Appendix 1.6: Quality of Supply Strategy

Regulatory proposal for the ACT electricity distribution network 2024–29

2022 • PO07495 • V1.1

QUALITY OF SUPPLY STRATEGY

APPROACH TO THE MANAGEMENT OF QUALITY OF SUPPLY

This strategy outlines our approach to the management of Quality of Supply at Evoenergy. This includes our responsibilities, challenges, and opportunities, and how they relate to business strategy and the asset management system.

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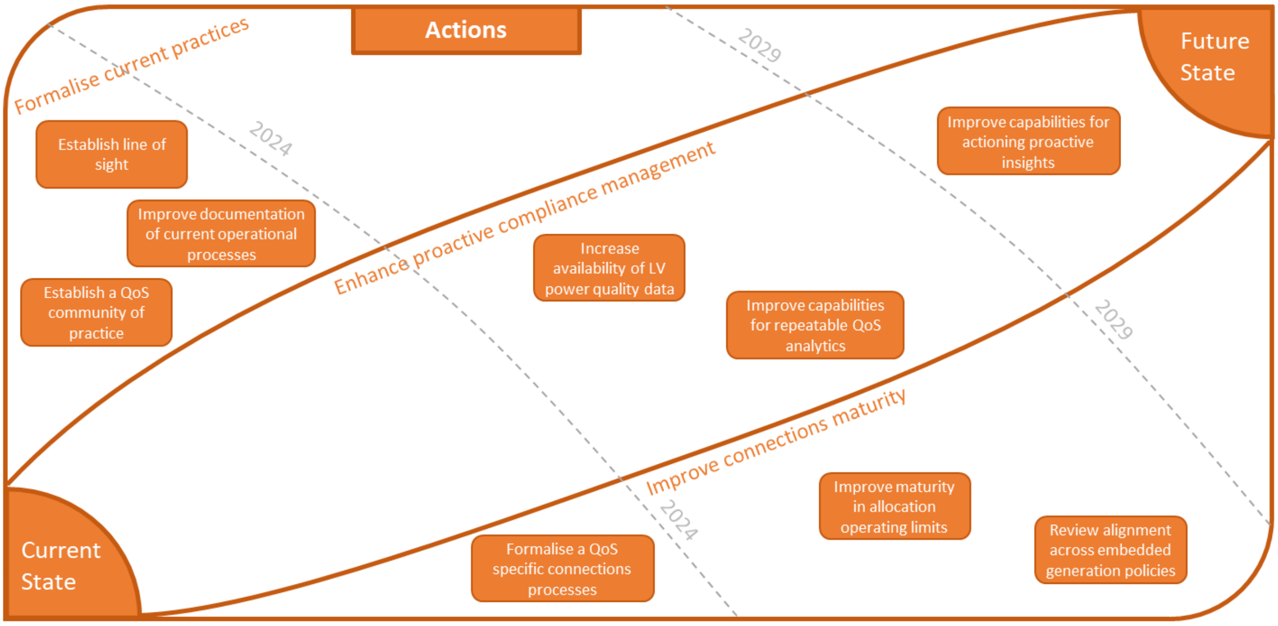
CONTENTS

EXECUTIVE SUMMARY

This document represents a substantial refresh of quality of supply strategy at Evoenergy. As such, it re-examines fundamentals such as what our organisational objectives are, where information comes from in its many forms, who is responsible for it, and how it is (or should be) used in decision-making.

OBJECTIVES	KEY CHALLENGES	IMPACT	GUIDING POLICIES
Maintain quality of supply performance.	Increasing distributed energy resource penetration is challenging our ability to meet quality of supply performance expectations using historical practices.	Deterioration of quality of supply performance if quality of supply practices are allowed to stagnate.	With so much change and uncertainty, the focus should be on no-regrets proximate steps to improve outcomes now while retaining options in future responses. • Formalise current practices • Enhance proactive compliance management • Improve connections maturity

Actions consistent with the above guiding policies are shown in the figure below with more details in Section 12.



INTRODUCTION

Establishing expectations about the intent and content of this strategy and how it fits into our broader asset management system architecture.

1. SCOPE

The Australian Power Quality and Reliability Centre (APQRC) defines power quality as "the study of the sources, effects and control of disturbances that propagate via the electric power supply". For the purposes of this strategy, Quality of Supply (QoS) is defined to encompass the management of power quality as it relates to electromagnetic compatibiltiy, system efficiency, safety, and environmental impacts.

Electromagnetic Compatibility (EMC) is perhaps the most common subject for QoS management, setting expectations about electricity network performance, and hence the level of immunity to disturbances consumer equipment should tolerate. Table 1 captures typical elements of EMC, as informed by the AS-NZS 61000 series of standards.

TABLE 1 EMC ELEMENTS OF QOS

DISTURBANCE TYPE	COMPRISES
Voltage disturbances	Interruptions, undervoltage, overvoltage, voltage unbalance, sag (dip), swell, voltage fluctuations (flicker)
Waveform (distortion) disturbances	Transients (impulsive/oscillatory), direct current (DC) offset, harmonics, interharmonics, notching, noise,
Power frequency variations	Underfrequency, overfrequency

Under the Utilities (Electricity Distribution Supply Standards Code) Determination 2013, Evoenergy is required to manage other disturbances relating to power quality. This includes topics relating to the management of environmental disturbance such as **electromagnetic fields** (EMF) and **inductive interference**, as well as safety of connections such as **voltage difference between neutral and earth**.

Finally, Evoenergy is obliged to minimise losses on its distribution system and maintain suitable interface characteristics to the transmission system. To this end, **power factor** is also defined to be a QoS metric included under this strategy.

Topics considered to be out of scope for this strategy include earth potential rise, and reliability (including the frequency and duration of supply interruptions). Evoenergy uses other strategy and planning mechanisms to manage these risks.

2. FOCUS FOR THIS VERSION

Strategy development is inherently an iterative process. Much of its value lies in identifying a small number of issues that will have a large impact if organisational attention and resources are focussed on addressing them. In developing this version of the strategy, the primary focus areas include:

- reinforcing QoS management fundamentals to ensure a strong baseline is maintained; and
- taking a more proactive approach with respect to steady state voltage.

