted both transmission and distribution network infrastructure assets across the state. Much as the previous storm events, this resulted in powerline failures either through vegetation faulting or direct line failures. This storm impacted approximately 297,000[1] customers across the AusNet network, and the extent of damage left some customers disconnected for several days.

2024 – September storm

September 2024 storm impacted approximately 171,000 customers.

The impact of these events on the distribution network is depicted in the figure below.

Figure 1: **USAIDI per Major Event Day from 2015 to 2024 (minutes/customer)**



Source: AusNet.

Weather event and forecasting climate change

The changing climate and its impact on our infrastructure, with flow on effects to our customers, is a key concern underpinning the need to invest in proactive solutions to mitigate the growing risk of weather hazards. To understand

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[1] Other sources reference 255k customers which is the coincident peak customers off supply.

the impact of climate change, AusNet procured climate data from an independent and external consultant. We used the climate data to forecast our expected unnerved energy.

Climate data: Climate data (which was first procured to support our network hardening investment case) explored various scenarios that could affect key network infrastructure, such as power poles, overhead lines, and other distribution assets. The modelling focussed on two critical hazards: bushfire and windstorms. To forecast bushfire risk, the model used a Forest Fire Danger Index (**FFDI**) exceeding 100 as a threshold to quantify annual fire risk days. To forecast windstorms risk, the model assessed days with wind speeds exceeding 11.3 m/s and maximum windspeed. The selection of these high thresholds ensures that AusNet's modelling is conservative in assuming climate change will only be driven by severe conditions and ensures the risk of over investment is reduced. The climate scenarios were based on the Representative Concentration Pathway (**RCP**) 4.5, a projection pathway reflecting moderate greenhouse gas emissions.

Risk Modelling: One of the outputs of the risk modelling (which was first developed to support our network hardening investment case) is the compound annual growth rate (**CAGR**) of risk in our network. The risk modelling projected a network wide CAGR of 0.63% (the sum of windstorm and bushfire risk). This network-wide risk rate can be disaggregated at the feeder level which are more granular and location specific. As a result, we have applied a feeder level climate change growth rate to our historical outages, to forecast future risk.

See the CutlerMerz Climate Resilience Economic Modelling – Model Methodology – September 2024 report.

Resilience vs Reliability

Resilience and reliability are critical and interrelated concepts but address different aspects of the energy system's performance.

Reliability refers to the consistent and dependable performance of the energy system under normal operating conditions. Reliability emphasises consistent performance and aims to reduce outage time during regular operating conditions, including scheduled maintenance. It is commonly quantified by metrics such as the average number of outages per customer, or the average duration of outages per customer, both normalised to provide a standardised measurement. A reliable energy system delivers power continuously without frequent interruptions. Regulatory standards and performance metrics exist (e.g., **USAIDI** – Unplanned System Average Interruption Duration Index, **USAIFI** – Unplanned System Average Interruption Frequency Index) to quantify network reliability. Regular and preventive maintenance is crucial to maintaining reliability.

Resilience refers to the ability of the energy system to withstand and recover quickly from disruptive events. It pertains to a system's ability to cope with and recover from challenges such as natural disasters and climate change. Ultimately, resilience is the ability of a network to respond rapidly to disruptions and restore normal operation quickly after unfavourable event.

To summate, whilst both reliability and resilience are essential for operations of a distributed energy service provider, reliability ensures the steady and predictable supply of energy under normal conditions, and resilience ensures the system can endure and recover from unexpected disruptions.

Vulnerability

The vulnerability of our customers can be assessed through various socio-economic and geographic metrics, particularly the remoteness score and the Socio-Economic Indexes for Areas (**SEIFA**). Understanding these factors is crucial for identifying areas that may be at higher risk due to their geographical and socio-economic conditions.

Remoteness score is a measure developed by the Australian Bureau of Statistics (**ABS**) to evaluate the relative isolation of geographic areas from urban centres. It categorises regions into different remoteness classes, ranging from major cities to very remote areas. Areas with higher remoteness scores typically face challenges such as limited access to essential services, increased response times during outages, and higher operational costs associated with maintaining infrastructure. Consequently, these regions may be more vulnerable to disruptions in service and can suffer greater impacts from outages.

Similarly, the SEIFA score assesses the socio-economic status of different regions based on factors such as income, education, and employment. Lower SEIFA scores indicate areas of greater disadvantage, where residents may have fewer resources to cope with service disruptions. These socio-economic challenges can exacerbate the vulnerabilities of the distribution network, as communities with limited means may struggle more during outages or infrastructure failures.

