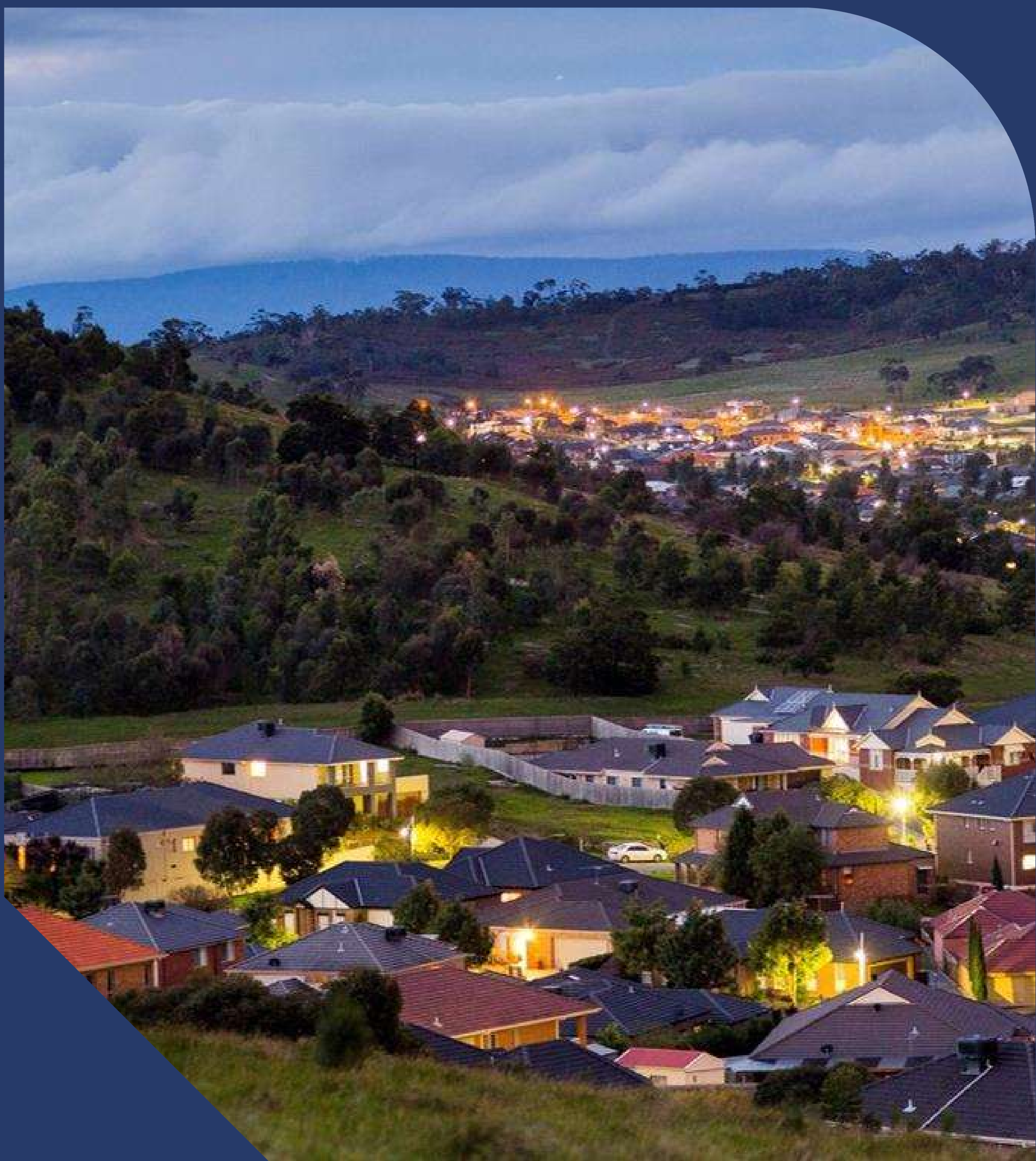
AusNet

Electricity Distribution Price Review (EDPR 2026-31)

Business case: Voltage Compliance

Date: 31 January 2025



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1. Executive summary

The Victorian Electricity Distribution Code of Practice (EDCOP) regulates the distribution of electricity by a distributor to its customers and promotes the long term interests of Victorian consumers. Part 3, Clause 20 of the EDCOP details the regulatory obligations for the quality of supply for a number of parameters, including voltage. Victorian distributors are subject to financial penalties for non-compliance with the EDCOP regarding voltage performance, unlikely in most other Australian jurisdictions.

This business case models the current and estimated future levels of identified voltage compliance limitations across the network and their impact on customers, the costs and benefits of potential options to mitigate those identified voltage compliance limitations, and proposals of forward looking programs for implementation in the 2026-31 regulatory control period. These programs ensure that our regulatory compliance obligations under the Victorian Electricity Distribution Code of Practice (EDCOP)[1] are met at least lifecycle cost.

Based on the EDCOP, steady-state voltage compliance is achieved for a low-voltage customer if the supply voltage is within the range 216 V to 253 V for 99% of the time for each limit over a one week period. AusNet functional compliance is achieved when 95% or more of our customers have compliant voltages.

AusNet has already carried out significant programs of work to date, which has enabled us to achieve functional compliance for the past 12 months in an environment of strong growth in solar PV connections in our network. Additionally, we have a program of works over the remainder of this current regulatory period that will ensure that we continue to achieve functional compliance against the background of continuing growth in solar PVs and other factors affecting voltage compliance. We expect to functionally compliant at the end of 2025-26.

Despite the planned work for this current period, we need to continue to invest in our network over the next 2026-31 regulatory period to ensure functional compliance continues to be maintained. For a do nothing investment scenario, we expect to go from functional compliance at the start of 2026-27 (that is, with no more than 5% of our customers with non-compliant voltages) to a non-compliance level of 6% of customer with non-compliant voltages at the end of the 2026-31 regulatory period[2].

AusNet has assessed two programs as part of this business case:

1. **Voltage Compliance Program** – low-voltage (LV) and high-voltage (HV) networks needed in response to the growing numbers of solar PV systems across the network and other contributors. Two Voltage Compliance Program options were considered in addition to the do nothing case,
    - **Do nothing** – no expenditure on addressing steady-state over-voltage non-compliances with potential non-compliance penalties of up to $11.5 million.
    - **Option 1** – undertaking works that would help us maintain functional compliance, also reducing voltage-curtailed generation for customers with over-voltage where economic, selecting only those projects that have a positive net present value (NPV).
    - **Option 2 (full compliance)**- following the least-cost, deterministic approach to remove all steady-state voltage non-compliances. It goes beyond our obligation for functional compliance under the EDCOP, by providing compliant voltages to all customers.
2. **Quality of Supply Program** – a recurrent program expenditure maintained at current period allowance levels targeted at addressing quality of supply issues on both the LV and HV networks that are not directly attributed to solar PV steady-state over-voltages, for example, addressing flicker, harmonics and sags/swells, typically driven by customer complaints. This is an urgent program, typically in response to customer complaints.

For the **Voltage Compliance Program**, AusNet proposes Option 1 at a capex requirement of $23.3 million (real, $June 2024) over the 2026-31 regulatory control period, which represents a prudent and efficient network augmentation investment to manage voltage compliance. At a discount rate of 5.56% per annum, this option has a NPV of $109.2 million (real, $June 2024) over the 20-year assessment period as shown in Table 1. We have proposed Option 1 as the preferred option as it produced the highest NPV of all the options assessed.

[1] Electricity Distribution Code of Practice – Essential Services Commission of Victoria, Version 2, 1st May 2023.