By focusing on these challenges now, the organisation will be well equipped to direct attention elsewhere in future versions, secure in the knowledge that the right systems are in place or in the process of being delivered for these areas of interest.

3. DOCUMENT HIERARCHY

The asset management system and its structure is undergoing review[1]. An interim document hierarchy during this revision period is shown in Figure 1. The QoS Strategy is classified as an operational strategy under this hierarchy.

FIGURE 1 ASSET MANAGEMENT SYSTEM DOCUMENT HIERARCHY (UNDER DEVELOPMENT). QOS STRATEGY IS CLASSIFIED AS AN OPERATIONAL STRATEGY.

[1] Point of contact: Manager - Environmental & Technical Regulatory Compliance

CONTEXT

Background on sources and effects of QoS disturbances, as well as context on the external and internal operating environment for Evoenergy.

4. BACKGROUND ON QOS

This section provides context on sources, effects, and responsibility for power quality disturbances. Much of the discussion is informed by or drawn from the work of Gosbell (1998) and the broader team at the Australian Power Quality & Reliability Centre.

4.1 Sources of power quality disturbance

Power quality disturbances can be triggered by a variety of events originating either on the supply system, at customer equipment, or at neighbouring equipment (propagated via the supply). A sample of power quality disturbance origins is illustrated in Table 2.

TABLE 2 ORIGIN OF POWER QUALITY DISTURBANCES

DISTURBANCE ORIGIN	EXAMPLE EVENTS
Supply system	Lightning strike, line capacitor switching, line/transformer asymmetry, fault on feeder / neighbouring feeder, sudden changes in generation.
Customer equipment or neighbouring installation	Sudden connection of large loads, unequal distribution of loads across phases, cyclic loads, poor wiring, large concentrations of power electronic loads, faulty switch mode or uninterruptable power supplies, switching events, inverter settings on embedded generation.

4.2 Effects of power quality disturbance

Power quality disturbances can have a range of impacts depending on the type of disturbance, and the types of load connected to the system. Broadly they can reduce equipment life, increase safety risks, and cause changes to the functioning of equipment, with some such effects summarised in Table 3.

TABLE 3 SOME EFFECTS OF POWER QUALITY DISTURBANCES, ADAPTED FROM GOSBELL (1998)

EVENT TYPE	DISTURBANCE	EFFECT
Voltage	Overvoltage	Overstress insulation, constrain export
Voltage	Undervoltage	Excessive motor current
Voltage	Unbalance	Motor heating
Voltage	Neutral-ground voltage	Digital device malfunction
Voltage	Interruption	Complete shutdown

Voltage	Sag	Variable speed drive & computer trip-out
Voltage	Swell	Overstress insulation
Voltage	Fluctuations	Light flicker
Waveform	Harmonics	Motor, transformer & neutral conductor overheating, instrumentation malfunction
Waveform	Notching	Zero-crossover device malfunction
Waveform	Transients	Electronic device failure or malfunction, drive trip-out
Waveform	Noise	Fast-running clocks, zero-crossover device malfunction

4.3 Responsibility for power quality disturbance

As a network operator Evoenergy is responsible for keeping power supply within both the EMC limits specified by the AS-NZS 61000 series of standards, and the limits within the Utilities (Electricity Distribution Supply Standards Code) Determination 2013. Customers similarly have a responsibility to ensure that their equipment does not cause disturbances which will propagate into the supply system at an excessive level. When Evoenergy investigates potential QoS issues, one of the important outcomes is to determine who is responsible for addressing any disturbances that are found.

5. EXTERNAL CONTEXT

5.1 National

A growing number and variety of distributed energy resources (DER) are being connected to Australian networks. This includes fixed location devices such as photovoltaics (PV) and batteries, as well as the emergence of mobile generation from electric vehicles (EVs). The Australian Standard for grid connection of energy systems via inverters, AS/NZS 4777.2:2020, is a recent revision of its 2015 predecessor that addresses power system security risks resulting from increasing PV penetration. It is anticipated that these changes will help to support power system security, prevent some major events, improve power quality, and increase hosting capacity of DER on distribution feeders. These effects in new devices may take some time before they balance those of legacy devices installed prior to the update.

The rise in numbers of customers with DER connected to the grid has coincided with rising smart meter penetration. The 2017 Power of Choice reforms placed responsibility for installing and maintaining smart meters with retailers and metering coordinators and affirmed the right for customers to choose whether or not to install a smart meter. A common trigger for such installations is when customers install DER, where the smart meters help to reconcile the resulting two-way electricity market. Smart meters are examples of a growing range of connected devices that collect rich, granular network performance data and provide new opportunities for power quality monitoring.

In 2021 the Australian Energy Market Commission (AEMC) introduced rule national rule changes to integrate distributed energy resources (DER) such as small-scale solar and batteries more efficiently into the electricity grid. Implications of this rule change for Evoenergy include that it:

- places clear obligations being placed on Evoenergy to support more DER connecting to the grid
- allows Evoenergy to offer a range of options to encourage solar owners to limit solar waste, save money, and benefit the grid
- strengthens customer protections and regulatory oversight by the Australian Energy Regulator (AER)

Many loads connected to the electricity network have an influence on power quality. Nonlinear loads are introduced by common devices such as switch mode power supplies and LED lighting which have become more prevalent in recent years with advances in consumer electronics. Networks across Australia are managing the impacts of these changes to load profiles, including harmonic content and increasingly capacitive behaviour.

5.2 Local

Evoenergy operates the majority of its network in the Australian Capital Territory (ACT) where the local government, as with many other jurisdictions, has outlined a policy to reach net zero carbon emissions. The timeline, set out in the ACT Climate Change Strategy, specifies an end target of net zero emissions by 2045, with interim targets every five years. The Evoenergy Distribution System Operator (DSO) Strategy (PO0731) discusses implications of the ACT Climate Change Strategy, with contributions to upwards pressure on network electricity demand from urban infill, a transition to all-electric infill and greenfield suburbs, and encouragement of zero emissions vehicle uptake.

