Reactive Distribution Augmentation

Business Case

17 January 2024

ERGON ENERGY NETWORK
Part of Energy Queensland

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DOCUMENT VERSION

Version Number	Change Detail	Date	Updated by
1	Initial Version	19/3/2023	Manager Distribution Planning
2	Updated with Latest Figures	29/5/2023	Manager Distribution Planning
3	Updated with Latest Figures and incorporate feedback	23/11/2023	Manager Distribution Planning

RELATED DOCUMENTS

Document Date	Document Name	Document Type
03/10/2019	Distribution Authority No. D07/98, Ergon Energy Corporation Limited	PDF
4/5/2023	Distribution Feeder Augmentation – Capacity and Voltage	PDF

1 SUMMARY

<table>
<tr><th>Title</th><th>Reactive Distribution Augmentation</th></tr>
<tr><td>DNSP</td><td>Ergon Energy</td></tr>
<tr><td>Expenditure category</td><td>☐ Replacement ☒ Augmentation ☐ Connections ☐ Tools and Equipment
☐ ICT ☐ Property ☐ Fleet</td></tr>
<tr><td>Identified need
(select all applicable)</td><td>☒ Legislation ☒ Regulatory compliance
☒ Reliability ☒ CECV ☒ Safety ☐ Environment ☐ Financial
☐ Other
Augment the Distribution Network (11kV, 22kV, 33kV, LV and SWER) as required to meet regulatory and legislative obligations associated with network capacity, voltage, and reliability. This augmentation is reactively driven typically from customer complaints or issues which cannot be predicted or planned.</td></tr>
<tr><td>Summary of preferred option</td><td>The Preferred Option is to provide funding as detailed below such that legislative obligations and customer expectations are met. This expenditure is linked with augmentation that typically results from issues directly raised from customers.</td></tr>
<tr><td>Expenditure</td><td>
<table>
<tr><th>Year</th><th>Previous period</th><th>2025-26</th><th>2026-27</th><th>2027-28</th><th>2028-29</th><th>2029-30</th><th>2025-30</th></tr>
<tr><td>$m, direct 2022-23</td><td>$48.62</td><td>$7.71</td><td>$7.71</td><td>$10.71</td><td>$12.70</td><td>$13.46</td><td>$52.29</td></tr>
</table>
</td></tr>
<tr><td>Benefits</td><td>Compliance with Regulatory and Legislative obligations regarding network capacity, voltage and reliability performance such that issues directly raised by customers are resolved.</td></tr>
</table>

2 PURPOSE AND SCOPE

Ergon Energy operates medium voltage distribution networks at 11kV, 22kV and 33kV as well as a range of 12.7kV and 19.1kV SWER systems. Ergon Energy operates a very different network to most Australian Distribution Network Service Providers (DNSPs) in the National Electricity Market (NEM), typified by small customer numbers, long network distances, large geographical spread of network and subsequent low network densities. The distribution network is made up of approximately 120,000km of overhead powerline and 9,000km of underground cable, with about 1,000,000 power poles and close to 100,000 distribution transformers. With approximately 8% of the total NEM customer base, Ergon Energy's network area is approximately 44% of the total area covered by the networks that form part of the NEM. Ergon Energy operates one of the lowest density networks in Australia which has a large impact on how the network is designed, managed, and operated. It is a largely overhead and radial network which includes one of the largest SWER networks in Australia and the world. The SWER Network is 64,000km in length, supplying around 26,000 customers predominately in regional Queensland.

The Reactive Distribution Augmentation program expenditure is aimed at resolving customer Power Quality complaints by augmenting the Low Voltage network, upgrade overload distribution transformers, maintain statutory clearances, and addressing simple reliability problems. A considerable portion of this program is to resolve issues raised by our customers and communities that are not identified or predicted as part of the planned network analysis and augmentation processes performed on the High Voltage network. The word "reactive" is used as this expenditure is required so that the business can address unforeseen or "reactive" issues raised by customers. This program is primarily focussed on the low voltage network.

The Reactive Distribution Augmentation expenditure is required to maintain the safety of the distribution system through the supply of standard control services. Ergon Energy has obligations under the Electrical Safety Act 2002 (Qld) to inspect, test and maintain works, and a duty to ensure that its works are electrically safe and are operated in a way that is electrically safe. Under the Work Health and Safety Act 2011 (Qld), Ergon Energy must ensure, so far as is reasonably practicable, that the fixtures, fittings, and plant are without risks to the health and safety of any person. Ensuring the safety of our staff, customers and communities is our foremost priority. To discharge these obligations, Ergon Energy must ensure that network assets do not exceed plant capacity ratings, fault ratings, voltage limits or other technical limits that may compromise the safety of the distribution system.