[2] EDCOP functional compliance for over-voltage is no more than 5% of our customers with non-compliant voltages. This corresponds to 16% of customers experiencing over-voltages based on modelling from AMI meter measurements. The difference is due to the smoothing effects of the measurement method prescribed by the EDCOP for determining compliance. The modelling results show that 19% of customers will experience over-voltages by the end of the 2026-31 period. Hence non-compliance levels are likely to be 19% x 5% ÷ 16% = 6% at that time.

Table 1: Economic evaluation of Voltage Compliance Program Options ($m, $June 2024)

	FY27 to FY31 (undiscounted)			Full assessment period (discounted)			Comments
	Capex	Opex	Total cost	Total cost	Total benefits	NPV	
Do Nothing	0.0	0.0	0.0	0.0	0.0[3]	0.0	This option does not address the identified need
Option 1 – Economic approach to voltage Compliance and voltage-curtailed generation	23.3	0.6	23.9	(26.5)	135.6	109.2	This is the preferred option as it maximises the NPV
Option 2 – Deterministic approach for full voltage compliance	745.7	18.4	764.1	(775.5)	162.4	(613.1)	This is cost prohibitive

Source: AusNet analysis (relative to the base case of do nothing)

Over the 2026-31 regulatory control period for an Option 1 investment, the percentage of customers with EDCOP non-compliant voltages, is expected to fall from a functional compliance level of 5% to 3.4%[4] by the end of the period, which is an improvement that brings AusNet closer to the benchmark Victorian distributors voltage performance. This option was also supported by our EDPR Availability panel, who supported AusNet investing proactively to improve performance to economic levels that are also in line with other Victorian distributors' performance. This is seen as valuable investment as it reduces solar generation curtailment and wasted renewable energy, and it reduces the need for reactive investment in areas with higher voltages traditionally.

For the Quality of Supply Program, AusNet is proposing to continue this recurrent supply improvement program maintained at current regulatory control period allowance levels to address quality of supply issues on the network. The current period allowance associated with this program (for the Base Case) is $7.24 million (Real $2024). This program is needed to continue to respond to and address identified and reported customer quality of supply issues, that are not otherwise addressed by other programs of work (such as the Voltage Compliance Program). The level of investment is anticipated to be consistent with the current regulatory period, as the proactive program to improve voltage performance will still result in areas of higher voltages where these voltages may have a significant detrimental impact on customers, particularly large customers.

[3] The present value of total risk of safety and increased energy consumption, voltage-curtailed generation and emissions being experienced by customers due to higher network voltages, is valued at $162.4 million over the analysis period (real 30th June 2024 dollars). Refer Table 6.
[4] Modelling results show 16% to 11% of customers experiencing over-voltages over the period (i.e., 11% x 5% ÷ 16% = 3.4%).

2. Background

2.1. Voltage compliance regulatory requirements

The Victorian EDCOP[5] regulates the distribution of electricity by a distributor to its customers. Part 3, Clause 20 details the regulatory obligations for the quality of supply for a number of parameters, including voltage. Clause 20.4.2 of the EDCOP states that a distributor must maintain a nominal voltage level at the point of supply (POS) or meter to the customer's electrical installation. The acceptable variation in those nominal voltages are documented by the EDCOP Clause 20.4.2 in its Table 2 (reproduced below) with the Australian Standard AS61000.3.100 row applicable for the bulk of our customers connected at low-voltage.

Table 2: EDCOP Voltage Variations

STANDARD NOMINAL VOLTAGE VARIATIONS					
	Voltage Level in kV	Voltage Range for Time Periods			Impulse voltage
		Steady State	Less than 1 minute	Less than 10 seconds	
1	<1	*AS* 61000.3.100*	+ 13% - 10%	Phase to Earth +50%, -100% Phase to Phase +20%, -100%	6 kV peak
2**		+ 13% - 10%			
3	1 – 6.6	± 6% (± 10% Rural Areas)	± 10%	Phase to Earth +80%, -100% Phase to Phase +20%, -100%	60 kV peak
4	11				95 kV peak
5	22				150 kV peak
6	66	± 10%	± 15%	Phase to Earth +50%, -100% Phase to Phase +20%, -100%	325 kV peak

** When examining network-wide compliance, functional compliance is met if the limits in Table 2 of AS 61000.3.100 (up to 1% of measurements below 216 V and up to 1% of measurements above 253 V) are maintained across at least 95% of a distributor's customers.*

*** Row 2 values (steady state, less than 1 minute, and less than 10 seconds) define the circumstances in which a distributor must compensate a person whose property is damaged due to voltage variations according to clause 20.4.8.*

Source: EDCOP

What is clear from this table is that for steady-state voltage variation, customer LV and HV voltages are subject to fixed limits, whereas customer LV voltages are also subject to softer limits as defined by AS61000.3.100 in its Table 2 (reproduced below).

Table 3: EDCOP LV Steady-State Voltage Variations

TABLE 2

230 V NOMINAL STEADY STATE VOLTAGE LIMITS

Steady state voltage measure (10 minute r.m.s.)	Phase-to-neutral voltage limit		Phase-to-phase voltage limit		1 phase 3 wire centre neutral phase-to-phase voltage limit	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
$V_{1\%}$	216 V	—	376 V	—	432 V	—
$V_{99\%}$	—	253 V	—	440 V	—	506 V

Source: AS61000.3.100

Noting that $V_{x\%}$ is the value of the voltage below which 'x' percent of measurements fall over a survey period (using the measurement technique prescribed in AS61000.4.30) at a customer's meter.

[5] Electricity Distribution Code of Practice – Essential Services Commission of Victoria, Version 2, 1st May 2023.

AusNet (and all other Victorian distributors) must report their steady-state voltage compliance levels to the Essential Services Commission (ESC)[6] of Victoria each quarter, a reporting mechanism that has been enabled by the availability of smart meter voltage data from our Advanced Metering Infrastructure (AMI). Victorian distributors are subject to financial penalties of up to $11.5m for non-compliance with the EDCOP requirements, unlikely in most other Australian jurisdiction.

2.2. AusNet's historical voltage performance

Our historical voltage performance is available on the Essential Services Commission's (ESC)[7] website and updated on a quarterly basis. The trend in our performance demonstrates over recent years that we have continued to improve our network-wide performance, reducing the proportion of our customers that are exposed to voltage levels outside of the regulatory limits, particularly for customers experiencing over-voltages.

We have already carried out significant programs of work to date, which have enabled us to achieve functional compliance (of no more than 5% of customers with voltages outside of the regulatory limits) for the past 12 months in an environment of strong growth in solar PV connections in our network. Additionally, we have a program of works over the remainer of this current regulatory period that will ensure that we continue to achieve functional compliance against the background of continuing growth in solar PVs and other factors affecting voltage compliance. We expect to remain functionally compliant by the end of 2025-26.

2.3. Asset management objectives

AusNet's strategic asset management objectives (as stated in Document No. AMS 01-01 Asset Management System Overview), are to:

- Comply with legal and contractual obligations (including regulatory compliance);
- Maintain safety;
- Be future ready;
- Maintain network performance at the lowest sustainable cost; and
- Meet customer needs.

This Voltage Compliance business case supports those objectives, by

- Maximising the levels of regulatory voltage compliance;
- Minimising the safety risk to customers of steady-state over-voltage impacts on their appliances, as far as practicable (AFAP);
- Preparing the network to support growth in consumer energy resources (CER) (including solar PV) both now and into the future;
- Applying an economic test to strike an optimal balance between cost, risk and performance; and
- Supporting customer needs by addressing over-voltages that are curtailing their CER.

2.4. Purpose and scope

The purpose of this business case is to describe the identified need in relation to managing voltage compliance across the AusNet electricity distribution network, and to present credible options for programs of work that are able to address the identified need. The purpose is to design a program that ensures we meet our voltage compliance obligations and maintain power quality compliance for our customers.

