Pole Replacements

Business Case

18 November 2024

Part of Energy Queensland

CONTENTS

REFERENCED DOCUMENTS

Document Number	Document Name	File Type
5.5.01A	Ergon - 5.5.01A - Repex Ex-Post and Ex-Ante Narrative Document - November 2024 - public	PDF
5.5.01B	Ergon - 5.5.01B - Cost Benefit Analysis Enhancement Presentation - October 2024 – public	PDF
5.5.02B	Ergon - 5.5.02B – Cost Benefit Analysis Pole Examples - November 2024 - public	Excel
5.5.02C	Ergon - 5.5.02C – Cost Benefit Analysis NPV Poles Model - November 2024 - confidential	Excel
5.2.02L	Ergon - 5.2.02L - Repex Poles Root Cause Analysis - November 2024 - public	PDF
5.5.01C	Ergon - 5.5.01C - RIN Repex Forecast Model Report – October 2024 - confidential	PDF
5.5.01D	Ergon - 5.5.01D - RIN Repex Forecast 2025-30 Revised Submission – October 2024 - public	Excel
5.5.02D	Ergon - 5.5.02D - Defect Bundling Scenario – October 2024 - public	PDF
5.5.01E	Ergon - 5.5.01E – Model validation- Reliability Cost Estimation – November 2024 - public	Excel

1. SUMMARY

Title	**ERG Poles Replacements AER 2025-30**
DNSP	Ergon Energy Network
Expenditure category	☒ Replacement ☐ Augmentation ☐ Connections ☐ Tools and Equipment ☐ ICT ☐ Property ☐ Fleet
Purpose	The purpose of this business case is to: - Justify the step change from pre 2018/19 volumes to increased volumes of replacements during the ex-post period (2018-23) due to root cause analysis undertaken of pole failures, addressing low strength poles and the resulting backlog of pole replacements due to changes to inspection cycles - Justify the cost benefit analysis (CBA) outcome that supports the step change in volume of replacements during the ex-post period - Demonstrate that this justification necessitates the volume of replacements into the 2025-2030 period as a continuation of business-as-usual (BAU).
Identified need	☒ Legislation ☒ Regulatory compliance ☒ Reliability ☐ CECV ☒ Safety ☒ Environment ☒ Financial ☐ Other Investment in the replacement/reinforcement of poles is required to comply with legislative and regulatory obligations and to maintain service level of our customers. Ergon Energy has a regulatory obligation as outlined in the Electrical Safety Code of Practice (ESCOP) 2020 Works Section 5.1 that states "*An electricity entity should have a maintenance system that achieves a minimum three-year moving average reliability against the incidence of failure of 99.99 per cent a year. Special consideration should be given to poles in areas of higher risk, such as 'cities and towns*". Unassisted pole failures went above the ESCOP threshold in 2018/19 and has consistently been above the three-year moving average since then, with over 105 failures, exceeding the limit and our obligations with ESCOP. These failures were increasing due to the increasing age of low strength timber poles, rot and termite damage. In 2018/19, significant analysis, research and risk assessments were completed due to the concerns surrounding field crews working on low strength poles (i.e. ≤5kN) and the increasing failure rate of this size of pole. This led to significant changes being made to the pole serviceability calculations and a range of other components of the asset management approach for low strength wood poles. This strategy has improved our asset performance and indicates that we need to continue with similar replacement volumes at a minimum to maintain our service level performance. This will ensure we maintain failure and defect rates at an acceptable level. Following the identification of a defective pole, we also conduct an evaluation of the condition of the equipment / assets affixed to the pole to determine whether it is feasible and cost-effective to replace the other equipment at the same time (consequential bundling). This equipment may include pole top structures / crossarms, transformers, service lines and switches.