Reactive Distribution Augmentation expenditure is necessary as it enables Ergon Energy to take action to resolve unexpected constraints and issues impacting customers. This Reactive Distribution Augmentation business case seeks to continue to deliver sustainable outcomes for customers and the business, with no compromise to safety and legislative compliance. The objective is to provide an affordable, safe, resilient, reliable, and secure quality of supply to meet the changing needs of our customers.

Growth in peak and minimum demand is a critical aspect that drives reactive augmentation work on the distribution network. Peak and minimum demands do occur at different times in different locations. Ergon Energy must maintain sufficient capacity to supply every home and business on the day of the year when electricity demand is at its maximum or minimum without exceeding network capacity / plant ratings yet still maintain voltages within statutory limits. Whilst the average demand growth in some parts of Ergon Energy's networks has historically been subdued so far, there are many other areas that have strong growth particularly where new property development is occurring, which requires the network to be upgraded, expanded, or modified. Without Ergon Energy's proposed Reactive Distribution Augmentation expenditure, Ergon Energy would not be

able to meet the expected demand for standard control services over the regulatory control period 2025-30.

The Reactive Distribution Augmentation program is made up of individual projects of relatively short duration, with the work typically expected to be constructed within approximately 2 years of projects being issued. Operating on a relatively short duration ensures projects can proceed efficiently with minimum risk of forecast inaccuracy and network reconfiguration changes. Given projects are created approximately 2 years in advance, this business case is not seeking funding for specific existing projects, but rather to continue with augmentation programs of work in these areas of focus.

2.1 Drivers for Investment

In the 2020-2025 regulatory period, system-wide growth on the Ergon Energy network has been moderate. Much of this growth has been driven at a more localised level primarily around the expansion of residential, industrial, and commercial subdivisions, rather than being caused by load increased from the existing customer base. It is expected this will change in the 2025-30 period such that not only will strong localised growth continue, but also significant growth from existing customers. This growth within the existing customer base will be predicated on Australia's and Queensland's acceleration towards achieving net zero. As detailed in AEMOs Electricity Statement of Opportunity 2021(ESSO) which provides and insight into the next 10 years, demand for electricity is expected to increase as part of the energy transformation to Net Zero. Consumers will transition to electric vehicles and households and business will move from carbon-based fuels to electricity. This transition will not only drive increase demand, but also create increased dependency on the reliability of supply to customers and the community.