This business case quantifies the

- current and estimated future levels of identified voltage compliance limitations across the network for each network asset;
- impact of steady-state over-voltages on customers in relation to

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[6] Voltage performance data – Essential Services Commission of Victoria, 2023.

[7] Voltage performance data – Essential Services Commission of Victoria, 2024.

  - **safety risk** - over-voltages may cause customer equipment damage and reduced life spans which is a potential safety risk for appliances overheating and catching on fire (also applicable to under-voltage);
  - **increased energy consumption** - over-voltages cause increased energy consumption by customers to levels higher than what would be the case if voltages were within the allowable operating range; and
  - **voltage-curtailment of solar PV systems** - over-voltages cause tripping or reduction of solar PV inverter power output, preventing Consumer Energy Resources (CER) customers from generating and exporting electricity;
- costs and benefits of potential credible options to mitigate identified voltage compliance limitations,
- forward looking programs of work for implementation in the 2026-31 regulatory control period that ensure our regulatory compliance obligations under the Victorian Electricity Distribution Code of Practice (EDCOP)[8] are met at least lifecycle cost,
- ongoing expenditure needed to support urgent unforeseen quality of supply investments in response to customer complaints. It is a continuation of the supply improvement program within which projects addressing valid customer complaints on quality of electricity supply can be raised and implemented. The current program has proven successful in resolving customer complaints on power quality to the satisfaction of our customers and avoided escalation of their complaints to the Energy and Water Ombudsman of Victoria (EWOV).

The scope of this Voltage Compliance business case is limited only to managing voltage compliance across the AusNet electricity distribution network, and for addressing quality of supply issues identified by customers. Programs of work either for CER enablement or for addressing under-voltages caused by maximum demand overload, are covered in separate business cases.

For investments that are common across all these business cases, AusNet has prioritised the investment into this Voltage Compliance business case, and removed it from the others, so as not to double count the expenditure. For example, a project in voltage management also unlocks solar and that has been taken out of CER enablement.

The hierarchy we have applied for removal of duplicate projects from the programs of work is as follows:

- 1st priority – Voltage Compliance (this business case)
- 2nd priority – Electrification (demand driven augex in the LV network)
- 3rd priority – CER Enablement

[8] Electricity Distribution Code of Practice – Essential Services Commission of Victoria, Version 2, 1st May 2023.

3. Identified need

3.1. Voltage compliance

Maintaining customer voltages within regulatory compliance limits has traditionally been achieved by using voltage-drop assumptions, based on the expected maximum demand and the impedance of the network between the voltage regulation source and the customer. With power traditionally flowing in only one direction, the network was designed (and assets specified) to maintain voltages toward the top end of acceptable limits, to allow a margin down to the lower limits to cater for the voltage-drop through the network under maximum demand. The voltage-drop design assumptions have been necessary to manage customer voltages, because there is currently no capability on AusNet's network for directly regulating customer voltages in real-time.

With the uptake of distributed solar PV and other forms of CER, power can now flow in both directions, placing pressure on AusNet to maintain acceptable levels of voltage regulation. This means that in a system which has the voltage biased towards the top of the allowable voltage range, solar PV may increase the voltage to the point that it is outside the allowable range, particularly when it is exporting to the network.

Whilst the network was designed for one-way power flow, it has some limited ability under the current voltage control arrangements to cater for reverse power flows which cause voltage-rises at the customer points of supply. However, this is becoming increasingly problematic as CER penetrations continue to rise, particularly at times of minimum daytime demand, when solar PV systems are most likely to be exporting into the network.

AusNet (and all other Victorian distributors) must report their steady-state voltage compliance levels to the Essential Services Commission (ESC)[9] of Victoria each quarter, a reporting mechanism that has been enabled by the availability of smart meter voltage data from our Advanced Metering Infrastructure (AMI). The ESC considers functional compliance is achieved for a distributor "if up to 1 per cent of measurements below 216 V and up to 1 per cent of measurements above 253 V are maintained across at least 95 per cent of a distributor's customers"[10].

The steady-state voltage compliance challenges for AusNet at a network-wide level lie with over-voltage rather than under-voltage, as we have maintained over-voltages within the current period to just within the functional compliance limit over the last 12 months of the current regulatory control period, whereas with under-voltage we have remained well within the functional compliance limit.

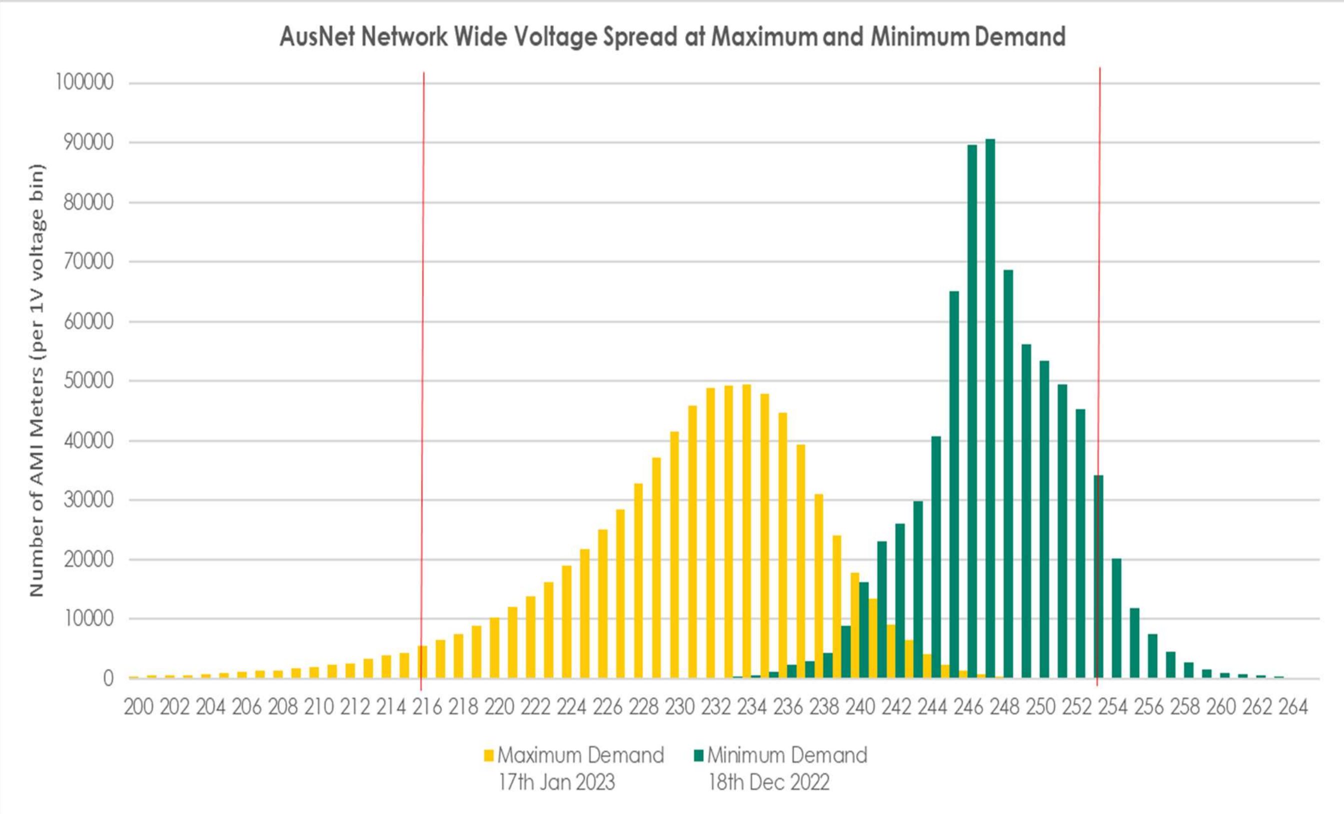
We expect that without a proactive investment in a Voltage Compliance Program during the next period, that we are at risk of losing our functional compliance status for over-voltages, with modelling revealing that our percentage of customer with non-compliant customers is expected to deteriorate from 5% to 6% over the 2026-31 regulatory control period. This would result in negative outcomes for customers in the form of inefficient solar generation curtailment, potential damage to appliances and higher than necessary consumption, while exposing the business to financial penalties. By comparison, we expect our under-voltages can continue to be managed effectively through our other economically justified maximum demand related augmentation programs.