AS 60038 Standard Voltages was first published in 2000 and introduced the change from a 240V to a 230V nominal voltage. This has since been adopted as the standard voltage within the ACT through the Utilities (Electricity Distribution Supply Standards Code) Determination 2013. This recent change to power quality compliance targets continues to have implications for asset configurations, such as tap settings on transformers.

6. INTERNAL CONTEXT

The 2021-2022 Evoenergy Business Strategy outlines the approach Evoenergy is taking to meeting our contribution to net zero emissions by 2045.This includes expanding the electricity network to accommodate increasing demand, while simultaneously exploring options for maintaining the viability of the gas network.

The DSO Strategy outlines a roadmap for a network transition to ensure that as the customer led broad-based rollout of DER occurs across the network, the capability to manage this DER is deployed in parallel to enable and optimise it.

Consistent with the national trend, the Evoenergy network is experiencing a rapid rise in DER connections. Over the last 15 years, exponential growth in installed PV capacity has seen cumulative capacity exceed 250MW as illustrated in Figure 2. Batteries are similarly undergoing exponential growth in installed capacity, with an apparent lag of approximately 10 years relative to PV.

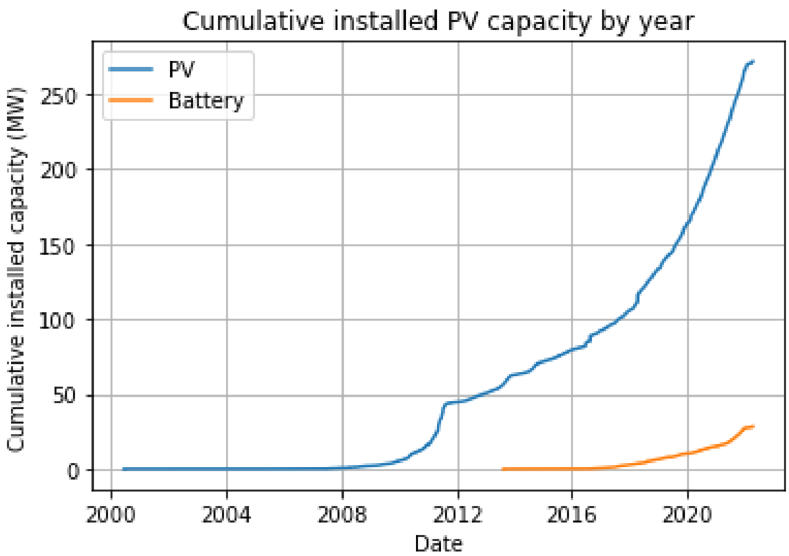


FIGURE 2 CUMULATIVE INSTALLED PV CAPACITY ON EVOENERGY NETWORK BY YEAR

A mismatch between residential load and PV generation profiles is leading to a reduction in daytime minimum demand. With so much connected PV generation, daytime minimum demand has been decreasing over the last 10 years and is expected to continue this trend with significant further decline forecast over the next 10 years as illustrated in Figure 3. These low levels of system demand are unprecedented within the Evoenergy network and could result in localised system security issues as discussed in the DSO Strategy.

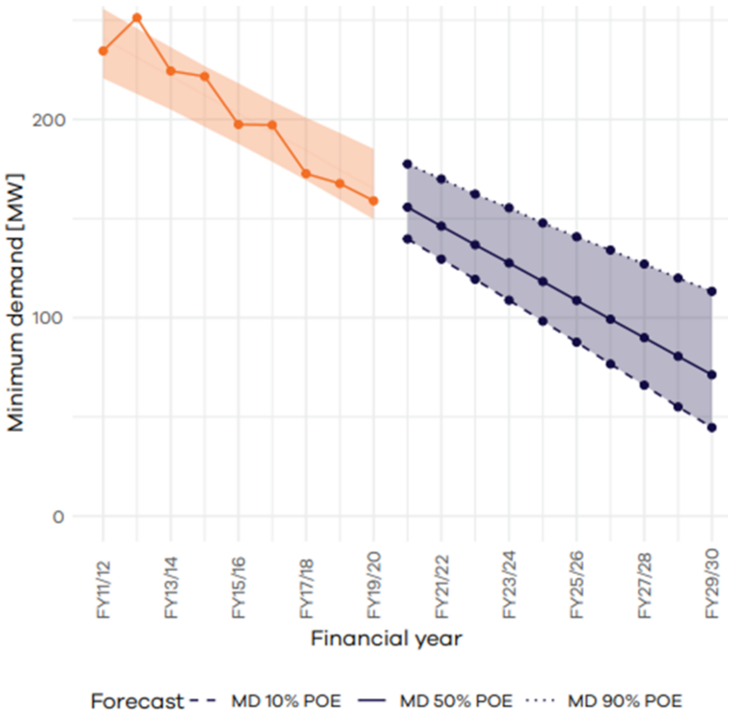


FIGURE 3 10-YEAR WHOLE-SYSTEM SUMMER AND WINTER DAYTIME MINIMUM DEMAND FORECAST[2]

[2] Adapted from Evoenergy 2021 Annual Planning Report

LINE OF SIGHT

QoS objectives and how they relate to regulatory and business requirements.

7. LEGISLATIVE AND REGULATORY REQUIREMENTS

Evoenergy is subject to statutory obligations regarding power quality through provisions of the technical code contained in the Utilities (Electricity Distribution Supply Standards Code) Determination 2013 (**the Code**), the National Electricity Law, and consequently, the National Electricity Rules. The Code requires compliance with several Australian Standards that relate to QoS as well as other obligations detailed within the Code. A review of the Code is currently being conducted by the Utilities Technical Regulator (UTR), the outcomes of which will need to be incorporated into future QoS guidance.

8. BUSINESS GUIDANCE

The QoS Strategy is informed by extant internal artefacts outlining Evoenergy strategy and management practices. Highlights of relevant content from these artefacts are captured in Table 4.