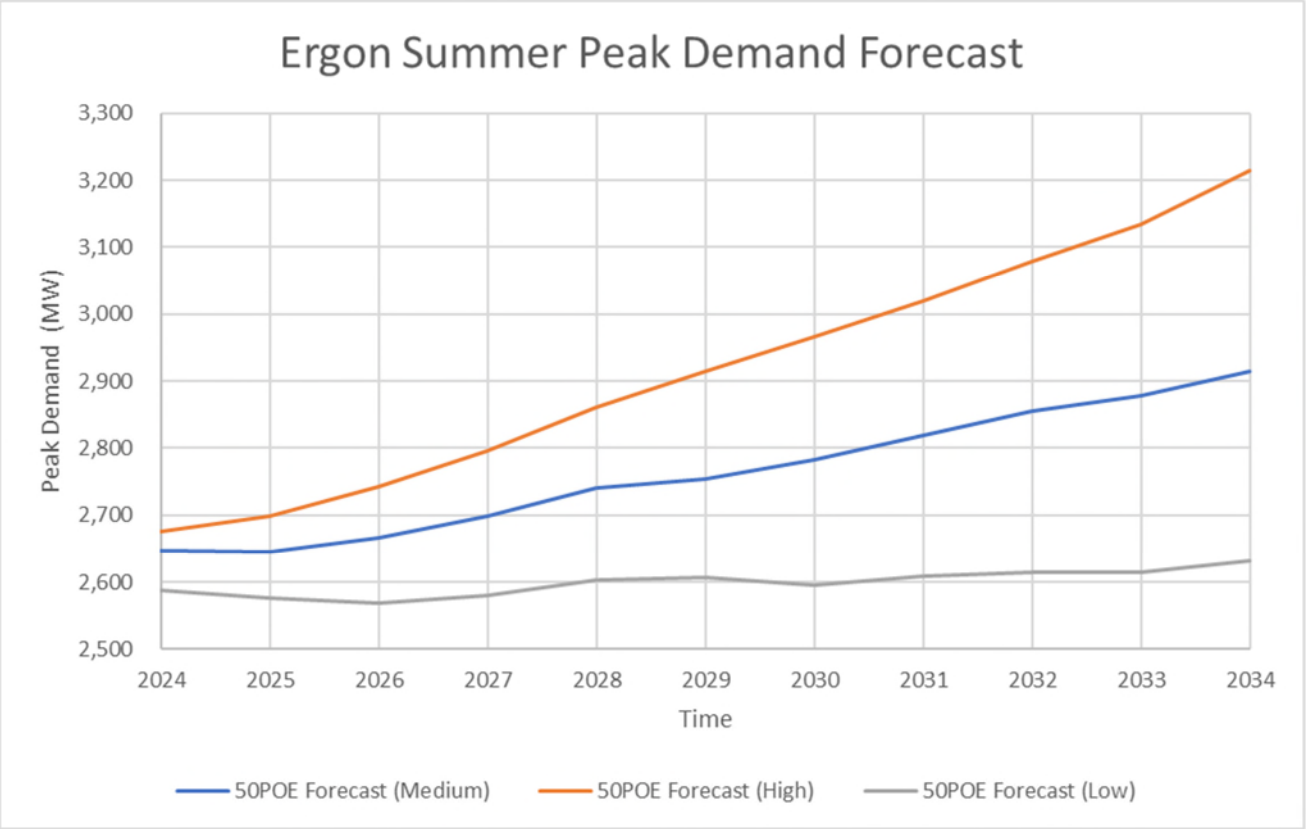
The Queensland Energy and Jobs plan is targeting 60% of energy will be delivered by renewables by 2030 and 70% by 2032. Business es and industries will endeavour to transition from fossil fuel sources to renewable energy supported by the Distribution Network. At a residential level we expect a significant uptake of Electric Vehicles. The Queensland government has announced it's new Zero Emission Vehicle Strategy (source: Queensland's new Zero Emission Vehicle Strategy | Transport and motoring | Queensland Government (www.qld.gov.au)) which details that:

- 50% of new light vehicle sales to be zero emissions by 2030, moving to 100% by 2036
- 100% of eligible Queensland Government fleet passenger vehicles to be zero emission by 2026
- every new TransLink-funded bus will be zero emissions from 2025 in South-East Queensland and from 2025-2030 across regional Queensland.

As customers uptake electric vehicles and convert from gas to electricity it is expected that these changes will first impact the Low Voltage network. This business case is to address those issues which do arise at this level.

Figure 1 details the historic Ergon Energy system wide peak and expected growth into the future.

Figure 1 Maximum Demand Historical and Forecast



2.2 Reactive Augmentation Expenditure Purpose

The majority of Reactive Augmentation Expenditure is required to address more 'operational' type of constraints and issues seen in Ergon Energy network, that are not anticipated, forecasted or planned by any other methodology. The Ergon Energy Low Voltage network has not been modelled to the level of the High Voltage distribution feeders so areas that may be subject to over-loading or voltage constraints cannot be proactively identified by power system planning process utilised for planned network augmentation.

Reactive Distribution Augmentation projects are typically simple lower cost more routine and repeatable type work raised for addressing operational constraints in the Low Voltage / distribution network. Reactive Distribution Augmentation expenditure is used to manage issues such as customer voltage complaints, arial trespass and pole relocations, reactive protection device overload issues and overloaded distribution transformers. The timing for this work is determined by the risk posed by the identified constraint(s). Constraints are generally identified through customer complaints or via power quality monitoring. For this reason, the capital expenditure in this space is reactive following a constraint being confirmed by field measurements and site visits. Once a constraint has been identified, confirmed and risk assessed, a scope is developed for the solution and the necessary approval processes are performed depending on the level of expenditure required.

The customer benefits of the reactive program are:

- Urgent Safety issues are resolved utilising funding from this program.