Other quality of supply parameters are prescribed for regulatory compliance in the EDCOP including harmonics, flicker (disturbing loads) and unbalance (negative sequence voltage) for example, however these compliance requirements are generally able to be managed within historical expenditure levels with a recurring supply improvement program of quality of supply works that is expected to be maintained at current regulatory control period levels into the future (the Quality of Supply Program).

Figure 1 illustrate AusNet's actual network-wide LV voltage distribution across our AMI meters for two extreme network operating conditions - maximum demand (17th Jan 2023) and minimum daytime demand (18th Dec 2022).

[9] Voltage performance data – Essential Services Commission of Victoria, 2024.
[10] EDCOP Table 2, Note 1.

Figure 1: AusNet steady-state voltage distributions at maximum demand and minimum demand



Source: AusNet analysis (red lines indicate EDCOP $V_{1\%}$ and $V_{99\%}$ voltage limits)

At both times of maximum and minimum demand there are material numbers of customers with voltages operating outside of the 216 V and 253 V EDCOP limits. Whilst presenting this data in this way is not an exact measure of compliance throughout the year, it does reflect the worst case operating conditions at the two extremes of network operation. Targeting mitigations at one or both of these extremes will deliver better compliance outcomes for AusNet, as the operation of the network at any time of the year is expected to have voltages lying between the two extremes. There is clearly a need for a Voltage Compliance Program to address these identified voltage compliance issues targeted across the AusNet electricity distribution network.

Of noteworthy from this data, is the significant offset between the median (50th percentile) values of customer voltages between minimum and maximum demand conditions, illustrating the fact that AusNet has not yet deployed a Dynamic Voltage Management (DVM) capability to dynamically raise voltages at times of maximum demand, and to dynamically lower voltages at times of minimum demand, to keep the distributions centred within the regulatory limits. With significant margins available for doing this, DVM is a credible solution to consider when assessing the range of solutions available for addressing AusNet's customer over-voltage (and under-voltage) issues. DVM is one of the solutions that we have included in the scope of works for the credible options in this business case.

We have already carried out significant programs of work to date, which has enabled us to achieve functional compliance for the past 12 months in an environment of strong growth in solar PV connections in our network, stimulated by the Victorian Government's Solar Homes program[11]. Additionally, we have a program of works over the remainer of this current regulatory period that will ensure that we continue to achieve functional compliance against the background of continuing growth in solar PVs and other factors affecting voltage compliance. We expect to remain functionally compliant by the end of 2025-26.

Despite the planned work for this current period, we need to continue to invest in our network over the next 2026-31 regulatory period to ensure functional compliance continues to be maintained. For a do nothing investment scenario, we expect to go from functional compliance at the start of FY27 (that is, with no more than 5% of our customers with non-compliant voltages) to a non-compliance level of 6% of customer with non-compliant voltages at the end of the 2026-31 regulatory control period[12].

[11] Solar Homes Program – Solar Victoria, 2023.

[12] EDCOP functional compliance for over-voltage is no more than 5% of our customers with non-compliant voltages. This corresponds to 16% of customers experiencing over-voltages based on modelling from AMI meter measurements. The difference is due to the smoothing effects of the measurement method prescribed by the EDCOP for determining compliance. The modelling results show that 19% of customers will experience over-voltages by the end of the 2026-31 period. Hence non-compliance levels are likely to be 19% x 5% ÷ 16% = 6% at that time.

3.2. Quality of supply

AusNet currently has a recurrent supply improvement program that aims to resolve power supply issues raised by customers. This is predominantly an urgent program (mainly triggered by the urgency of customer complaints due to the lack of permanently installed quality of supply metering across the network[13]), to address quality of supply issues.

Each year the AusNet Customer Service Centre receives a significant number of customer complaints on quality of electricity supply. Complaints received by the Customer Service Centre are referred to the regional Voltage Quality Investigation Officer (Network Operations). Complaints are investigated to identify the problem and develop a solution to address the issue based on least cost, prioritising lower cost opex solutions over capex. The process follows a detailed investigation proving that no technically or economically feasible alternative solution exists.

Since 2021, AusNet has averaged 540 customer complaints per year at an average total cost of $3.5 million per annum as tabulated in Table 4.

Table 4: Quality of Supply Program Current Period Expenditure ($m, nominal)

	Actual				Forecast			
Year	2021	2022	2023	2024	2025	2026	Total	Average (pa)
Expenditure	(2.74)	(4.63)	(2.44)	(5.68)	(3.25)	(2.50)	**(21.25)**	**(3.5)**

Source: AusNet analysis

In many cases, the causes for voltage complaints are solar inverter trips due to high voltages and identification of high voltages by solar PV installers at customer premises during the installation process. Whilst a substantial portion of these could be resolved through a targeted Voltage Compliance Program (particularly those in the spring and summer periods when solar PV output is at its greatest), there remains a base level of customer complaints that are not directly attributed to over-voltage, that require a response to other quality of supply issues such as harmonics, flicker, unbalance, sags or swells (for example). Hence a level of zero customer complaints is unachievable.

AusNet is obligated to meet quality of supply standards prescribed in the EDCOP[14] Chapter 20. Hence, an ongoing urgent Quality of Supply Program is needed to support the management of the residual quality of supply issues that a proactive Voltage Compliance Program does not address.

Failing to respond to and resolve customer complaints on power quality to the satisfaction of our customers, risks an escalation of their complaints to the Energy and Water Ombudsman of Victoria (EWOV)[15]. As well as the need to resource the EWOV enquiry processes, there is a likelihood of more extensive and expansive corrective action being required because of the EWOV's investigations.

To address this base level of customer complaints, AusNet is proposing to continue a supply improvement program that is maintained at current regulatory control period allowance levels to address quality of supply issues on the network. The current period allowance associated with this program (for the Base Case) is $7.242 million (Real $2024).

We do not expect an increase in complaints if this Quality of Supply Program is maintained at current period allowance levels if it is undertaken concurrently with the Voltage Compliance Program. Increasing solar PV penetration would increase the quality of supply complaints, but we expect the proactive program to reduce this back to current period levels.

3.3. Key inputs and assumptions

Key inputs, calculations and assumptions used in this business case are described in detail in AusNet's Hosting capacity and voltage compliance, electrification and CER enablement methodology document.

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[13] While AusNet uses AMI to measure steady-state voltage, it is only able to measure other power quality parameters at a limited scale - at the zone substation bus, and at the end of the longest feeder of each zone substation. Customer complaints generally trigger AusNet to temporarily install portable power quality meters at or near the customer's point of supply to confirm the issue and identify remedial action.

[14] Electricity Distribution Code of Practice | Essential Services Commission, version 2, 1st May 2023.

[15] The Energy and Water Ombudsman (Victoria) is a dispute resolution scheme established by EWOV Limited, a private company limited by guarantee and not having share capital. Members of EWOV Limited are also 'scheme participants' (retailers, network infrastructure owners and operators, etc., in the energy and water infrastructure industries in Victoria). The Ombudsman has authority under the EWOV Charter to receive, investigate and facilitate the resolution of complaints made by customers of the scheme participants. EWOV offers its service free to customers with the objective of independently and efficiently resolving disputes between customers and energy and water service providers in Victoria.