By analysing SEIFA scores alongside remoteness scores, AusNet can identify regions that not only face logistical challenges but also have a population that may be less equipped to handle service interruptions. Utilising both remoteness and SEIFA scores enables AusNet to prioritise investments and interventions in the most at-risk areas of our network.

The role of non-network solutions in improving resilience

Non-network solutions are a vital tool in enhancing the resilience of the energy grid, particularly for DNSPs. For example, it can involve the use of battery equipment, solar energy, and local generation to replace capital intensive augmentation projects.

1. **Cost Savings:**

   Non-network solutions, such as solar power and energy storage systems, can be a more economical alternative to traditional capital-intensive augmentation projects. In regions with low customer densities, the cost of upgrading or replacing existing grid infrastructure can be particularly high. By implementing decentralised energy systems, AusNet can avoid significant capital and operational costs associated with grid maintenance.

2. **Enhanced Reliability and Resilience:**

   Non-network solutions can significantly bolster the reliability of power supply, especially in areas prone to extreme weather or other disruptions. Local generation and storage systems can operate independent of the main grid, ensuring that communities have access to power even during outages.

3. **Improved Power Quality:**

   Integrating non-network solutions can enhance power quality by mitigating issues such as voltage sags and frequency variations. Local energy sources can provide instantaneous power adjustments, helping to maintain stable voltage levels and reduce harmonics in the electrical supply. This results in fewer disruptions to sensitive equipment and appliances, improving overall satisfaction and productivity for consumers.

4. **Mobile and Deployable Solutions:**

   Mobile energy solutions, such as portable generators or battery units, can be quickly deployed in response to outages, providing immediate relief to affected areas. These systems can be transported to where they are needed most, allowing for rapid restoration of power.

The role of SAPS in resilience

Improved resilience can be delivered through a variety of network and non-network solutions. Network solutions, such as network hardening involve installing new, higher specification equipment or reconductoring or undergrounding sections of the network. These solutions can alleviate the risk of outages by strengthening core network assets against extreme weather conditions. Non-network solutions are also being evaluated and involve implementing battery-based solutions or other non-traditional methods to provide reliable or direct supply to customers following an outage. Non-network options range from SAPS to mobile generation and response vehicles to provide deployable support.

SAPS are comprised of a suite of distributed energy solutions that will provide customers with supply at or close to the point of connection. These services include solar PV generation, battery energy storage and a back-up diesel generator as contingency. Suitable locations are typically located at the ends of feeders, in low density areas; yet customer level analysis is required as confirmation. Removal of the existing line and installing self-sufficient generation equipment for customers in suitable locations have been shown to deliver good outcome for the targeted communities whilst also being the most cost-effective option.

This project proposes to deploy SAPS at high cost-to-serve, poor reliability and low resilience locations, which will:

- Minimise bushfire and storm risks by removing grid assets that, when damaged, can lead to power outages or cause fires.
- Lower asset maintenance costs, including inspections, maintenance, and vegetation management, by replacing long, remote line sections with SAPS.
- Provide a cost-effective alternative to capital intensive augmentation.
- Improve reliability and resilience

SAPS trial

In 2021, 17 SAPS were deployed to customers in rural and remote network areas to test the viability of using dedicated power systems to act as their primary power supply. This trial was conducted as a cheaper alternative to the replacement of network assets to supply power to affected customers. The primary objective of the trial was to deliver a more cost-effective alternative to replacing codified sections of SWER network flagged for replacement. SAPS presented themselves as a more economical alternative to the network replacement solution proposed while simultaneously improving resilience and reliability for the customers being supported.

Figure 2: SAPS T1 site image and locations (Tolmie & Swifts Creek).

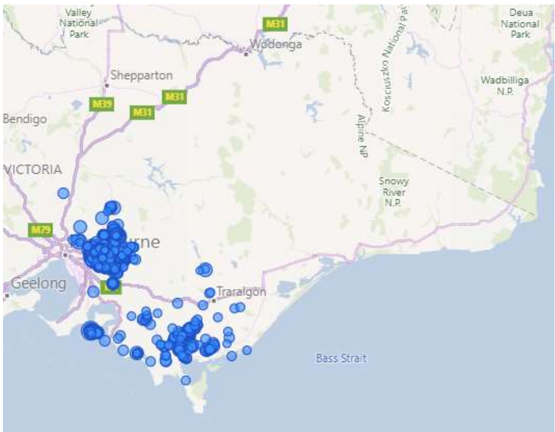
Source: AusNet.