- Unforeseen constraints that impact on customer's business and household activities are addressed in a timely and efficient manner.
- Unforeseen network operational issues are able to be remediated to limit customer and/or staff impacts.
- Customer quality of supply issues can be addressed in a timely manner.
- Any augmentation performed will be scheduled to be completed at a time appropriate to the level of risk that exists and in a manner which minimises costs.

A more detailed explanation of the individual components associated with this business case are detailed below:

Uprate Pole Transformer

Uprate of Pole transformers is focussed on managing overloaded pole mounted distribution transformers. The main solutions are to replace the existing overloaded transformers with larger units or alternatively install a new distribution transformer to take load off the existing unit. Loading issues are typically discovered through customer complaints, network monitoring or predictive modelling that is then followed up with real time measurements. This does not include condition-based replacements (that are typically non-proactive and upon failures).

Uprate Padmount Transformer

Uprate of Padmount transformers is focussed on managing overloaded padmount distribution transformers. The main solutions are to replace the existing overloaded transformers with larger units or alternatively install a new distribution transformer to take load off the existing unit. Loading issues are typically discovered through customer complaints, network monitoring or predictive modelling that is then followed up with real time measurements. This does not include condition-based replacements.

Maintain Network Reliability

This program is targeted at reactively resolving reliability problems typically associated with overloading that emerge on the network and need to be addressed. Issues will be identified typically through fault reporting or customer complaints. Some typical issues include:

- Fuses blowing due to loading.
- Reclosers tripping due to load encroachment with over current settings and protection limitations.
- Lack of primary protection reach.

The physically work includes the installation of Load Break Switches, Master Drop Out (MDO) fuses, sectionalises & reclosers to address the loading and protection issues. Without remediating these issues, customers will continue to experience ongoing and regular outages due to overloading of plant and protection devices. Additionally, without having primary protection reach, Ergon Energy will be in breach of Part 9 Division 2 of Queensland Electrical Safety Regulation 2013.

Customer Voltage Improvement Remediation Work

The Customer Voltage Improvement Remediation program involves minor augmentation work to address voltage and Quality of Supply issues on the network driven through customer queries/complaints. Rectification of voltage complaints often involves the following solutions:

- Re-conductoring of the Low Voltage network with larger conductor to improve voltage performance. This includes both voltages drop due to load and voltage risk associate with excessive solar generation.

- Installation of additional transformers to reduce load and thereby improve voltage performance.
- Installation of switching points and transferring load.
- Better balancing customers over the three phases to address voltage unbalance issues.

Maintain Statutory & Standard Requirements

CA50 involves capital solutions to rectify priority network defects relating to non-standard network conditions. This is an area that is being closely monitored and overseen by the Electricity Safety Office of Queensland. Solutions are targeted to ensure Ergon Energy complies with Electrical Safety Regulation (2013) and Electrical Safety Act 2002 and some typically examples include:

- Installation of new stays and stay poles.
- Rectification of below statutory height mains.
- Rectification of non-standard service arrangements.
- Relocation of overhead & UG mains for example to address trespass issues.

3 IDENTIFIED NEED

Various sub-programs of this investment have different regulatory compliance drivers. Table 1 details the drivers of each component that make up this Reactive Distribution Augmentation business case. As detailed in this table all categories of this program are compliance driven.

Table 1 Distribution Augmentation Justification Matrix

Program	Sub Program	Justification	Justification Detail
Reactive Distribution Augmentation	Uprate Pole Transformer	Compliance-Regulatory Obligation	Electrical Safety Regulation (2013) and Electrical Safety Act 2002
Reactive Distribution Augmentation	Uprate Padmount Transformer	Compliance-Regulatory Obligation	Electrical Safety Regulation (2013) and Electrical Safety Act 2002
Reactive Distribution Augmentation	Maintain Network Reliability	Compliance-Regulatory Obligation	Electrical Safety Regulation (2013) and Electrical Safety Act 2002
Reactive Distribution Augmentation	Customer Voltage Improvement Remediation Work	Compliance-Regulatory Obligation	Queensland's Electricity Regulation 2006, AS 60038 and AS61000
Reactive Distribution Augmentation	Maintain Statutory & Standard Requirements	Compliance-Regulatory Obligation	Electrical Safety Regulation (2013) and Electrical Safety Act 2002

3.1 Compliance

Ergon Energy has an obligation to comply with the Electrical Safety Regulation (2013) and Electrical Safety Act 2002 when managing network capacity. When managing voltage, compliance is required with Queensland's Electricity Regulation 2006 and Chapter 5 of the National Electricity Rules. The work required to address Non-compliance is a regulatory obligation and has not been justified by applying an investment value stream methodology/ resulting cost-benefit analysis.