Title	**ERG Poles Replacements AER 2025-30**
Summary of options considered	Six options were considered and compared against the counterfactual replacement option in order to meet the identified need: 1. Replace Failed Poles Only (Wood) | Total replaced units: 570 2. Low Volume Option (Wood) | Total replaced units: 25,000 **3. Actual 3 year average (Wood) | Total replaced units: 83,000 (recommended)** 4. Actual 3 year average (Concrete) | Total replaced units: 83,000 5. Actual 3 year average (Composite) | Total replaced units: 83,000 Actual 3 year average + 10,000 Low Strength Poles (Wood) | Total replaced units: 133,000.
Expenditure for Proposed Option	Ergon Energy delivered 16,631 poles per annum in 2020/21 to 2022-/23 based on the average three-year historical defect volume, which reflects the step change due to the root cause analysis, revised serviceability calculations and changes to inspection cycles. Ergon Energy is proposing to continue the step change in the volume of pole replacements delivered in the ex-post period into the ex-ante period, which is approximately 16,600 poles per annum. Proposed replacement expenditure (repex) for poles and consequential replacements of other assets bundled with pole replacements for 2025-30 regulatory period are outlined in the table below.

Year $m, direct 2024-25	**2025/26**	**2026/27**	**2027/28**	**2028/29**	**2029/30**	**Total**
Pole replacement	85.3	85.7	86.1	86.6	87.2	431.0
Pole reinforcement	9.6	9.6	9.7	9.7	9.8	48.4
Pole Intervention Total	**94.9**	**95.4**	**95.8**	**96.3**	**97.0**	**479.4**
Consequential Pole-top	30.8	31.0	31.1	31.3	31.5	155.6
Consequential Services	6.2	6.2	6.3	6.3	6.3	31.3
Consequential Distribution Transformer**	7.8	7.8	7.9	7.9	8.0	39.5
Consequential Switchgear **	7.7	7.7	7.7	7.8	7.8	38.7
Consequential Total	**52.5**	**52.7**	**53.0**	**53.3**	**53.6**	**265.0**
Grand Total	**147.4**	**148.1**	**148.8**	**149.6**	**150.6**	**744.4**

Title	ERG Poles Replacements AER 2025-30
	*** Consequential distribution transformer & switchgear – Ergon Energy has accepted the AER alternate forecast as per Draft Decision.*
Preferred Option	Ergon Energy is committed to adopting an economic, customer value-based approach to ensure the safety and reliability of the network. The benefit of the preferred option and outcome is supported by Net Present Value (NPV) modelling. This commitment is in line with our strategic direction and efforts to maximise the value for our customers. A review in 2018/19 identified that unassisted pole failures were above the three-year rolling average and adherence to a legacy strategy meant defective poles were remaining in service for longer than they should have. This meant the ex-post period saw identification and replacement of a higher volume of poles to reduce the failure rate within the prescribed threshold, manage defective pole volumes and maintain service levels to customer. From the CBA, it is demonstrated that Option 3 is the most prudent and efficient option that delivers the greatest benefits and improves the service level outcomes for our customers compared to the pre-expost period. . In our Ex-ante period, the preferred option will replace poles with wood poles, and introduce composite material where possible (in bushfire and termite prone areas) and maintain supply chain management, at the optimised volume of 16,600 per annum in order to maintain the current performance, with a focus on optimising existing processes and enhancing efficiencies where possible.

2. PURPOSE AND SCOPE

The purpose of this document is to:

- justify the step change from pre 2018/19 volumes to increased volumes of replacements during the ex-post period (2018-23) due to root cause analysis undertaken of pole failures, addressing low strength poles and the resulting backlog of pole replacements due to changes to inspection cycles.
- Justify the CBA outcome that supports the step change in volume of replacements during the ex-post period.
- Demonstrate that this justification necessitates the volume of replacements into the 2025-2030 period as a continuation of BAU.

The proposed pole replacement program is in accordance with lifecycle management strategies detailed in the Asset Management Plan. CBA has been completed to demonstrate that the step change in our actual delivery during the ex-post period was efficient and provided benefit to our customer. The analysis of the volumes and expenditure in the ex-post period supports the basis for the investment of our ex-ante 2025-30 period.

This business case covers both the costs and benefits directly associated with replacement of poles. This document is to be read in conjunction with the Attachment 5.5.01A.