TABLE 4 BUSINESS GUIDANCE FROM ARTEFACTS THAT INFORM THE QOS STRATEGY

SOURCE(S)	ABOUT	GUIDANCE
Evoenergy Business Strategy	Outlines strategic pillars and initiatives for Evoenergy.	Pillars of the Evoenergy Business Strategy are to: 1. plan for our zero-carbon future. 2. create positive customer experiences. 3. work our assets and networks harder. 4. outperform our regulatory determination. This QoS Strategy iteration notes alignment with the first two pillars, which articulate that success factors include: • ongoing analysis of pathways to meet net zero carbon emissions by 2045, and its impact on stakeholders. • compliance monitoring and proactivity improvements. Interpreting this from a QoS perspective we are looking to be a network that can cost effectively integrate technology changes required for net zero carbon emissions whilst mitigating negative QoS impacts to stakeholders. Moreover, we will understand our performance better and improve our ability to before risks manifest as issues.
DSO Strategy	Outlines the context and driving forces behind Evoenergy's transition to a contemporary DSO	DSO Strategy objectives are to: 1. manage the integration of DER while maintaining core service obligations. 2. leverage DER to support network functions. This QoS Strategy iteration focuses on enabling elements of the first of these DSO objectives. The DSO Strategy observes that we need to:

		• maintain QoS and thermal issues attributed to DER within required limits, particularly for the LV network. • maintain the commercial viability of the network, acknowledging growing inequality between DER and non-DER customers.
Formal Safety Assessment (FSA) – Public or property exposed to threat	Key component of the Energy Network Safety Management System (ENSMS)	Poor power quality is identified as a hazard requiring formal controls in the Evoenergy Public or property exposed to threat FSA. Whilst the existing level of risk is deemed tolerable within the existing controls, opportunities for improvement have been identified including: • development of end-to-end processes for addressing customer QoS complaints.

9. OBJECTIVES

This QoS Strategy has been developed to achieve one key objective: *maintain QoS performance,* as captured in Table 5.

TABLE 5 QOS STRATEGY OBJECTIVES

REFERENCE	DESCRIPTION
PQO1	Maintain QoS Performance

This objective has been developed with the understanding that current performance levels are compliant with the applicable regulatory requirements. In the event that service level requirements change, or that performance levels are found to be non-compliant, this objective would need to be revisited.

As will be expanded on in subsequent Sections, without intervention we would expect a trend of decreasing performance over time due to increasing DER penetration. The objective of maintaining performance is an appropriate level of ambition in this context.

STRATEGY

Identification of our current challenges in meeting QoS objectives, with actions to address these informed by guiding principles.

10. KEY CHALLENGES

Results of an investigation into key challenges for QoS at Evoenergy can be summarised as follows:

- Increasing DER penetration is challenging our ability to meet QoS performance expectations using historical practices.

10.1 Customer-driven focus areas

One method for gauging salient power quality issues for customers on the Evoenergy network is to examine data on complaints and enquiries. Figure 4 displays the annual number of customer complaints and enquiries by financial year dating back to FY 2007, showing a long-term trend of rising numbers of complaints and enquiries each year, with an additional spike in numbers during FY 2018 and FY 2019.

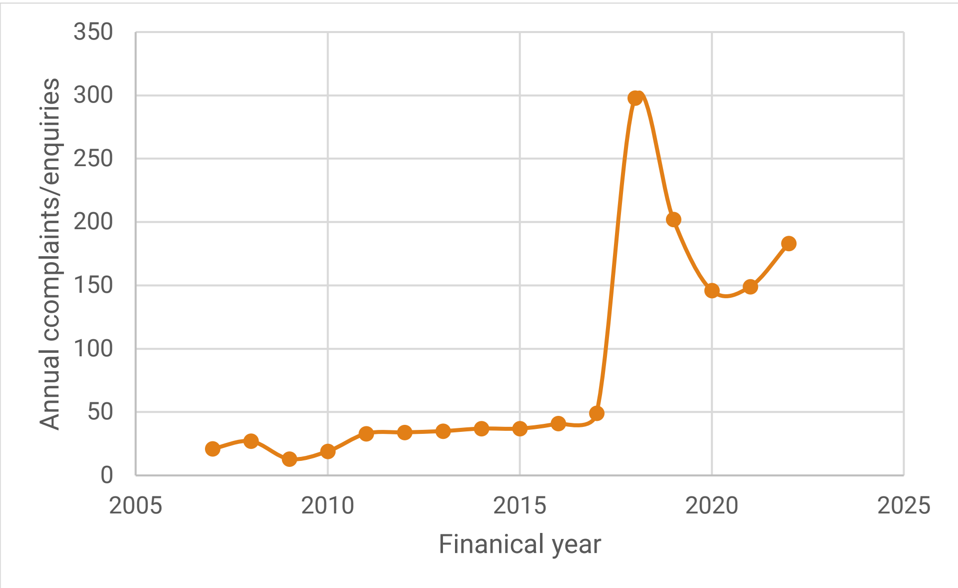


FIGURE 4 ANNUAL COMPLAINTS AND ENQUIRIES BY FINANCIAL YEAR.

Whilst this measure gives some insight into trends in customer levels of (dis)satisfaction, care should be taken in using this directly for decision-making given its limitations, which include:

- lack of confidence in record keeping, with no centralised register prior to FY 2018;
- a need for sub-categorisation, with complaints and enquiries lumped together; and
- disconnect between legislative performance expectations and individual customer satisfaction

Complaints and enquiries may trigger reactive investigations into power quality performance. We can gain further insights into the topics that are concerning customers by examining data on investigation triggers and outcomes. Figure 5 a) shows that more than half of reactive investigations in FY 2022 were triggered by a customer enquiry relating to over-voltage, with a substantial minority triggered by electric shock. Figure 5 b) shows that outcomes of these investigations revealed a roughly even split between sites with identifiable performance issues and sites with no problem found.