3. Identified need

Power supply outages can have severe impacts on individuals and communities. Our research has shown that reducing prolonged power outages was most highly valued by our customers, and it was the value stream that customers were most willing to pay for in our Quantifying Customer Values (**QCV**) study, which was undertaken prior to the February 2024 storms.

The need for a resilience program is particularly important in areas of heightened risk of experiencing interruptions resulting from extreme weather-related events.

Figure 3: Major event day outages (FY21-24) data plotted across Victoria



FY21 (1.7.20-30.6.21)

FY22 (1.7.21-30.6.22)

FY23 (1.7.22-30.6.23)

FY24 (1.7.23-29.2.24)

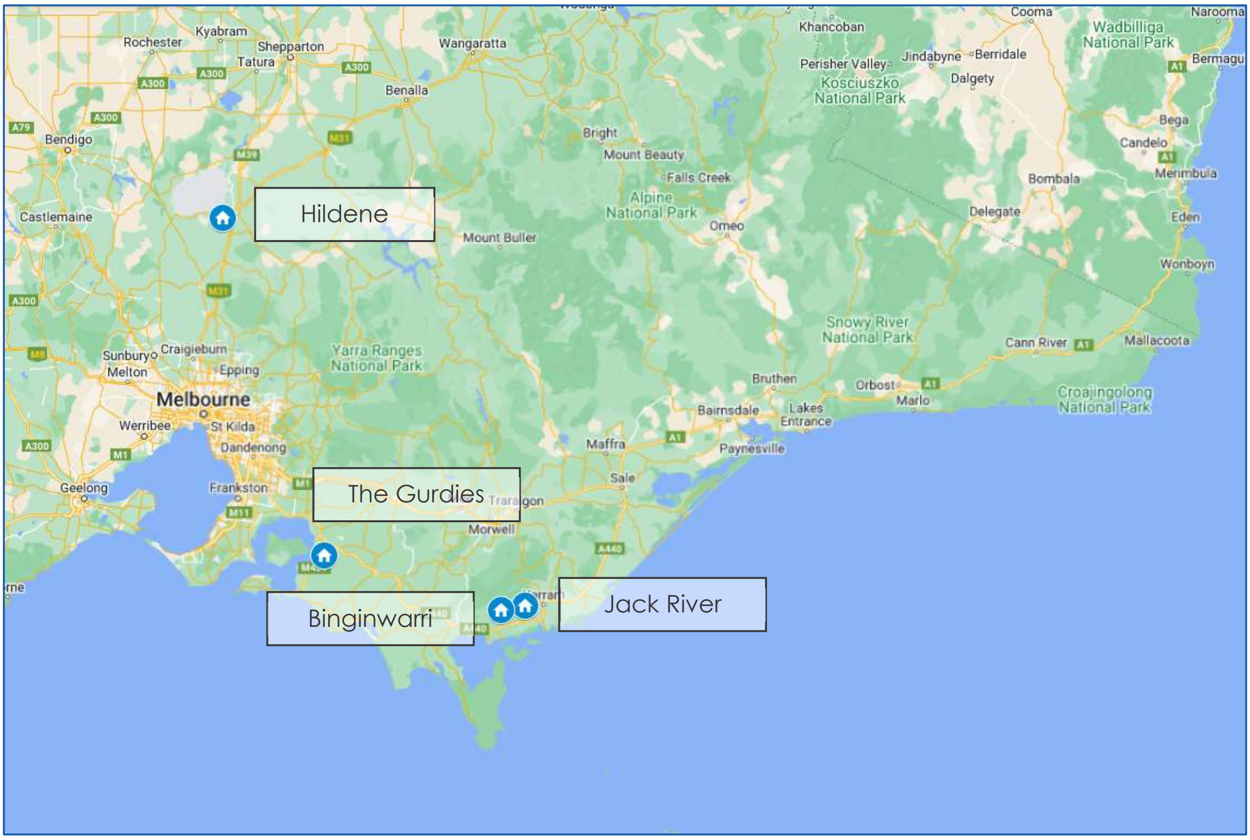
The 25 SAPS locations identified in this proposal have been selected due to a combination of their exposure to weather-related outages, high augmentation costs, and remoteness/vulnerability characteristics. Remoteness and vulnerability metrics were factors in the selection process, ensuring that customer locations are prioritised within areas of the network that are most prone to disruptions. This approach targets regions with frequent interruptions and high costs, offering more reliable and resilience and cost-efficient solution for affected customers. The table and figure below present the metrics from the analysis, along with the geographic locations of the proposed sites.