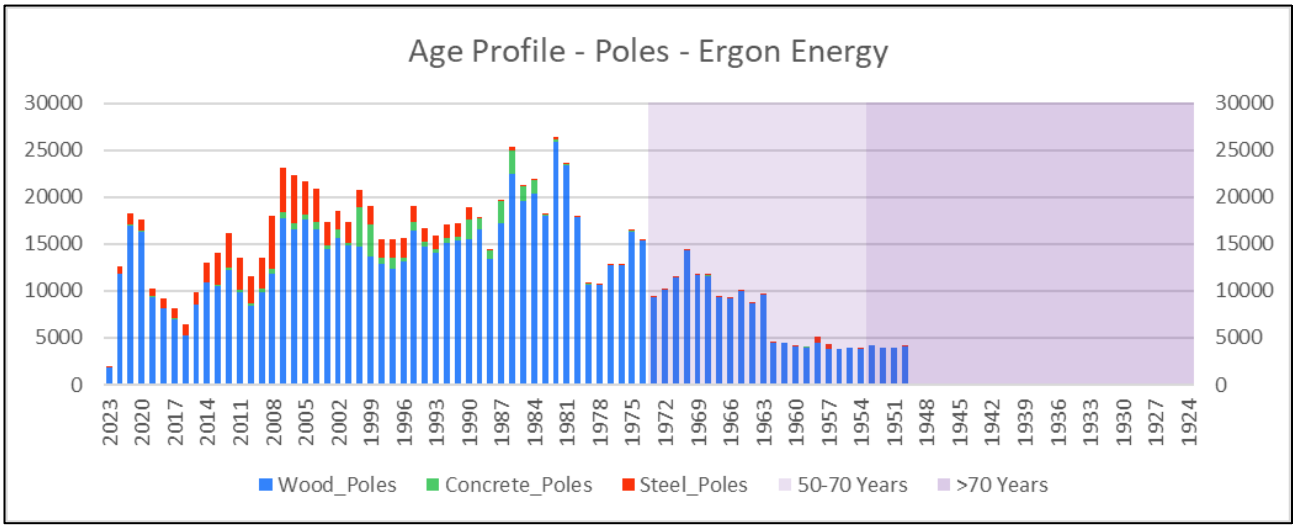
All dollar values in this document are based upon direct 2024-25 dollars and exclude overheads.

3. ASSET PORTFOLIO

3.1 Asset Population

Ergon Energy has a total of 981,669 poles, with approximately 871,300 wood poles, as detailed in Figure 1. Approximately 19% of the current Ergon Energy pole population is older than 50 years old, with another 5% of the population due to reach this age in the next 5 years.

Figure 1: Network Pole Age Profile



The predominant timber species of Ergon Energy's timber poles is Spotted Gum at around 46% of the total population, therefore it is also the predominant species of pole that is being replaced. There are 46 different species of timber poles (including those that are unknown) used in the Ergon Energy network. In addition to rotting caused by the sub-tropical climate, termite damage is another significant cause of unserviceable poles in all areas, but particularly in Ergon Energy's western areas, with the two most damaging termite species found in Australia being prevalent in Ergon Energy's network.

Ergon Energy's poles are separated into an East and West region of Queensland with approximately 51% in Eastern regions and 49% in Western areas. The distinctions between these regions include:

Eastern region

- The replacement to nailing ratio is approximately 60:40.
- 5kN poles are the predominant pole size that becomes unserviceable, many of which are in rural areas.