Other key assumptions are presented in Table 5.

Table 5: Key assumptions

Parameter	Value	Comments
Discount rate	5.56%	Average of 4.11% and AEMO's 2023 IASR central case (7.00%)
Evaluation period	20 years	Benefits calculated for the first 10-years, then maintained from years 11 to 20. No benefits assumed beyond year 20.
CECV & VER	AER June 2024 Values	Used for voltage-induced curtailment of CER.
Energy consumption value	30 c/kWh	Typical flat residential retail energy consumption rate.
Safety disproportionality factor	6 times	Multiple used for applying AFAP safety.

Source: AusNet analysis

4. Options assessed

4.1. Credible solutions

In developing the options for this business cases, AusNet has considered a range of credible solutions that are able to address the voltage compliance limitations identified. To identify which solutions are least-cost technically feasible to resolve the nature of the identified limitation, a set of decision rules are applied to each asset (at each network level) using the measured actual and forecast operating conditions and limitations.

The range of credible solutions considered are as follows:

- Dynamic Voltage Management (DVM)
- Network capex solutions
  - Switched Reactors
  - Transformer upgrades (lower impedance) and replacements (with wider tapping ranges)
  - New transformers
  - New feeders and circuits
  - Splitting or reconfiguring circuits
- Network opex solutions
  - Tap changes
  - Float voltage setting changes and line drop compensation
  - Phase balancing
- Non-network alternatives (including storage, inverter support).

Options 1 and 2 use a combination of the credible solutions above to create a program, which is then subject our assessment process. Each site is assessed for the best credible solution and both options 1 and 2 use the same set of credible solutions.

These solutions are discussed in further detail below.

4.1.1. Dynamic Voltage Management (DVM)

Like other Victorian distributors, AusNet is ideally placed with its ubiquitous availability of Advanced Metering Infrastructure (AMI) smart meters to adopt DVM as a credible solution to addressing steady-state voltage non-compliance. AMI to date has given AusNet greater visibility of steady-state voltage performance through a suite of analytical tools which has enabled the business to understand, monitor, report on, and act upon voltage compliance issues within the network, yet AusNet has not used AMI for near real time voltage control.

As such, AusNet is now embarking on using the AMI smart meter voltage data for near real time operational voltage control through a trial adopting Dynamic Voltage Management (DVM) capability at several of our zone substations with high penetrations of CER in the current regulatory control period. We intend (at the conclusion of this trial) to transition to a more widespread use of DVM which provides a more advanced, data-driven way to manage both HV and LV voltages over network augmentation, eliminating the need for voltage drop assumptions, and having the capability to dynamically respond to changes in CER operation in near-real-time.

The application of a DVM system on AusNet's distribution network will act to try to maintain the AMI voltage distribution (across customers covered by the DVM system), within the Electricity Distribution Code of Practice (EDCOP) steady-state voltage limits, for all operating conditions between maximum demand and minimum demand. It operates continuously 24x7 (day and night) as an adjunct to AusNet's existing HV voltage regulation schemes.

We have assessed the deployment of this new DVM capability against other network augmentation and other non-network alternatives in this business case, to develop a Voltage Compliance Program that achieves the maximum compliance improvements at least cost.

We expect this Voltage Compliance Program will achieve compliance outcomes that are similar to the performance outcomes of our peers, most of whom have or are now adopting DVM.

4.1.2. Network capital and operating expenditure solutions

It should be noted that DVM acts on a population basis (per HV voltage control zone) rather than act to achieve voltage compliance for any individual customer. Hence, whilst DVM capability can act to keep the bulk of customers within the regulatory voltage limits, addressing non-compliance for individual customers would need to continue to be undertaken at the localised level using more network solutions.

The extent that an automated DVM system would cease to be effective from a population basis would arise under two conditions:

- an excessive (greater than 37 V being the difference between the higher 253V and lower 216V EDCOP limits) LV voltage distribution spread (per HV voltage control zone) at times of maximum demand (usually on days of extreme ambient temperature) where LV voltage distributions may be so broad that non-compliance is occurring at the lower and upper ends of the regulatory limits at the same time, preventing DVM from positioning the voltage distribution between the regulatory limits, in which case some network augmentation would be required to enable a DVM solution; and
- running out of available taps (on a zone substation transformer) at times when voltage distributions are operating so far above the higher end of the regulatory limits that there is no ability to lower voltages to achieve compliance, in which case a transformer replacement (with wider tapping range) or switched reactor would be required with a DVM solution.

The typical work undertaken under network augmentation solutions include:

- **Switched reactors** – these are used to draw more reactive power through the network to create a voltage drop which will result in transformers operating on more nominal taps during times of minimum demand, rather than at their extreme buck tap.
- **Transformer upgrades (lower impedance) and replacements (with wider tapping ranges)** – to cater for voltage limitations that are caused by low short-circuit levels, or a lack of available buck taps during times of minimum demand.
- **New transformers and new circuits** – to cater for voltage limitations that are caused by long or high impedance circuits, by splitting up and reconfiguring the network with shorter circuits and fewer customer per circuit.

The typical opex work undertaken to complement network augmentation solutions include:

- **Tap changes** – to allow the voltage to be lowered (raised) when the voltage is elevated (depressed) across all operating conditions. Many of AusNet's legacy transformers are operating at their extreme buck tap and cannot be tapped down any further without a transformer replacement.
- **Float voltage setting changes** – this has been completed across many of AusNet's sites already.
- **Phase balancing** – targeted at sites where there is significant unbalance at maximum demand causing a wide voltage spread across phases.

4.1.3. Non-network opex alternatives

Battery energy storage and CER inverter settings could be used to support network voltage.

AusNet has already mandated the use of Volt-Watt and Volt-VAr settings on CER inverters to allow the voltage to be lowered by either drawing reactive power through the network impedance, or curtailing the generation output of the inverter, to the extent that the inverter is able to achieve this. It is expected that as more customers apply the settings, the reactive power support would enable more solar customers to be connected to the network with reduced levels of non-compliance. Furthermore, customers having mandated Volt-Watt and Volt-VAr settings on CER inverters will support the voltage of other customers in local area.

The opportunity lies with storage in being able to defer or displace a network augmentation by charging during minimum demand or discharging during maximum demand, and/or utilising its inverter for voltage support. The opportunity to adopt storage as a non-network alternative will be assessed on a case-by-case basis, since the business case for using storage for network support, requires value stacking with market benefits, given its current higher cost premium. Given network benefits alone are unlikely to fund a storage solution, it will be necessary to seek a market response via a competitive tendering process.

4.2. Assessment approach

4.2.1. Assessment methodology

AusNet has developed an economic approach to valuing the impact of overvoltage on customers with the aim to address AusNet's functional non-compliance (i.e. more than 5% of customer with non-compliant voltages) with steady-state over-voltages through a Voltage Compliance Program. The network assets considered for this program are those that have actual and forecast steady-state voltage limitations whose Voltage Compliance solutions are in themselves economically viable to achieve our compliance obligations. To identify the voltage compliance limitations and economic viability of the projects which make up the Voltage Compliance Program, AusNet has developed a detailed model that maximises the use of its AMI data and other measurement data, to determine the network performance and its characteristics, in-lieu of power system simulation and modelling assumptions. Using actual data is a more robust modelling approach to simulation.

Figure 2 identifies the modelling components of AusNet's Voltage Compliance Program. The components identify and economically justify expenditure on this program for the 2026-31 regulatory control period, based on an economic ranking of identified and forecast steady-state voltage non-compliance and any associated CER voltage-related curtailments.

Figure 2: Voltage Compliance Program Modelling

Modelling Inputs

Customer segmentation and demand scenarios, network characteristics, outputs from AusNet's Tactical Hosting Capacity (THC) model, actual voltages, operating states and demand measurements from AMI and SCADA.