Table 2. SAPS Location Information

Locality	Customers	SEIFA (IRSD)	Remoteness Score	Average Annual Non-MED duration off supply (hours) 2019-2024	Average Annual MED duration off supply (hours) 2019-2024	Annual operating costs, vegetation management and fault response
Hilldene	13	922.7	1.0	0.7	2.6	C-I-C
Jack River	10	940.8	1.5	89.5	58.9	C-I-C
The Gurdies	1	980.0	1.0	15.3	28.8	C-I-C
Binginwarri	1	940.8	1.5	35.6	93.9	C-I-C

Source: AusNet.

Figure 4: SAPS Locations



Source: AusNet

4. Methodology

The SAPS methodology evaluates the economic and operational feasibility of replacing traditional network infrastructure with stand-alone power systems. It leverages key economic principles by focusing on regions with high operational costs and frequent outages, offering a pathway to reduce expenditures while improving reliability and resilience. By combining operational cost savings, avoided unserved energy (quantified through the AER's Value of Network Resilience or VNR methodology), and climate risk projections, the approach ensures a robust cost-benefit framework.

Step 1: Outage Data Analysis
Historical outage data (2019–2024) was examined to determine the frequency and duration of power outages on different network segments.

- **Major Event Days (MEDs):** Captured large-scale events like storms.
- **Non-MED Days:** Provided a baseline for typical reliability issues.

Step 2: Load Estimation
The average National Metering Identifier (**NMI**) load data from 2023 represented energy demand for customers in the analysed areas.

Step 3: Unserved Energy Calculation
Outage frequency/duration and load data were combined to calculate expected unserved energy, quantifying energy not delivered due to outages.

Step 4: Value of Network Resilience (VNR)
The AER's VNR methodology translated unserved energy into a dollar risk figure, quantifying the economic value of reducing outages.

Step 5: Operational Cost Analysis
Operational costs, such as preventative maintenance, vegetation management, and fault response, were evaluated to identify areas with high expenditures and frequent outages as potential SAPS candidates.

Step 6: Network Feasibility Analysis
A topology analysis assessed the practicality of implementing SAPS, verifying land availability and proximity to customer locations.

Step 7: Vulnerability and remoteness

Vulnerability and remoteness metrics were checked for the targeted locations to determine if customers are from low socioeconomic areas and if the regions are considered remote. This was done by examining the SEIFA scores and remoteness scores for the selected regions.

Step 7: Benefit and Cost Projection

- **Annual Benefits:** Combined avoided unserved energy (using VNR) with operational cost savings.
- **30-Year Projection:** Evaluated SAPS investments over 30-year period.
- **Climate Risk Growth Rate:** Incorporated increasing risks from severe weather events.

Step 8: Comparative Analysis
SAPS were compared against three alternatives over a 30-year period:

1. BAU i.e., like-for-like asset replacement.
2. Replacement with underground cabling.
3. Replacement with covered conductors.

Step 9: Selection of Viable Segments
Segments offering the best cost-benefit outcomes (including SAPS maintenance costs) were prioritised for SAPS implementation.

4.1. Assessment approach

Our options assessment is based on a cost benefit analysis approach, whereby we require data related to asset age, outage and expected unserved energy metrics and careful consideration of location specific factors. The approach integrates outage data to analyse historical disruptions from major event day outages and typical unplanned interruptions, providing insights into network vulnerabilities and areas for improvement. Moreover, we incorporate climate data forecasts to anticipate the escalating impact of severe weather events, such as storms.

The methodology for selecting the identified areas of this program involved:

- Identifying network areas with high asset ages and high conductor length per customer ratios to determine if they are low customer density locations on radial network sections that might be suitable candidates for options other than BAU.
- Aligning MED outage data over network data to identify sections heavily affected by extreme weather events with high Value of Expected Unserved Energy
- Lining up climate forecasts with historical outage locations to identify expected increases in future risk of climate events
- Identifying vulnerability by looking at remoteness scores and SEIFA scores for the sections.
- Comparing expected costs and quantifying benefits

Initial investigations focused on identifying network sections with an average asset age older than 45 years and with high length of conductor per customer. Sections were then prioritised by the highest duration of unplanned and major event day outages that customers experienced. Other factors were also assessed such as SEIFA and remoteness. Once sections had been shortlisted, a sense check was conducted. If a site didn't have suitable space for SAPS equipment, was too urban or had other impacting geographical constraints then the section was removed from our analysis.