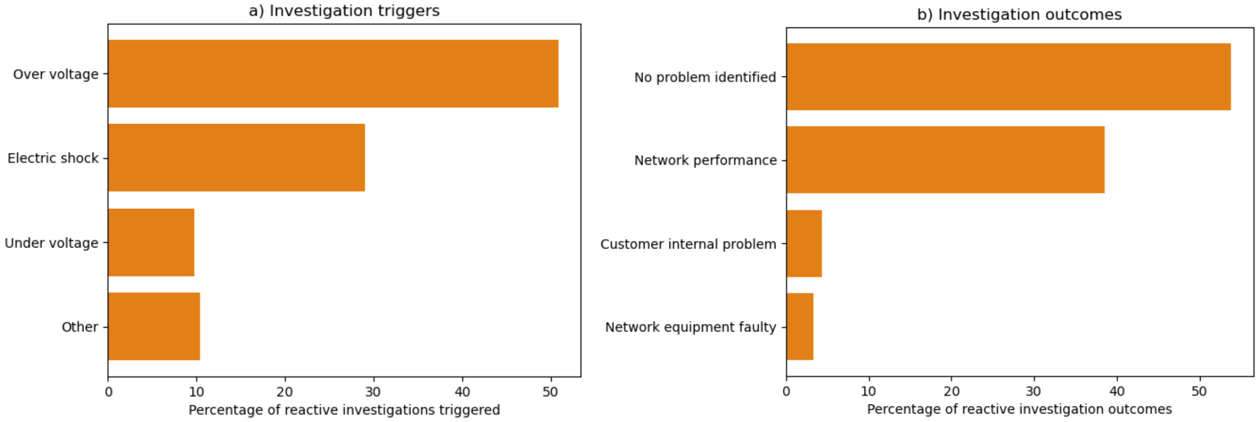


FIGURE 5 INVESTIGATION A) TRIGGERS AND B) OUTCOMES FOR FY 2022.

10.2 Network performance

Given the dominance of over-voltage as a topic of customer complaint and trigger for reactive investigations, it is worthwhile exploring network steady state voltage performance at Evoenergy in more detail to identify any systemic concerns.

The Evoenergy network has adopted the AS 60038-2012 definition of steady state voltage limits (for which the monitoring and application are described in AS 61000.3.100-2011). For individual sites connected to the LV network the limits are statistical in nature and are defined relative to the 1st (V1%) and 99th (V99%) percentile voltage measured over a monitoring period as summarised in Table 6.

Table 6 AS 61000.3.100-2011 LV VOLTAGE COMPLIANCE THRESHOLDS

MEASURE	THRESHOLD DIRECTION	THRESHOLD TYPE	VALUE (V)
V1%	Minimum	Limit	216
V99%	Maximum	Limit	253
V50%	Minimum	Preference	225
V50%	Maximum	Preference	244

For a population of sites across a network, these limits apply to the 5th (P5_V1%) and 95th (P95_V99%) percentile site respectively. Evoenergy undertakes annual temporary monitoring at 100 randomly selected sites on the LV network to gain a representative sample of performance. Figure 6 a) illustrates that the network experienced relatively consistent steady state voltage performance between Winter 2019 – Spring 2021 regardless of season, with voltages skewed towards the upper end of the compliance band. Data collection in this manner is a resource intensive process, so sample sizes are small (approximately 20 sites at any given time) leading to relatively high error margins and risks of under-representing parts of the network that may not have been measured in each season.

Performance trends are somewhat different when customers with high DER penetration are examined. Figure 6 b) displays a five-year summary of voltage performance data for 1000 fixed monitoring sites[3] that represent residential customers with both PV and battery systems installed. The large number of sites gives high statistical power, leading to relatively low error margins. Over the same Winter 2019 – Spring 2021 reporting period we can see that DER is driving seasonal variability in voltage performance. This means that the voltage experiences periods both closer to upper (summer) and lower (winter) ends of the allowable voltage range. As DER penetration across the network increases, we are likely to see this broadening of the annual voltage envelope through seasonal variability become more prevalent in across the entire LV network, not just a select group of customers.