↓

HV and LV Models

These models determine the voltage compliance limitations arising in each part of the network (HV and LV) over the forecasting period, for different demand and customer segmentation scenarios. The outputs of the models are:

Forecast annual numbers of customers in each steady-state over-voltage and under-voltage (defined in the Victorian Electricity Distribution Code of Practice - EDCOP) voltage distribution bin.	Forecast voltage-curtailed generation for each network asset in each half-hour over the planning horizon, for CER being curtailed by its own inverters (defined by AS4777.2:2020 Volt-Watt, Volt-VAr and tripping characteristics), in response to steady-state LV network over-voltages.

↓

Voltage Compliance Economic Model

The steady state voltage compliance program economic model uses the CECV and VER methodologies and values to provide an economic basis for ranking investment in the program for reducing over-voltage-induced CER curtailment. It also uses a value of increased consumption due to over-voltages and AFAP safety disproportionality factor to justify investment in the programs for correcting identified non-compliance with the EDCOP, and is specifically tailored for assessing the scale of steady state voltage non-compliance.

This model using the costs and characteristics of credible options to identify the preferred option for each location, ranking the projects to develop a program of works of the most economically viable projects in the worst-served voltage compliance areas.

↓

Voltage Compliance Program Business Case (this business case)

The methodology applied is described in detail in AusNet's Hosting capacity and voltage compliance, electrification and CER enablement methodology document, with the quantification of the identified needs and economic evaluation approach summarised from this document below.

4.2.2. Valuing over-voltage curtailed energy generation

Over-voltages cause tripping or a reduction of solar PV inverter power output, preventing CER customers from generating and exporting electricity.

This Voltage Compliance business case utilises the Customer Export Curtailment Value (CECV) methodology and the AER assessment guideline. On 30th June 2022, the AER made a final decision[16] on its CECV methodology and published an explanatory statement. Oakley Greenwood was the consultant that had worked with the AER in developing the methodology and a model for calculating CECV. At this time, the AER published a set of CECV which it expected distributors utilise in justifying investments associated with alleviating CER export curtailment.

[16] https://www.aer.gov.au/networks-pipelines/guidelines-schemes-models-reviews/customer-export-curtailment-value-methodology/final-decision

On 1st July 2024, the AER published updates to the CECV[17] values. These updates have been used verbatim (copied directly from the AER workbook, as values) into the Voltage Compliance models, filtered for the Victorian region. They cover every half hour period from 1/7/2024 to 30/6/2045 and are expressed in Australian dollars per MWh (Real, 2023).

The assessment approach in this business case applies CECV to voltage-induced curtailment of generation from the action of Volt-Watt control in AS4777.2 solar PV inverters at that location. To estimate the level of voltage-induced curtailment on inverters, it is necessary to understand the gross level of solar PV generation being produced during the year and its profile during the day, and the voltage levels that are being experienced by the inverter which may trigger the operation of the Volt-Watt or inverter tripping functions in solar PV inverters.

The steps taken to do this included

- identifying a seasonal gross generation equation for a typical solar PV system located in outer eastern Melbourne, being representative of the heartland of AusNet's residential solar PV customer population.
- identifying an equation that describes the curtailment of the gross generated energy from the action of the Volt-Watt and tripping settings that occurs from the inverter responding to steady-state over-voltages
- netting out the impacts of shading and cloud cover that can change across different seasons.
- multiplying the net curtailed energy calculated from this process with the escalated CECV for each half hour of the analysis period.

4.2.3. Valuing emissions reduction

The voltage compliance program is also supported by the quantification of greenhouse gas emissions reductions. The curtailment of CER generation from the action of Volt-Watt control in AS4777.2 solar PV inverters, could result in higher emissions of greenhouse gasses if additional fossil-fuel generation is dispatched to meet the increased demand. The AER has released draft guidance on applying value of emissions reduction for network capital investments utilising a Value of Emissions Reduction (VER) Methodology[18], as well as forecasts VER for use by DNSPs in economic evaluations.

4.2.4. Valuing over-voltage increased energy consumption

Over-voltages cause increased energy consumption by customers to levels higher than what would be the case if voltages were within the allowable operating range. The approach applies a value of increased consumption due to over-voltages to the identified voltage non-compliance limitations.

The value of increased consumption due to over-voltages is estimated using a product of:

- AusNet's typical flat-rate residential retail energy consumption tariff
- AusNet's total gross annual energy consumption of all AusNet's customers
- the size of the over-voltages (voltage delta above 253V)
- the number of customers with those over-voltages (for each voltage bin)
- the average over-voltage for customers expected to experience over-voltages
- the percentage change in energy consumption per volt above 253V
- the disproportionality factor (refer to valuing safety below)
- dividing by the total number of NMIs assessed in the model.

4.2.5. Valuing over-voltage safety

Over-voltages and under-voltages may cause customer equipment damage and reduced life spans which is a potential safety risk for appliances overheating and catching on fire. A recognised approach to safety in economic evaluation of investment is to apply a disproportionality factor to the quantified risk contributing materially to the safety risk – that being the over-voltage impact on customer appliances.

AusNet adopts the "As Far As Practicable" (AFAP) principle to safety which usually applies a disproportionality factor ranging between 1 and 6. A value of 6 is used that is commensurate with the safety risk, in this case being the operation customer appliances and network equipment beyond their technical design limits.

This multiplier has been applied to the value of increased consumption as shown above.

[17] hhttps://www.aer.gov.au/industry/registers/resources/guidelines/customer-export-curtailment-value-methodology/update-0
[18] AER releases draft guidance on applying value of emissions reduction | Australian Energy Regulator (AER), 28th March 2024.

4.2.6. Economic evaluation approach

The proposed program expenditure is derived from an assessment approach that aims to maximise the net economic benefit to customers as follows:

- Using the costs and avoided risks (calculated from the do nothing risks above) of the identified credible solutions, the net present value (NPV) of the solution at each asset location is calculated.
- The site NPVs are ranked to develop a program of works of the most economically viable projects, comprising only NPV positive projects.
- The optimum timing for each project occurs when the annualised avoided risk exceeds the annualised cost of the project.

The present values are calculated using a discount rate over a 20-year planning horizon, keeping forecasts of risk and benefits beyond 10-years constant at the year 10 value.

Meeting voltage compliance obligations is an outcome of the approach at sites that are determined to be economically viable.

An expenditure profile is developed based on the list of economically viable sites and their optimum timing forming a programme of works.

Two program options were considered, with Options 1 following the economic approach. Option 2 applies a similar approach to Option 1, considering multiple solutions to remove constraints in the low voltage and the 22 kV network to allow for zero constraints.

4.3. Do nothing

The do nothing (counterfactual) option assumes that AusNet would not undertake any ongoing investment in voltage compliance – that is, none of the Voltage Compliance Programs are adopted. Under this option, the voltage non-compliance would only be managed as a reactive measure as part of Quality of Supply Program. Since this option assumes no investment outside of the normal operational and maintenance processes, this is a zero incremental investment cost option.

For a do nothing investment scenario, we expect to go from functional compliance at the start of FY27 (that is, with no more than 5% of our customers with non-compliant voltages) to a non-compliance level of 6% of customer with non-compliant voltages at the end of the 2026-31 regulatory control period.

The present value of total risk (safety, increased energy consumption, and voltage-curtailed generation) being experienced by customers due to higher network voltages, is valued at $162.4 million over the analysis period (real 30th June 2024 dollars).Table 6 shows the undiscounted risk values.