Once high-risk, poor performing segments of the network were successfully identified, we estimated the BAU costs and compared it with the forecast costs needed for SAPS (option 1), undergrounding (option 2) and insulating conductors (option 3). The forecast cost for SAPS included the expenditure needed to retire existing assets; benefits included avoided opex, including a reduced need to spend on repairs following storms.

To calculate the value of expected unserved energy, we used inputs such as average customer load, value of network resilience (VNR), expected outage duration from major event day (MED) outages, and outage duration from typical unplanned interruptions. The reduction in the value of expected unserved energy – for a particular option – is the benefit of implementing a particular solution.

The AER has developed a tiered multiple approach to calculate the Value of Network Resilience (VNR)[2], which considers the varying impacts of prolonged outages on residential and business customers. Specifically, outages are disaggregated into different outage bands, with multipliers for each band. The multipliers apply to the AER's standard VCRs. Residential customers are subjected to an additional upper bound limit of $3,500. The tiers and multipliers are set out in the table below.

We have adopted the VNR in our assessment of risk, applying the VNR multiples to the AER's standard 2023 VCRs.

Table 3. VNR Tier multiples

Tier (Duration)	Residential	Business
<12 hours	1.0x	1.0x
12-24 hours	2.0x	1.5x
Greater than 24 hours up to $3,500 upper bound (residential customers only)	1.5x	0.5x
24-72 hours (business customers only)	-	1.0x
Greater than 72 hours (business customers only)	-	0.5x

Source: AusNet.

[2] *Value of network resilience 2024*. Available at: https://www.aer.gov.au/system/files/2024-09/Final Decision - Value of Network Resilience 2024.pdf.

The average customer load provides insight into the typical demand, while the VCR quantifies the monetary value customers attribute to uninterrupted service. Understanding the duration of outages, both during major events and regular unplanned incidents, allows for a comprehensive assessment of resilience and reliability.

Expected unserved energy is calculated using:

$$\text{Expected unserved Energy (EUE)} = T \times L$$

- T is the duration off supply (measured in hours), and
- L is the average load not served during the outage (measured in kW).

$$\text{Value of Expected Unserved Energy (VoEUE)} = EUE \times VNR$$

- VNR is the value of customer reliability measured in dollars per kWh.

The reduction in the VoEUE is a benefit that is compared with the cost of delivering each option to calculate the Net Present Value (NPV). Differing asset lives are also considered in the NPV calculation (e.g., SAPS have an asset life of 15 years, so renewal costs are required after 15 years).

Effectiveness coefficients were used to estimate the benefit of network hardening options. The values selected highlight that the customers along these sections are still exposed to outages located upstream, overhead network sections and replacing the immediate section still leaves customers susceptible to interruptions.

Table 4: Key assumptions

	Value	Comments
Discount rate	5.56%	The average of 4.11% and AEMO's central discount rate (7.0%) in its latest 2023 Inputs Assumptions Scenario Report
Evaluation period	30 years	Typical assessment period
Value of Network Resilience (per kWh)	The AER's 2023 VCRs and the AER's VNR multipliers were used to value expected unserved energy. The 2023 VCRs used are: • Residential: $25.13 • Farming/Agriculture: $44.4 • Commercial: $52.2 • Industrial: $74.79 The multipliers used for residential customers are: • 1.0 for outages less than 12 hours • 2.0 for outages between 12-24 hours • 1.5 for outages greater than 24 hours, limited by an upper bound of $3,500 The multipliers for business customers are: • 1.0 for outages less than 12 hours • 1.5 for outages between 12-24 hours • 1.0 for outages between 24-72 hours • 0.5 for outages greater than 72 hours	
SAPS unit rate	$248,000 per unit $100,000 (end of life replacement)	End-of-life replacement targets critical equipment and doesn't require the full replacement of all plant assets.
Annual operating costs	$2,000 per unit	Annual operating costs for the SAPS systems.
Decommissioning Costs	Pole retirement: C-I-C per pole Span retirement: C-I-C per span Connection retirement: C-I-C per customer	Costs to decommission existing network infrastructure.