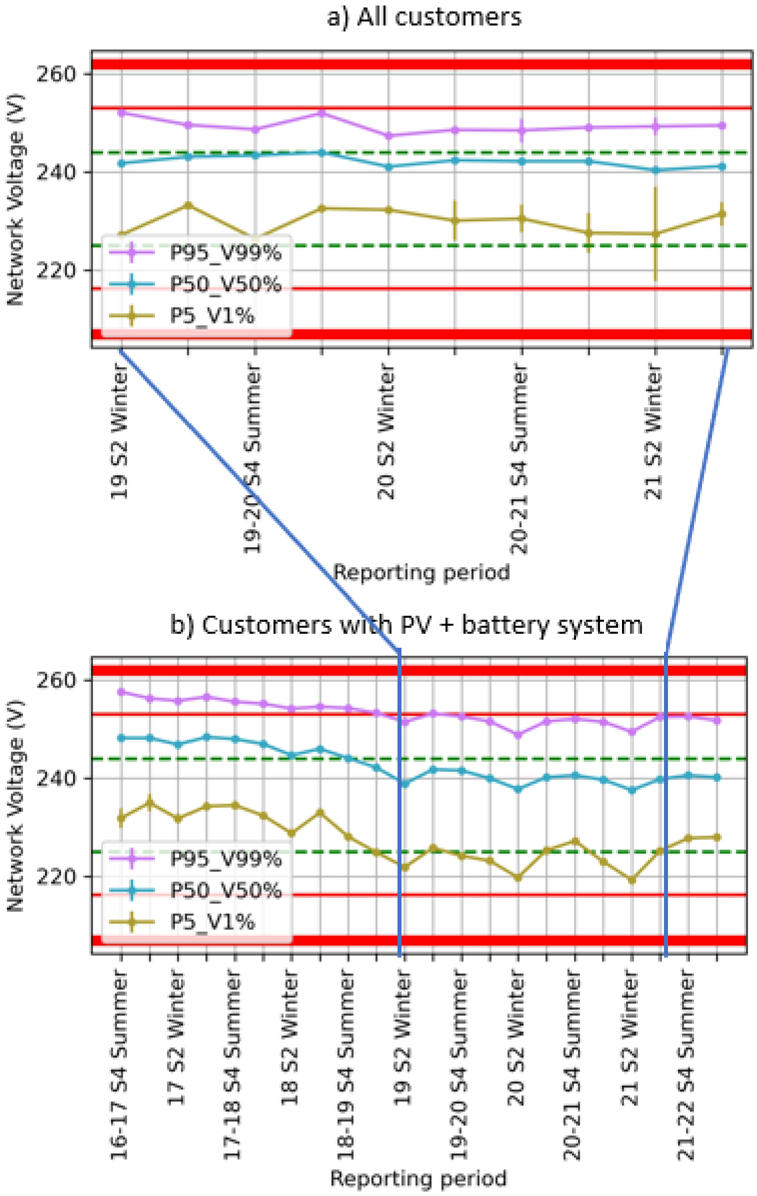


FIGURE 6 LV NETWORK VOLTAGE PERFORMANCE FOR A) RANDOMLY SELECTED SITES AND B) SITES WITH PV AND BATTERY SYSTEMS INSTALLED

Examining the longer 5-year view of voltage performance in Figure 6 b) also reveals that voltage performance (at least for DER-connected customers) improved substantially over the 2017-2019 period and

[3] Evoenergy procures data for a selection of Reposit customers.

has remained consistent on an annual basis since the improvement. Contributing to these results are some one-off network adjustments that would be difficult to repeat including:

- lowering the 132kV transmission system voltage regulation set-point in collaboration with Transgrid at the Canberra 330kV Substation from 136kV to 132 kV; and
- lowering the zone substation voltage regulation set-points from 11kV to 10.8kV to increase tap headroom for distribution transformers.

Moving forward, the residual LV network voltages will need to be managed proactively to ensure that the performance levels achieved since 2019 do not deteriorate as the level of DER penetration increases.

10.3 Reconciling network performance with customer feedback

It appears somewhat paradoxical to have a network that is both performing well and driving elevated complaints and enquiries. Clues to unpacking this story can be found in Figure 2 which showed previously that the pace of DER connection on the Evoenergy network remains high, with record numbers of customers now owning grid-connected inverter-based systems such as PV and batteries. Customers connect these systems with an expectation (whether legislated or not) that they can derive value from exporting excess power to the grid, and that the network will be sufficiently strong to accommodate such connections without substantially impacting QoS. What we are likely seeing is increased customer sensitivity to voltage levels as the impacts of non-compliance become more visible and more readily felt. Individual instances of high voltage cause constrained generation and have a direct impact on perceived value for owners of DER, leading to increased likelihood of raising a complaint or enquiry.

10.4 Other salient issues

Although (steady state) voltage is the main issue raised by customers, other emerging issues to be managed as a network operator include:

- **DER Phase Balancing** – the majority of residential DER is connected to a single phase beyond the connection point and Evoenergy does not currently have a process for validating DER phase connection. This has the potential to produce phase-balancing issues in the future.
- **reverse power flow** – with increasing connection of DER on the LV network, the possibility of reverse power flow through distribution transformers will challenge the assumptions underpinning protection and control philosophies, and may reduce asset lifespans. Additionally, the use of on-load tap changers (OLTCs) may transfer issues initiated on the LV network into the HV network.
- **power factor** – Evoenergy’s transmission connection agreement with TransGrid requires a lagging power factor between 0.8 and 1.0 to be maintained at the connection point. This becomes challenging, particularly at times of light load, when there are high levels of DER penetration in the network. The effect is exacerbated by increasingly capacitive loads and a network with high underground asset representation.[4]
- **neutral integrity** – defective neutrals pose risks to safety, property, and equipment. Technology improvements associated with facilitating DER integration present new opportunities to monitor and manage these risks cost effectively at scale.
- **undervoltage** – with the prospect of single phase residential 32A electric vehicle chargers gaining prevalence, undervoltage may become a noticeable issue for customers.
- **additional QoS Attributes** – a significant increase in DER penetration could result in additional power quality disturbances, such as harmonics, being introduced to the network.

10.5 Conclusions

Increasing DER penetration is challenging our ability to meet QoS performance expectations using historical practices. Where there are constrained resources that have not historically been managed proactively, the effects of DER on network characteristics can no longer be considered negligible. There are growing consumer and regulatory expectations for networks to have capabilities that enable smooth management of

[4] This is discussed in more detail in the Gold Creek Zone Substation Technical Study (Mott MacDonald, 2022)

DER integration, and the consequences for failing to update historical practices to meet new challenges are growing.

11. GUIDING PRINCIPLES

With so much change and uncertainty, the focus is on no-regrets proximate steps to retain options in future responses. This is summarised by the following principles:

- Formalise current practices
- Enhance proactive compliance management
- Improve connections maturity

11.1 Formalise current practices

Many of the work practices at Evoenergy have evolved over time as methods for 'getting the job done' that are not formally documented or coordinated. In an unchanging operational environment this can serve a company adequately, however the reasons behind practices can be lost over time. This leaves a company vulnerable to loss of information through staff turnover or to difficulty responding to changes in circumstances. Formalisation of work practices can help to improve the efficiency, repeatability, and accountability for work practices and improvement activities. This is particularly relevant when the importance of these practices, in terms of risk implications and consequences, is growing with a changing operational environment. For these reasons, one of the guiding principles for this strategy is to formalise current practices in the business, making explicit who does what when and why.

11.2 Enhance proactive compliance management

Evoenergy is obliged to run a network with compliant QoS performance. If left unchecked, we would expect complaints to continue growing and QoS performance to deteriorate over time as DER penetration increases. To create a safer, more reliable network that provides more value to customers, we need to identify and act on emerging risks before they impact customers and result in Evoenergy becoming noncompliant. To be a more proactive manager of QoS compliance we will need to invest substantially in capability uplift for timely identification, recording and remediation of emerging issues. This will take time and is likely to be an area of continuing improvement beyond the review cycle of this strategy iteration. As such, the Actions for this guiding principle will have varying levels of maturity.