Table 6: Do nothing risk ($m, undiscounted, 30th June 2024 dollars)

	FY27	FY28	FY29	FY30	FY31	Total FY27-31	Full assessment period
Increased consumption	1.0	1.0	1.2	1.3	1.3	**5.7**	**30.6**
Safety	5.0	5.1	5.8	6.3	6.4	**28.5**	**152.8**
Emissions	0.2	0.1	0.1	0.1	0.2	**0.8**	**8.8**
CER curtailment	0.4	0.4	0.7	0.5	0.5	**2.4**	**37.8**
Do nothing risk	**6.6**	**6.7**	**7.7**	**8.1**	**8.3**	**37.4**	**230.0**

Source: AusNet analysis

The incremental investment cost of do nothing is zero.

The do nothing risk represents an upper limit of the pool of potential benefits that are available to credible options that can address the identified need, as detailed below.

4.4. Option 1 – Economic approach

This option is an ongoing Voltage Compliance Program which is specifically targeted at addressing voltage non-compliance, by selecting sites that satisfy the economic approach to minimising steady-state over-voltage non-compliances, *including* benefits of reduced voltage-curtailed generation for customers with over-voltage.

The sites which have been identified under this option for targeting voltage compliance solutions are shown in Table 7. All projects in this listing are NPV positive, all considering the benefits of the avoided risks of increased energy consumption, safety risk and voltage-curtailed generated energy. The NPV is shown in Table 8.

Table 7: Option 1 projects

Optimum project type	Identified sites
DVM	MYT, LGA, FTR, HPK, WGL, LDL, CRE, WOTS, LLG, NLA, TT, BDL, CPK, BN, ELM, MOE, EPG, MFA, BRA, PHM, LYD, MWL
Zone substation reactor and DVM	CLN, WGI, DRN, PHI, KLO, OFR, WN
HV distribution feeder voltage regulator and DVM	MYT12, LDL23, FTR23, NLA34, WGL12
Distribution substation transformer replacement distribution substation tap down	BRANDY CREEK
Distribution substation phase peak load balance distribution substation tap up	68 sites

Source: AusNet analysis

Table 8: Option 1 NPV analysis ($m, $June 2024)

	FY27	FY28	FY29	FY30	FY31	Total FY27-31	Full assessment period
Cost (undiscounted)	(5.5)	(3.6)	(5.4)	(3.0)	(6.4)	**(23.9)**	**(31.2)**
Benefits (undiscounted)	2.6	4.3	5.8	7.1	7.8	**27.6**	**200.0**
NPV (discounted)	**109.2**						

Source: AusNet analysis (benefits are relative to do nothing, representing reduced do nothing risk).

4.4.1. Cost

4.4.1.1. Capital expenditure

Table 9 represents the forecast capital expenditure that is economically prudent for AusNet to be investing in the network to meet its voltage compliance obligations for network-wide functional compliance as required by the EDCOP, and to facilitate reduced CER voltage curtailment.

Table 9: Option 1 capital expenditure ($m, undiscounted, $June 2024)

	FY27	FY28	FY29	FY30	FY31	Total FY27-31	Full assessment period
Capex	(5.5)	(3.5)	(5.3)	(2.8)	(6.2)	**(23.3)**	**(26.3)**

Source: AusNet analysis

4.4.1.2. Operating expenditure

Table 10 represents the forecast incremental operational expenditure that is economically prudent for AusNet to be investing in the network to meet its voltage compliance obligations for network-wide functional compliance as required by the EDCOP, and to facilitate reduced CER voltage curtailment.

Table 10: Option 1 operating expenditure ($m, undiscounted, $June 2024)

	FY27	FY28	FY29	FY30	FY31	Total FY27-31	Full assessment period
Opex	(0.0)	(0.1)	(0.1)	(0.2)	(0.2)	**(0.6)**	**(4.9)**

Source: AusNet analysis

4.4.2. Benefits

Over the 2026-31 regulatory control period for an Option 1 investment, the percentage of customers with EDCOP non-compliant voltages, is expected to fall from a functional compliance level of 5% to 3.4%[19] by the end of the period. The cumulative benefits delivered by this option are forecast to avoid 74%[20] of the do nothing risk over that period, and by the end of the 20-year economic analysis period, avoid 87%[21] of the total do nothing risk.

Table 11: Option 1 NPV benefit ($m, undiscounted, 30th June 2024 dollars)

	FY27	FY28	FY29	FY30	FY31	Total FY27-31	Full assessment period
Increased consumption	0.4	0.6	0.9	1.1	1.2	**4.2**	**27.7**
Safety	2.0	3.2	4.4	5.4	6.0	**21.0**	**138.4**
Emissions reduction	0.1	0.1	0.1	0.1	0.1	**0.5**	**5.5**
Reduced CER curtailment	0.1	0.3	0.5	0.4	0.5	**1.8**	**28.4**
Total	**2.6**	**4.3**	**5.8**	**7.1**	**7.8**	**27.6**	**200.0**

Source: AusNet analysis (benefits are relative to do nothing, representing reduced do nothing risk)

19 Modelling results from 16% to 11% of customers experiencing over-voltages over the period (i.e., 11% x 5% ÷ 16% = 3.4%).
20 27.6 ÷ 37.4 = 74%
21 200.0 ÷ 230.0 = 87%

4.5. Option 2 – Deterministic approach

This option is an ongoing Voltage Compliance Program which is specifically targeted at addressing voltage non-compliance. It goes beyond our obligation for functional compliance under the EDCOP, by providing compliant voltages to all customers. The sites which have been identified under this option for targeting voltage compliance solutions are shown in Table 12. All projects in this listing have gross benefits (the same range of benefits as Option 1) but are not necessarily NPV positive to achieve a full voltage compliance outcome. Project solutions are based on least cost. The NPV is shown in Table 13.

Table 12: Option 2 projects

Optimum project type	Identified sites
Sub-Transmission augmentation	9 sub-transmission lines
DVM	38 zone substations
Zone substation reactor and DVM	22 zone substations
HV distribution feeder voltage regulator	30 feeders
HV Distribution Feeder Voltage Regulator and DVM	176 feeders
SWER augmentation	163 sites
Distribution substation and LV circuit augmentation	42 sites
Distribution substation transformer replacement Distribution substation tap down	5,634 sites
Distribution substation phase peak load balance distribution substation tap up	315 sites

Source: AusNet analysis

Table 13: Option 2 ($m, 30th June 2024 dollars)

	FY27	FY28	FY29	FY30	FY31	Total FY27-31	Full assessment period
Cost (undiscounted)	(165.5)	(128.5)	(127.5)	(129.8)	(212.8)	**(764.1)**	**(893.6)**
Benefits (undiscounted)	6.5	9.1	10.3	11.9	12.2	**49.9**	**233.0**
NPV (discounted)	**(613.1)**						

Source: AusNet analysis (benefits are relative to do nothing, representing reduced do nothing risk)

4.5.1. Cost

4.5.1.1. Capital expenditure

Table 14 represents the forecast capital expenditure that is required for deterministic investment to remove all voltage non-compliance.

Table 14: Option 2 capital expenditure ($m, undiscounted, $June 2024)

	FY27	FY28	FY29	FY30	FY31	Total FY27-31	Full assessment period
Capex	(164.6)	(126.0)	(123.7)	(124.8)	(206.5)	**(745.7)**	**(831.0)**

Source: AusNet analysis

4.5.1.2. Operating expenditure

Table 15 represents the forecast operating expenditure that is required for deterministic investment to remove all voltage non-compliance.

Table 15: Option 2 operating expenditure ($m, undiscounted, $June 2024)

	FY27	FY28	FY29	FY30	FY31	Total FY27-31	Full assessment period
Opex	(0.9)	(2.5)	(3.8)	(5.0)	(6.2)	**(18.4)**	**(62.6)**

Source: AusNet analysis

4.5.2. Benefits

Over the 2026-31 regulatory control period, the percentage of customers with EDCOP non-compliant voltages, is expected to fall from levels of 5% to close to 0% for Option 2, avoiding 100% of the do nothing risk.