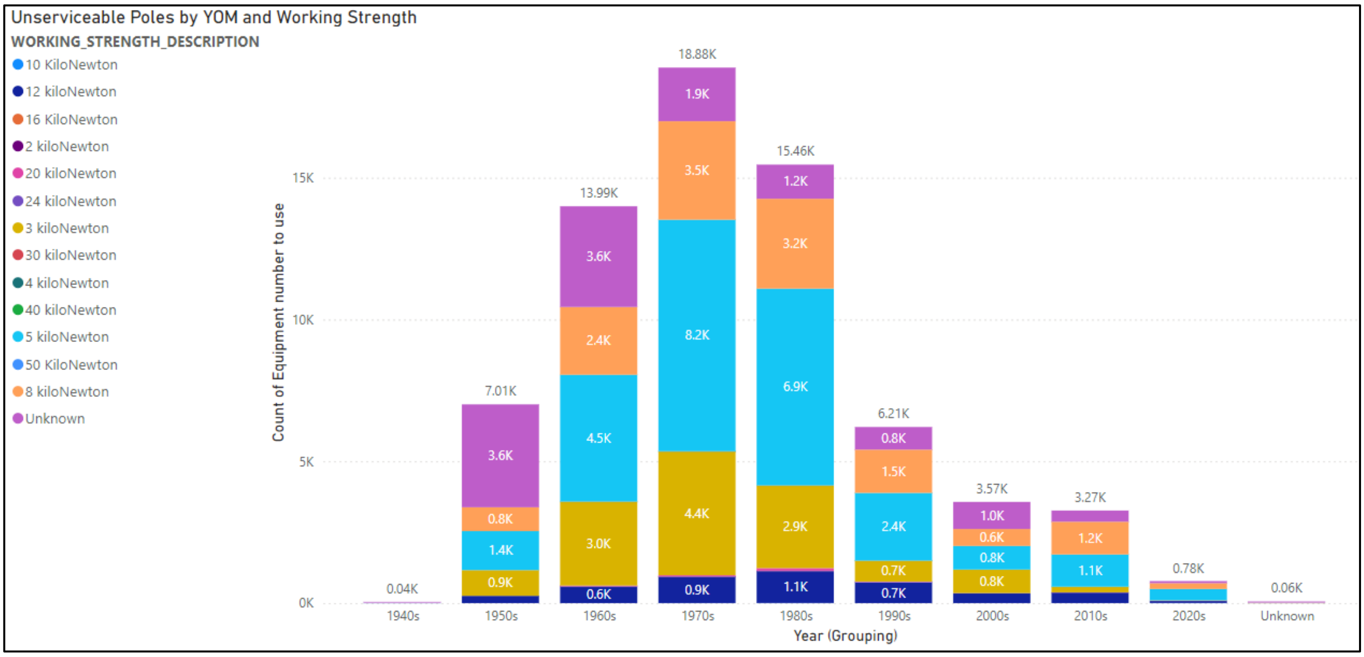
Western region

- 73% of 3kN poles installed in Western areas prior to 1990.
- 3kN Single Wire Earth Return intermediate poles dominate the unserviceable poles and failure rates in Western areas.

- The replacement to nailing ratio is approximately 80:20 (unable to nail many 3kN poles)
- Increased nailing from 2021 due to a change to enable nailing of poles with a calculated limit state strength between 4.5kN and 5kN.

Figure 2 shows information about the year of manufacture of the poles that are unserviceable and the working strength of these poles. The data shows that most of the poles that are unserviceable are aged greater than 40 years old with a high volume have a 5kN and 3kN strength rating.

Figure 2 : Unserviceable poles by year of manufacture



3.2 Historical Asset Performance

Table 1 presents the two main functional failures of Poles.

Table 1 : Description of Functional Failure

Functional Failure Type	Description
Catastrophic **(unassisted failure)**	Loss of structural integrity of a pole, excluding any associated hardware or crossarm mounted plant, such that the residual strength of the component required immediate intervention. Functional failure of this asset under normal operating conditions not caused by any external intervention such as abnormal weather or human.
Degraded (**defect**)	A pole asset deemed defective based on serviceability calculation criteria and if not rectified within a prescribed timescale (P0/P1/P2) could cause an unassisted catastrophic failure.

3.2.1 Pole failures

Concerns with increasing pole failures led to an improvement in data collection of defective poles in 2017/18 followed by a review of the pole strength calculation (also called serviceability calculation) in early 2019 leading to the following changes:

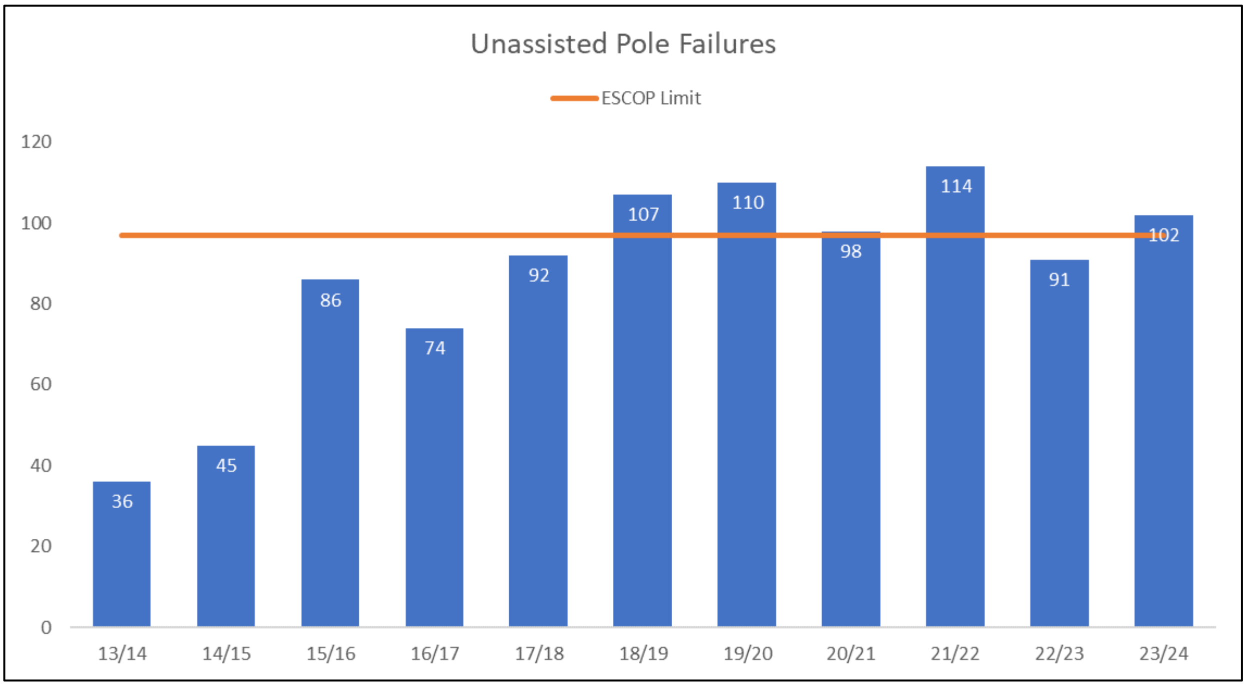
- reduced the pole inspection cycles to five years in alignment with the ESCOP requirements
- improved field staff training in data capture and collection
- improved pole inspection serviceability calculations to increase the accuracy in the estimation of residual pole strength, the classification of unserviceable poles and the estimation of pole health and probability of failure in current and future years.

These changes and decisions that impacted the asset management practices for poles led to an increase in defect rates being detected, resulting in a higher level of investment in pole remediations during the ex-post period (2018-23).

The total number of unassisted pole failures is shown in Figure 3. The majority of failures is contributed by wood poles which make up approximately 89% of the pole population but represent 99.7% of the unassisted pole failures, mainly due to degradation caused by rot and termites.

Our failure data indicates that pole failures are currently averaging 105 poles per year with yearly fluctuations. Figure 3 shows that this is above the three-year moving average limit of 97 poles per year; a reliability limit set out by the ESCOP of 1:10,000 pole failures (i.e. a failure rate of 0.01% per year). The 3-year rolling average has exceeded the ESCOP requirement in all but three months (September – November 2023) since January 2020.

Figure 3 : Unassisted Pole Failures



In terms of unassisted pole failures and unserviceable poles:

- 3kN poles installed as SWER intermediate poles in western areas are the primary pole construction that have driven the higher replacement rates.
- there are still 94,000 3kN poles in the network in-service and it is likely that rate of unassisted pole failures will increase.
- an intervention program option, such as a dedicated program to replace 3kN poles in Western areas has been considered as a prudent.

Given the increasing trend in pole defects from 2017/18, we considered there was a genuine need to address this increasing trend during the ex-post period.

As the reliability performance for poles has a regulatory standard set via the ESCOP, occurrence of in-service pole failure in urban areas has much higher associated risk, due to the higher likelihood of public presence. The desired level of service for poles in the Ergon Energy network is to achieve in-service pole failure numbers which deliver a safety risk outcome which is considered So Far As Is Reasonably Practicable (SFAIRP), and as a minimum, maintains current performance standards.

3.2.2 Pole defects

Identified defects are scheduled for repair according to a risk-based priority scheme (P0/P1/P2/C3/no defect). The P0, P1 and P2 defect categories relate to priority of repair, which effectively dictates whether normal planning processes are employed (P2), or more urgent repair works are initiated (P1 and P0).