11.3 Improve connections maturity

With the rate and diversity of connections (particularly for embedded generation) increasing, we need to refine our processes for allocating resources and assessing applications. We aim to have a process that is fair, transparent, and consistent. This will help to ensure that connections proceed in a timely manner, and that any risks to QoS are appropriately understood and managed before any connections occur.

12. ACTIONS

Each of the guiding principles in the previous section provided a high-level guideline to solving the key challenges for QoS. In this section, a set of actions is outlined under each guiding principle for greater specificity on who needs to do what by when. Timeframes are categorised as:

- short term – prior to the 2024-2029 regulatory period.
- medium term – within the 2024-2029 regulatory period.
- long term – ongoing or extending beyond the 2024-2029 regulatory period.

Further detail on specific content, timelines, and resourcing for these Actions will be built out by Action owners through the QoS Community of Practice (which will be established as one of the Actions), and the QoS Operations Plan[5].

Note that medium term and long-term Actions may require short term interim deliverables.

12.1 Formalise current practices

TABLE 7 ACTIONS RELATING TO FORMALISATION OF CURRENT PRACTICES

ACTION	RESPONSIBLE / ACCOUNTABLE (SUPPORTIVE)	TIMEFRAME
Establish line of sight Current state • Historically, QoS activities have been performed largely in isolation from each other, with minimal traceability between the activities and the reasons for performing them. • This iteration of the QoS Strategy improves line of sight between regulatory obligations, business strategy, the ENSMS, and the QoS Strategy. Changes • Develop a QoS Operations Plan that bridges the line-of-sight gap between the QoS Strategy and work practices. Outcome • By improving the line-of-sight picture for QoS throughout the business, Evoenergy will enhance its ability to identify improvement opportunities and obligations, and drive any necessary changes. Additionally, activities that already take place can be more robustly justified to ensure that they continue to be resourced appropriately.	Market Transactions (Planning & Future Networks)	Short term
Improve documentation of current operational processes Current state • Management of customer resolutions relating to QoS enquiries typically occurs on a case-by-case basis with little standardisation and heavy reliance on the accumulated personal knowledge of those undertaking the resolution. • Broken and high resistance neutral issues are inefficiently and inconsistently recorded in ADMS (recorded in free text). Changes • Create documentation for current operational processes that sets out steps and decision points, roles and	Market Transactions (Planning & Future Networks, System Operations)	Short term

[5] The first iteration of a QoS Operations Plan containing this detail will be developed after publication of this iteration of the QoS Strategy. As such, there will be a delay during which the detailed information will not be available.

responsibilities, and timeframe expectations for managing QoS enquiries. • Set guidelines on consistent recording and categorisation of broken and high resistance neutral defects at the point of data entry into the ADMS (failed component part of Incident Forms). Outcome • Build organisational capability by converting existing staff knowledge into organisational artefacts that encapsulate the knowledge. • Realise efficiency gains by routinising processes and reducing problem complexity, with clear steps that can be followed for common enquiries. • Highlight and address any process or resourcing gaps. • Improve accountability, managing expectations both internally and externally.		
Establish of a QoS community of practice Current state • Informal, ad-hoc communication between teams working on QoS. Changes • Formalise communications by establishing a QoS community of practice – a working group that meets regularly to discuss news, issues, and progress against actions. Outcome • Better QoS coordination across the organisation.	Planning & Future Networks (Market Transactions)	Short term

12.2 Enhance proactive compliance management

TABLE 8 ACTIONS RELATING TO ENHANCEMENT OF PROACTIVE COMPLIANCE MANAGEMENT

ACTION	RESPONSIBLE / ACCOUNTABLE (SUPPORTIVE)	TIMEFRAME
Increase availability of LV power quality data Current state • Limited visibility of LV QoS performance. • Limited access to historical network performance data. Changes • Improve coverage of LV network locations (at the NMI and substation level) that have power quality data streams sent to Evoenergy. • Increase variety of QoS parameters logged, including EMF emissions.	Planning & Future Networks (Data & Analytics, Market Transactions, System Operations, Zone Assets)	Medium term

• Establish and populate an accessible storage location for QoS performance data (both raw and processed). Outcome • Sufficient QoS performance data is collected to inform decision-making. • Data is available for use by appropriate parties throughout the organisation.		
Improve capabilities for repeatable QoS analytics Current state • In general, we tend to have reactive confirmation of performance issues rather than early detection or prediction. • Simple voltage alarms are sent to the control room for real-time performance awareness. • Simple voltage alarm-style queries are available for obtaining performance history on LV substation and meter points. • Presentation of analytical insights biases actions towards site-level rather than network-level performance management. • We continue to trial and develop innovative solutions to performance insights and real time performance management aids, with historical projects such as the Streeton Feeder analytics case study, and current projects such as the Converge real time DER control project. Changes • Invest substantial resources into uplifting analytical capabilities for performance assessment and decision support regarding QoS. This is likely to require a combination of in-house development and purchased capabilities. • Extend the generalisability of single site data streams by realising a reliable state estimation system (and breaking down any barriers to its trustworthiness). This is intended to be delivered through the ADMS 3.8 upgrade. • Develop defect identification support tools for analysing incoming data streams, including for neutral integrity issues. • Develop reporting tools that give a network-level view to performance (to complement site-level analytics). Outcome • Available data sources are utilised effectively to extract insights. • QoS performance information is available to decision-makers at network and site levels, enabling early detection of issues.	Data & Analytics (Planning & Future Networks, System Operations)	Medium term