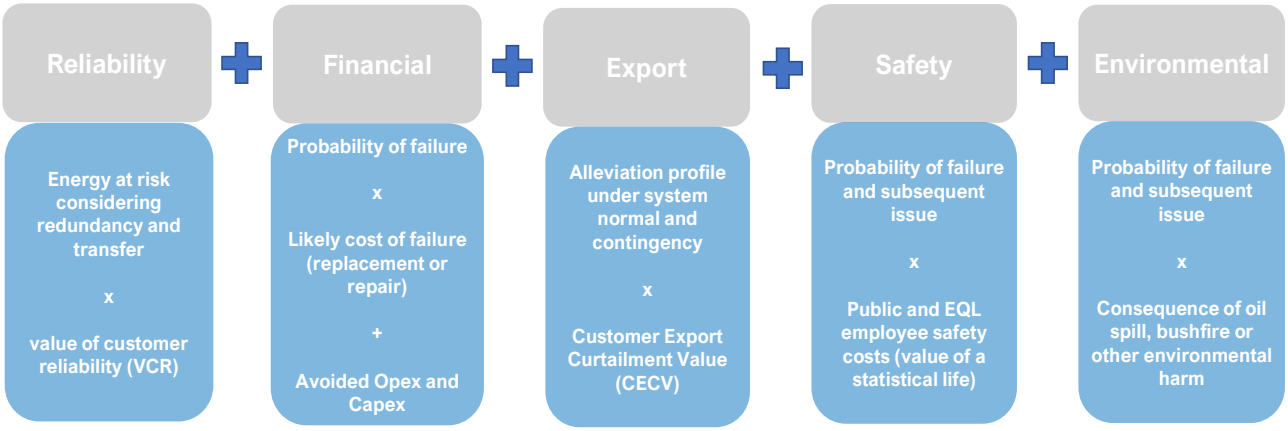
3.2 Counterfactual Analysis

The identified need outlined in this business case to address capacity and voltage requirements is a regulatory obligation. As this work is compliance driven there is no counterfactual, however, individual projects which make up this program will be based on the lowest cost to meet Ergon Energy's obligations.

3.2.1 Summary

Energex broadly considers five value streams for investment. These are shown in Figure 2.

Figure 2– Value Streams for Investment



3.3 Impact of Doing Nothing

By doing nothing, Ergon Energy will fail to meet the regulatory obligations. By not addressing these obligations, customers supplied from these feeders, or feeder sections, will experience unacceptable voltage performance and network plant and equipment will be loaded beyond plant capability. That does not comply with the requirements detailed under Electrical Safety Regulation (2013) and Electrical Safety Act 2002 for Capacity and Queensland's Electricity Regulation 2006, AS 60038, AS61000 and Chapter 5 of the National Electricity Rules for voltage.

By doing nothing complaints customers have lodge directly with Ergon Energy or the Energy and Water Ombudsman will remain unaddressed. Voltage and capacity issues will remain, and network reliability Guaranteed Service Level expectations detail in the Distribution Authority - D01/99 for ergon energy will not be met.

3.4 Optimal Timing

The individual projects that make up the Reactive Distribution Augmentation program are typically shorter duration projects of two years and under. Operating on a relatively short duration ensures projects can proceed efficiently with minimal risk of timing inaccuracy. The project timing is created to meet the associated timing of constraints and associated regulatory obligations. This business case is predominantly driven by customer complaints and unforeseen issues that emerge on the network over time.

The programs of work presented in this business case are formed by a large number of smaller projects. A prudent level of investment is assured by prioritising the timing and need for projects that make up this program based on risks, ensuring a range of viable alternative options are considered to minimise the cost and optimise the timing of any investments made within the

network. Each individual investment that forms part of this program will be approved via an individual stand-alone business case and financial delegate approval before funding is released.

4 RECOMMENDATION

It is recommended to establish the program or work and breakdown as detailed in this business case. Table 3 summarises the key components of this program.