	Value	Comments
Replacement unit rates	Undergrounding: $ C-I-C per meter Covered Conductor: $ C-I-C per meter Pole: $ C-I-C per pole Span replacement (like for like): $ C-I-C per span	Unit rates for standard network replacement of distribution assets.
Historical outage hours off supply	Location dependent	Expected time off supply for customers based on historical values.
Historical Opex and Vegetation management	Location dependent	Expected costs to repair assets following storm events.
Annual average customer load	Customer dependent	Average customer loads for CY23 were extracted and used in calculations to determine the VoEUE.
Climate impact rate	Feeder average per annum rate applied	Sourced from Climate Data
Socio-Economic Indexes for Areas (SEIFA)	Location dependent	Socio-economic status of different regions.
Remoteness score	Location dependent	Relative remoteness of geographic areas.
Covered Conductor and Undergrounding effectiveness	CCT - 100% UG - 100%	The effectiveness ratings have been assumed as best-case scenario for both solutions.

Source: AusNet.

5. Options assessed

Business as usual: Like-for-like replacement. this BAU approach involves like-for-like asset replacement at the end of the assets useful life which continues typical service operations. We have assumed that the current level of operating expenditure (including vegetation management) will continue.

Option 1: Installing SAPS for selected customers. This option involves supplying customers with self-sufficient power systems comprised of solar PV generation, battery energy storage and diesel generation to act as the singular energy source for the customer.

Option 2: Network Augmentation through Underground Cable: This approach involves proactively upgrading existing network assets with underground cables, offering increased outage mitigation, however, it is the highest cost solution. Despite its effectiveness, this option may not be the most suitable for areas with low customer densities and long line sections, as the benefits may not justify the investment.

Option 3: Network Augmentation through replacement with Covered Conductor: This entails upgrading existing network assets through reconductoring with covered conductors.

5.1. Business as usual

The BAU option is to maintain the current process of emergency response and grid repairs following extreme weather events and like-for-like replacement across FY2037 to FY2041 (5 years) when the assets are forecast to reach end of life (the age of the assets within our assessment exceed 45 years). This option serves as the control to compare the costs and benefits of alternatives solutions.

5.1.1. Summary

The BAU option involves a like for like replacement across FY2037 to FY2041 (5 years) when the assets are forecast to reach the end of their useful life. The table below outlines the cost and benefits of the BAU option.

Table 5: Economic Outcomes of BAU ($m, discounted, 2023-24 dollars)

	FY27-31	FY32-36	FY37	FY38	FY39	FY40	FY41	Total FY37-41	Full assessment period
Cost	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C
Benefits	$-	$-	$-	$-	$-	$-	$-	$-	$-
NPV	C-I-C								

Source: AusNet analysis

5.1.2. Cost

5.1.2.1. Capex

Under BAU, capex will not be required from FY2027 to FY2036 as assets will not have reached the end of its useful life. The total costs account for like-for-like replacement during FY2037 to FY2041 when assets are forecasted to require replacement. End-of-life replacement for grid-connected assets, including spans and poles, has been estimated at $2.7 million (discounted) over the full assessment period.

Table 6: Capex Distribution of BAU ($m, discounted, 2023-24 dollars)

	FY2027-2031	FY36	FY37	FY38	FY39	FY40	FY41	Full assessment period
Capex	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C

Source: AusNet analysis

5.1.2.2. Opex

The opex for the BAU case assumes no change to current costs as the network is being maintained as current (emergency and repair cost also embedded).

Table 7: Opex Distribution of BAU ($m, discounted, 2023-24 dollars)

	FY2027-2031	FY2032-36	FY37	FY38	FY39	FY40	FY41	Full assessment period
Opex	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C

Source: AusNet analysis

5.1.3. Benefits

There are no benefits from this BAU option.

5.2. Option 1 - SAPS

This option relates to the replacement of the grid connection of customers with a dedicated SAPS generation and storage unit located at the point of connection. The customers selected are in rural network areas on radial sections at the ends of feeders. This option involves replacing the grid connection of all 25 customers with their own SAPS solution and retiring the existing grid connection.

This option is effective in eliminating the risk of outages from extreme weather events and interruptions through typical operation. This option also provides benefits through a reduced need to perform vegetation management and line repair works following extreme weather events which can damage wide areas of the network.

This solution has proven to be feasible through a trial that AusNet has conducted to evaluate the effectiveness of SAPS in providing improved reliability and resilience to customer and critical infrastructure providers in remote areas. Currently, AusNet owns and operates 17 SAPS around the network which have been effective in improving supply reliability and resilience for customers. The experience with this technology has allowed AusNet to develop learnings from implementing these types of solutions to reduce delivery and maintenance costs.