Improve capabilities for actioning proactive insights Current state • Lack of clarity in budget responsibility for QoS interventions that require network augmentation. • Temporary QoS improvement measures are not systematically followed up with permanent measures. • Market-based mechanisms are seldom utilised to alleviate location-based constraints on the network. • Lack of clarity on authority to act regarding customer non-compliances, particularly regarding inverter settings. Changes • Clarify funding streams for QoS-initiated network augmentation (see 'library of well characterised tools' below). [Short term] • Develop a library of customer engagement tools for managing connection compliance. This will require appropriate consultation on customer impacts, as well as legal and brand implications. [Short term] • Upgrade voltage regulation relays at zone substations and investigate more sophisticated LDC schemes. [Medium term] • Continue to enhance maturity in capabilities for real-time capacity management, including dynamic operating envelopes and demand management. [Medium term] • Develop a library of known and well characterised tools for QoS-initiated network augmentation, with decision aids for when and how they should be considered (e.g., on-load tap changer, capacitors, dampers, static synchronous compensators, etc.). This may require trials and performance characterisation. [Long term] • Continue to review and trial tariff structures that enhance cost reflectivity and fairness on the network. [Long term] Outcome • Evoenergy can rectify QoS issues quickly and efficiently when they are identified.	Market Transactions (Zone Assets, Regulatory Pricing, Customer Interactions, Planning & Future Networks)	Short term – long term (see timeframe against individual changes)

12.3 Improve connections maturity

TABLE 9 ACTIONS RELATING TO IMPROVEMENT OF CONNECTIONS MATURITY

ACTION	RESPONSIBLE / ACCOUNTABLE (SUPPORTIVE)	TIMEFRAME
Formalise QoS specific connections processes Current state • Triggers for QoS analysis on connection applications, such as network technical studies, are ambiguous, with	Market Transactions (Zone Assets, Planning & Future Networks)	Short term

many listed as discretionary in embedded generation documentation. • Responsibilities and workflow stages for approving connections that require analysis are not clearly defined. • Expected timeframes for moving through different stages of the approvals process are not well defined or performance managed. • Risks associated with cumulative long-term QoS effects of approving connection proposals are poorly controlled. This is particularly problematic where connection characteristics are changing, such as electrification of vehicles and gas appliances. • Many installers and owners of noncompliant residential-scale embedded generation are unaware of the rules when export or inverter settings do not meet connection requirements. Changes • Develop an end-to-end process map for connection applications from a QoS perspective. Clarify the triggers for involvement of the QoS team, and any tasks, responsibilities, and timeframes for resolving them. • Specify exact requirements for network technical studies (information checklist) in respective embedded generation technical requirement documents. • Improve availability of tools and organisational skillsets for assessing the impact of proposed connections on QoS performance and managing the corresponding risks. This may require software procurement. • Develop community outreach content (factsheets etc.) for educating customers and installers on their embedded generation connection responsibilities. This should draw attention to common issues in a simple and accessible manner. Outcome • Connection proponents and Evoenergy staff have shared expectations on application requirements, steps, and timeframes. • Reduced likelihood of unintended instances of common forms of noncompliance. • Risks associated with connections are managed fairly in the short term and the long term.		
Improve maturity in allocating operating limits Current state • Assessment of QoS disturbance compliance in connection applications uses very basic assumptions. • Static export limits, not necessarily well matched to the capacity of the network. Changes • Enhance maturity in allocating QoS disturbance limits for connecting customers.	Planning & Future Networks (Customer Delivery)	Medium term

• Develop internal capability for managing dynamic operating envelopes. Outcome • Engineering controls in place to ensure that the network remains compliant in the presence of connected disturbances into the future, and to ensure that the allocation process is fair. • Capture mutual benefits from a responsive market. • Utilise the network effectively.			
Review alignment across embedded generation policies Current state • Embedded generation rules have been recently reviewed for internal consistency. Changes • Compare embedded generation, and Service & Installation rules against any documentation developed through the 'Formalise current practices' principle. Update for consistency where necessary. Outcome • Alignment between QoS strategy, QoS operations plan, QoS processes, and embedded generation documentation.	Market Transactions (Planning & Future Networks)	Medium term	

GOVERNANCE

Our approach to implementing, maintaining, and updating the QoS Strategy.

13. ROLES AND RESPONSIBILITIES

The Strategy and Operations group is responsible for the development and maintenance of this QoS Strategy. Specific roles for strategic initiatives are indicated next to the Actions where they are defined in Section 12.

14. REPORTING

Reporting on Strategy progress will occur through the QoS Community of Practice which will be set up as an Action out of this Strategy.

15. REVIEW CYCLES

In addition to ongoing performance monitoring and minor annual updates, this strategy requires a major revision every three years or when triggered by external changes. Examples of triggers that would result in the need for revision are:

- Changes to the organisational structure
- Regulatory or legislative changes (both jurisdictional and national)
- Changes to business risk and valuation tools such as the value framework and network risk register

The responsibility for identifying a trigger for review and undertaking the review sits with the Strategy and Operations group.

The strategy is expected to undergo ongoing minor updates annually and during implementation as actions are completed and new information is obtained. Table 10 provides guidance around the classifications of major and minor reviews.

TABLE 10 – REVIEW CYCLE CATEGORIES

Update Category	Detail
Minor	Examples of minor updates involve refreshing data sources, updating administrative items or amending/adding actions.
Major	Examples of major updates include revision of QoS objectives, or any updates that are initiated by the triggers outlined above.

16. CHANGE MANAGEMENT

Change management should occur in accordance with the Evoenergy Change Management Framework (PO0777).

17. VERSION CONTROL

VERSION	DETAILS	APPROVED BY	DATE
0.1	Initial draft for review.	N/A	10/06/2022
1.0	First publication	Leylann Hinch	21/07/2022
1.1	Review of document for external audience	Leylann Hinch	27/09/2022

18. DOCUMENT CONTROL

DOCUMENT OWNER	PUBLISHED DATE	REVIEW DATE
Group Manager, Strategy & Operations	27/09/2022	22/07/2025

19. REFERENCES

Gosbell, V. (1998). *Understanding Power Quality* (Technical Note No. 1). Australian Power Quality & Reliability Centre. https://eisweb.adeis.uow.edu.au/apqrc/content/technotes/APQRC%20TN001-9806%20Understanding%20Power%20Quality.pdf