This Option 2 investment program effectively delivers full voltage compliance performance outcome for all customers. However, this option is prohibitively expensive (compared to the other options) and may not be practically achievable for all locations. Furthermore, the program may not be delivered in its entirety by the end of the 2026-31 period. There are rapidly diminishing returns for customers that only have marginal voltage violations.

Table 16: Option 2 ($m, undiscounted, 30th June 2024 dollars)

	FY27	FY28	FY29	FY30	FY31	Total FY27-31	Full assessment period
Increased consumption	1.0	1.4	1.5	1.8	1.9	**7.6**	**30.6**
Safety	5.0	6.9	7.7	9.2	9.3	**38.0**	**152.8**
Emissions reduction	0.2	0.2	0.2	0.2	0.2	**1.0**	**8.8**
Reduced CER curtailment	0.4	0.6	0.9	0.7	0.8	**3.3**	**37.8**
Total	**6.5**	**9.1**	**10.3**	**11.9**	**12.2**	**49.9**	**233.0**

Source: AusNet analysis (benefits are relative to do nothing, representing reduced do nothing risk).

4.6. Quality of supply program

This is a recurrent supply improvement program focussed on quality of supply issues within the network which is specifically targeted at addressing customer complaints. Furthermore, AusNet is obligated to meet quality of supply standards prescribed in the EDCOP Chapter 12.

The program is "reactive" and is required so that immediate corrective actions can be undertaken to respond to customer complaints and quality of supply compliance issues. All work undertaken arises from registered customer complaints where there is a high probability of the situation being referred to the EWOV, if not addressed promptly. As well as the need to resource the EWOV enquiry processes, there is a likelihood of more extensive and expansive corrective action being required because of the EWOV's investigations.

Each year the Customer Service Centre receives a significant number of customer complaints, mainly relating to the following issues:

- Voltage quality – low voltage (LV), high voltage (HV), voltage fluctuations and flicker
- LV circuit failures (e.g. fuse operations) due to LV unbalance issues
- Minor network load re-balancing.

Complaints received by our customer service centre are referred to our investigation office to identify the problem and develop a least cost solution to address the issue. Capital works follow a detailed investigation only if no technically or economically feasible alternative solution exists. Individual authorisation of the scope of works of each remedial project is required prior to corrective action being undertaken. Solutions often include:

- Reducing circuit loading by upgrading, or splitting circuits;
- Creating LV Bus
- Rearranging the network to distribute customers evenly and balance load across the three phases
- Upgrading LV service lines
- Installation or upgrading distribution transformers to units with a greater tap range
- Low voltage regulation equipment.

Through this supply improvement program, valid customer complaints on power quality have been resolved to the satisfaction of our customers. If this work had not been completed it is probable that customers would escalate their complaints to the EWOV, in which case AusNet would likely be compelled by the EWOV to address the customer complaints. As such the program is intended to be used to undertake projects to address these customer complaints without escalation to EWOV. This program represents a sustainable commitment to our customers to provide a network that aims to maintain our compliance with the EDCOP quality of supply obligations.

Table 17 presents the Quality of Supply Program forecast expenditure. The expenditure that has been identified for this program reflect the allowance for the current regulatory control period.

Table 17: Quality of Supply Program Forecast Expenditure ($m, 30th June 2024 dollars)

	FY27	FY28	FY29	FY30	FY31	Total FY27-31	Total allowance current period
Capex	(1.579)	(1.586)	(1.463)	(1.329)	(1.283)	**(7.242)**	**(7.242)**

Source: AusNet analysis

This represents the forecast capital expenditure that is prudent for AusNet to be investing in the network to address its quality of supply of supply EDCOP non-compliance and customer complaint issues that are not otherwise addressed by the Voltage Compliance Program. The forecast expenditure is lower than the current period actual expenditure but maintained at the current period allowance in real terms.

5. Preferred option and sensitivity testing

This business case outlines the identified need and the quality of supply and voltage non-compliance mitigation investment that AusNet have assessed over the 2026-31 regulatory control period.

For the Voltage Compliance Program, Option 1 is the preferred option at a capex requirement of $23.3 million (real, $June 2024) over the 2026-31 regulatory control period, which represents a prudent and efficient network augmentation investment to manage voltage compliance. Applying a discount rate of 5.56% per annum, this proposed program option has a NPV of $109.2 million (Real, $June 2024) over the 20-year assessment period, as shown in Table 18.

Table 18: Economic evaluation of Voltage Compliance Program options ($m, $June 2024)

	FY27 to FY31 (undiscounted)			Full assessment period (discounted)			Comments
	Capex	Opex	Total cost	Total cost	Total benefits	NPV	
Do Nothing	0.0	0.0	0.0	0.0	0.0[22]	0.0	This option does not address the identified need
Option 1 – Economic approach to voltage Compliance and voltage-curtailed generation	23.3	0.6	23.9	(26.5)	135.6	109.2	This is the preferred option as it maximises the NPV
Option 2 – Deterministic approach for full voltage compliance	745.7	18.4	764.1	(775.5)	162.4	(613.1)	This is cost prohibitive

Source: AusNet analysis

Over the 2026-31 regulatory control period for an Option 1 investment, the percentage of customers with EDCOP non-compliant voltages, is expected to fall from a functional compliance level of 5% to 3.4%[23] by the end of the period. Despite the increases in CER connections and increases in HV underground cable length expected over the period which both place upward pressure on network voltages, this Option 1 investment program effectively delivers an improved voltage compliance performance outcome for customers.

Table 19 compares the costs and benefits of the four Voltage Compliance Program options for credible variations in input variables.

Table 19: Sensitivity of Voltage Compliance Program NPV ($m, $June 2024)

	Central assumptions	Projects delayed by one year	4.11% discount rate	15% reduction in capital costs	5% increase in demand	25% increase in failure probability	7.00% discount rate	15% increase in capital costs	5% reduction in demand	25% reduction in failure probability	Comments
Do nothing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Option 1	**109.2**	**98.5**	**134.3**	**113.1**	**122.7**	**143.0**	**89.4**	**105.1**	**88.8**	**75.2**	Preferred option under all credible sensitivities
Option 2	(613.1)	(600.0)	(638.2)	(496.8)	(597.0)	(572.5)	(587.3)	(729.4)	(637.5)	(653.7)	Not economic under credible sensitivities

[22] The present value of total risk of safety and increased energy consumption, voltage-curtailed generation and emissions being experienced by customers due to higher network voltages, is valued at $162 million over the analysis period (real 30th June 2024 dollars). Refer Table 6.

[23] Modelling results show 16% to 11% of customers experiencing over-voltages over the period (i.e., 11% x 5% ÷ 16% = 3.4%).

Source: AusNet analysis

This table illustrates that the decision to select Option 1 as the preferred option remains robust, being the option with the highest NPV and remaining positive under all credible sensitivities.

For the Quality of Supply Program, AusNet is proposing to continue this recurrent program maintained the current period regulatory allowance to address quality of supply issues on the network as the preferred option. The current five-year allowance associated with other quality of supply needs (for the Base Case) is $7.242 million (Real $2024) and is maintained over the 2026-31 regulatory control period, to allow AusNet to continue to respond to and address identified and reported customer quality of supply issues.

Table 20: Quality of Supply Program Forecast Expenditure ($m, 30th June 2024 dollars)

	FY27	FY28	FY29	FY30	FY31	Total FY27-31	Total allowance current period
Capex	(1.579)	(1.586)	(1.463)	(1.329)	(1.283)	**(7.242)**	(7.242)

Source: AusNet analysis

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