5.2.1. Summary

Customers with SAPS will benefit from reduced outages during both major event days (**MED**) and typical unplanned interruptions, leading to a decrease in Expected Unserved Energy (**EUE**). We have valued the reduction in EUE – provided by SAPS – by taking the EUE and multiplying it by the AER's VNRs. The implementation of SAPS will also reduce the need for ongoing operating expenditure including vegetation management that's associated with grid-connected assets.

Our cost estimate includes the capital expenditure required to renew SAPS after 15 years, and the ongoing operating expenditure related to SAPS.

The table below outlines the costs and benefits of SAPS for our customers.

Table 8: Economic Outcomes of Option 1 ($m, discounted, 2023-24 dollars)

	FY27	FY28	FY29	FY30	FY31	FY32-36	FY37-41	FY42-46	Full assessment period
Cost	$3.3	$2.5	$0.6	$0.1	$0.0	$0.2	$0.1	$1.2	$8.1
Benefits	$0.0	$0.1	$0.1	$0.1	$0.1	$0.5	$0.4	$0.3	$2.2
NPV	-$5.8								
NPV (Relative to BAU)	$4.3								

Source: AusNet analysis

5.2.2. Cost

5.2.2.1. Capex

The capex profile below assumes the deployment of 25 units between 2026 and 2031, with front-loading across the period due to the grouping of SAPS sites by locality. SAPS have been estimated to cost around $248,000 per unit over the FY2027 to 2031 period. The unit rates used include the assumed cost in materials, labour, design, plant, and equipment.

We have also estimated the cost of renewing the SAPS after 15 years when they have reached the end of its useful life. Renewal costs have been captured in FY42-46.

We have also included the cost of retiring existing grid-connected assets.

Table 9: Capex of Option 1 ($m, discounted, 2023-24 dollars)

	FY27	FY28	FY29	FY30	FY31	FY32-36	FY37-41	FY42-46	Full assessment period
Capex	$3.2	$2.3	$0.4	$-	$-	$-	$-	$1.1	$7.1

Source: AusNet analysis

5.2.2.2. Opex

Operating expenditure for SAPS includes servicing and refuelling of the generator, cleaning the solar PV array and maintenance of the battery and other equipment. The estimated opex is $2,000 per unit per year.

The avoided operating expenditure associated with grid-connected assets have been estimated based on historical data over a 4-year period for each network section.

Table 10: Opex of Option 1 ($m, discounted, 2023-24 dollars)

	FY27	FY28	FY29	FY30	FY31	FY32-36	FY37-41	FY42-46	Full assessment period
Opex	$0.0	$0.2	$0.1	$0.1	$0.0	$0.2	$0.1	$0.1	$1.0

Source: AusNet analysis

5.2.3. Benefits

We have quantified the benefits of SAPS by assuming that it will avoid all future outages compared to BAU.

The VoEUE under BAU was estimated based on:

- **Analysing historical outages:** Using historical data, a network load assessment was performed to estimate the average consumption rate of customers across 25 sites. An average expected load was calculated per section.
- **Applying a feeder level climate change growth factor:** The climate data and risk modelling that was undertaken for our network hardening resilience program showed that the network average climate change growth rate was 0.63% p.a. However, feeder level climate change growth rates were also provided as a part of that modelling exercise. We have used the feeder level climate change growth rate and applied it to historical outages.
- **Deriving the weighted average VNR**: We calculated the weighted VNR for each section by analysing the type of customer loads in each section and multiplying it by the relevant VNR type (e.g., residential, commercial, industrial).

Benefits are the reduction expected unserved energy

Table 11: Reduction in VoEUE of Option 1 ($m, discounted, 2023-24 dollars)

	FY27	FY28	FY29	FY30	FY31	FY32-36	FY37-41	FY42-46	Full assessment period (Discounted)
Reduction in VoEUE	$0.0	$0.1	$0.1	$0.1	$0.1	$0.5	$0.4	$0.3	$2.2

5.3. Option 2 – Undergrounding

This section details the assessment of underground replacement for 12.5 kilometres of network assets. Due to its high costs, this option was more NPV negative compared to BAU.

5.3.1. Summary

Table 12: Economic Outcomes of Option 2 ($m, discounted, 2023-24 dollars)

	FY27	FY28	FY29	FY30	FY31	Total FY27-31	Full assessment period

Cost	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C
Benefits	$0.0	$0.1	$0.1	$0.1	$0.1	$0.5	$2.2
NPV	C-I-C						
NPV (Relative to BAU)	C-I-C						

Source: AusNet analysis

5.3.2. Cost

5.3.2.1. Capex

The following table depict our estimated capex spend for FY27 through FY31, which comes to $ C-I-C million for replacing around 12.5 km of existing overhead cables with undergrounding.