Table 2 Options Analysis Scorecard

Criteria	Detail
Net Present Value	Only applicable for investments that make up this program that are not a regulatory requirement.
Investment cost (TCO)	$52.29m
Investment Risk	Medium
Benefits	Meet Regulatory Obligations, Network Reliability Expectations
Delivery time	This business based is for a rolling program made up of numerous individual projects that typically have a life cycle of less than 24 months
Detailed analysis – Benefits	By implementing this business case Ergon Energy will be able to meet its regulatory requirements in terms of capacity and voltage management of the network. Network reliability performance will also be addressed by economically justifiable (with Net Present Value positive) investments. Additionally, customer complaints will be able to be addressed.
Detailed analysis – Risks	This business case does not consider constraints in the 2020-2025 regulatory period that have not been addressed during the 2020-2025 period. As such the expenditure stated in this business case does not consider work/investments that carry over from the 2020-2025 period into the 2025-2030 period.
Detailed analysis - Advantages	This option results in a distribution network where capacity and voltage are managed and customer complaints are addressed, as well as ensuring optimised investment around reliability.

Appendix 1: Alignment with the National Electricity Rules

Table 3 Recommended Option's Alignment with the National Electricity Rules

NER capital expenditure objectives	Rationale
A building block proposal must include the total forecast capital expenditure which the DNSP considers is required in order to achieve each of the following (the capital expenditure objectives):	
6.5.7 (a) (1) meet or manage the expected demand for standard control services over that period	Section 2.2 and Section 3
6.5.7 (a) (2) comply with all applicable regulatory obligations or requirements associated with the provision of standard control services;	Section 3
6.5.7 (a) (3) to the extent that there is no applicable regulatory obligation or requirement in relation to: (i) the quality, reliability or security of supply of standard control services; or (ii) the reliability or security of the distribution system through the supply of standard control services, to the relevant extent: (iii) maintain the quality, reliability and security of supply of standard control services; and (iv) maintain the reliability and security of the distribution system through the supply of standard control services	Section 3
6.5.7 (a) (4) maintain the safety of the distribution system through the supply of standard control services.	Section 4
NER capital expenditure criteria	**Rationale**
The AER must be satisfied that the forecast capital expenditure reflects each of the following:	
6.5.7 (c) (1) (i) the efficient costs of achieving the capital expenditure objectives	Section 4
6.5.7 (c) (1) (ii) the costs that a prudent operator would require to achieve the capital expenditure objectives	Section 4
6.5.7 (c) (1) (iii) a realistic expectation of the demand forecast and cost inputs required to achieve the capital expenditure objectives	Section 2.1

Appendix 2: Reconciliation Table

Table 4 Reconciliation

Expenditure	DNSP	2025-26	2026-27	2027-28	2028-29	2029-30	2025-30
Expenditure in business case $m, direct 2022-23, aligns with the input sheet in the Capex model	Ergon Energy	$7.71	$7.71	$10.71	$12.70	$13.46	$52.29

Appendix 3: Glossary

Term	Definition
10 PoE Forecast	Peak load forecast with 10% probability of being exceeded in any year (i.e. a forecast likely to be exceeded only once every 10 years), based on normal expected growth rates and temperature corrected starting loads. 10 PoE forecast load is not to exceed NCC for system normal (network intact) in all cases excepting distribution substations network element category.
50 PoE Forecast	Peak load forecast with 50% probability of being exceeded in any year (i.e. an upper range forecast likely to be exceeded only once every two years), based on normal expected growth rates and temperature corrected starting loads.
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
CAPEX / capex	Capital Expenditure
Cyclic Load	Power load that occurs in such a way that periods of overloads are followed by periods of light load. A piece of equipment may be cyclically loaded and its life expectancy not reduced, if the accelerated rate of deterioration of the insulation during heavily loaded periods, is counterbalanced by the decelerated rate of deterioration during the light loaded periods.
DA	Distribution Authority
DER	Distributed Energy Resources
DF	Distribution Feeder
DNSP	Distribution Network Service Provider
EV	Electric Vehicle
Feeder Utilisation	Percentage of feeder rating utilised under network maximum demand conditions with thermal rating of the feeder measured at the time and season of maximum demand.
High Voltage (HV)	(1.) For distribution networks in Australia, HV normally refers to 11,000 V or higher. (2.) For the purpose of the Electrical Safety Act 2002 (Qld), HV is defined as voltage above 1000V AC or 1500V DC. (3.) HV and LV may also be used to distinguish between the higher voltage side of a transformer and the lower voltage side of a transformer.