Table 13: Capex of Option 2 ($m, discounted, 2023-24 dollars)

	FY27	FY28	FY29	FY30	FY31	Total FY27-31
Capex	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C

Source: AusNet analysis

5.3.2.2. Opex

No operating expenditure (opex) is assumed for this option. Undergrounding assets involves very little operational and maintenance requirements.

5.3.3. Benefits

The installation of underground cable delivers similar benefits to SAPS.

Table 14: Reduction in VoEUE of Option 2 ($m, discounted, 2023-24 dollars)

	FY27	FY28	FY29	FY30	FY31	FY32-36	FY37-41	FY42-46	Full assessment period (Discounted)
Reduction in VoEUE	$0.0	$0.1	$0.1	$0.1	$0.1	$0.5	$0.4	$0.3	$2.2

Source: AusNet analysis

5.4. Option 3 – Covered Conductor

This section details the alternative approach to improving network resilience through upgrading network supply assets with covered conductor.

This solution would involve replacing around 12.5 km in overhead line assets with an insulated alternative.

5.4.1. Summary

Table 15: Economic Outcomes of Option 3 ($m, discounted, 2023-24 dollars)

	FY27	FY28	FY29	FY30	FY31	Total FY27-31	Full assessment period
Cost	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C
Benefits	$0.0	$0.1	$0.1	$0.1	$0.1	$0.5	$2.2
NPV	C-I-C						
NPV (Relative to BAU)	C-I-C						

Source: AusNet analysis

5.4.2. Cost

5.4.2.1. Capex

The following table depict our estimated capex spend for FY27 through FY31, which comes to $ C-I-C (discounted) for replacing around 12.5 km of existing overhead cables with covered conductors.

Table 16: Capex of Option 3 ($m, discounted, 2023-24 dollars)

	FY27	FY28	FY29	FY30	FY31	Total FY27-31
Capex	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C

Source: AusNet analysis

5.4.2.2. Opex

There are still opex requirements for maintaining overhead wire even if it's been replaced with covered conductor. There is also some expected saving with reduced vegetation management, faults and fire starts, however there will still be operational expenditure to maintain the lines.

Table 17: Opex of Option 3 ($m, discounted, 2023-24 dollars)

	FY27	FY28	FY29	FY30	FY31	FY27-31	Full assessment period
Opex	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C

Source: AusNet analysis

5.4.3. Benefits

The installation of covered conductor provides benefits from improvements to EUE.

Table 18: Reduction in VoEUE of Option 3 ($m, discounted, 2023-24 dollars)

	FY27	FY28	FY29	FY30	FY31	FY32-36	FY37-41	FY42-46	Full assessment period
Reduction in VoEUE	$0.0	$0.1	$0.1	$0.1	$0.1	$0.5	$0.4	$0.3	$2.2

Source: AusNet analysis

6. Preferred option and sensitivity testing

6.1.1. Sensitivity Analysis

The preferred option is to install 25 SAPS for customers in the targeted network locations as it provides the greatest benefit to customers at the lowest available cost across a range of sensitivity scenarios. The network hardening approaches of proactively replacing the overhead lines with undergrounding or covered conductors were not selected due to the high cost. The business-as-usual option to make no network changes but replace the network at the end of their useful life also was not selected as customers would remain impacted by the storms.

Table 19: Net Present Value Sensitivity Analysis ($m, discounted, 2023-24 dollars)

	Central Assumptions	Higher Discount Rate	Lower Discount Rate	Higher Costs	Lower Costs	Average	Comments
Business-as-usual (End of asset life replacement)	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C	This is a like-for-like replacement at the end of the existing asset's life
Option 1 – Stand-alone Power Systems	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C	The installation of 25 SAPS is the preferred option as it maximises the NPV
Option 2 – Undergrounding	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C	The replacement of 12.5 km existing overhead cables with undergrounding.
Option 3 – Covered Conductor Replacement	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C	The replacement of 12.5 km existing overhead cables with covered conductor.

Source: AusNet analysis

6.1.2. Recommendations

Considering all economic results and the sensitivity testing results, option 1 (installation of SAPS), involving a capital investment of $6.02 million over the FY27-31 period, was determined as the preferred option for investment as it delivered a positive NPV of $4.3 million compared to BAU.

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