The defect data indicates a step change between 2018/19 and 2019/20, approximately doubling the identified unserviceable poles requiring remediation.

The primary reason for this step change between 2018/19 and 2019/20 are the changes made to the pole serviceability calculations, resulting in more poles being assessed as unserviceable by calculation and requiring replacement or reinforcement. Additionally, reduction in the inspection cycle from six and eight years to five years along with the improvement in data quality and recording system has contributed significantly to rising number of identified defects over the years.

3.3 Asset Management

3.3.1 Overview

Poles are very high volume, relatively low individual cost assets, and are managed on a population basis through periodic inspection for condition and serviceability. Poles are currently inspected and tested every five years and assessed for serviceability based on clear criteria set out in the Network Schedule of Maintenance Activity Frequency Master 2024-25 in compliance with our Poles and Towers Asset Maintenance Strategy. Pole serviceability is driven by well-established inspection programs which identify severe structural strength degradation. Structural strength is determined in accordance with AS/NZS7000:2010.

All the poles reinforced or replaced are based on their condition failing to meet the acceptance criteria through visual inspection assessment or serviceability calculation and are classified as defective as per descriptions in Standard for Classifying the Condition of Network Assets. Pole reinforcement by nailing/staking is considered effective to prevent failure and replacement due to decay caused by the soil and hostile ground conditions and hence providing a life extension of 10-15 years.

Under Section 5.3.4 of the ESCOP, if a pole has been determined a suspect pole, it should be reassessed within three months, and all unserviceable poles should be replaced or reinstated within six months.

Pole Stays are an important part of the mechanical support system for poles and structures, used to balance the forces imposed at the top of a pole or structure. Stay systems typically consist of a conductor that is tied to buried steel screw anchors, wooden bed logs (now obsolete) or concrete blocks. These systems may also include a dedicated stay or bollard pole.

Failure of the stay cable or rod can result in the pole falling or leaning, impacting energised conductor heights. Over time, stay rods have corroded below ground and the legacy hardwood bed logs have deteriorated and rotted, reducing their foundational strength. There is no practical way to detect this below ground degradation. Analysis has shown that deterioration visible at and above groundline is not always a reliable indicator of below-ground condition.

Stay replacement is typically undertaken based on the standards defined in the Lines Defect Classification Manual or in association with pole replacement works. Stays may be proactively replaced where criteria indicates that assets are either at or end of life can be identified. As the stays are not a uniquely identified assets, in the RIN profile, as per the historical apportionment, the expenditure for this investment is integrated into distribution asset investments.

3.3.2 Background

In 2018/19 Ergon Energy comprehensively reviewed our pole inspection, serviceability assessment and methodologies after experiencing a rising trend of pole failures because of the increasing ages of low strength timber poles as well as rot and termite damage causing safety/reliability concerns. This review ensured that our pole management practices were better aligned with industry best practice.

This review was commissioned to enable us to accurately model and assess our pole health and serviceability and allowed us to ensure the provision of a safe and reliable electricity distribution network for our customers in urban, rural and regional Queensland.

In addition, we have made significant improvements to the quality of the failure data, the data gathered by pole inspectors in the field and the data systems which rely on the pole data. The improved failure data capture has uncovered an escalating unassisted pole failure rate, particularly in poles with a low nominal strength.

The changes made to pole serviceability calculations included:

- moving from a Factor of Safety and working strength calculation to a Limit State calculation in line with overhead design calculations and standards.
- implementing changes to the Characteristic Bending Strength values for pole strength groups to align with the requirements of AS/NZS 7000:2010[1] and overhead design calculations.
- adding additional Pole Structures to enable a more accurate pole tip load comparison across the population and incorporate changes to account for the requirements of Wind Region C (Wind Region C is defined as “Cyclonic” with wind speeds of up to 238km/h).
- introducing a new serviceability threshold of Minimum Calculated Limit State Strength. Calculated Limit State strength must be ≥ 5kN Limit State to be serviceable before moving to a level 2 actual load calculation.
- changes to pole nailing criteria to cease nailing specific unserviceable poles with <30mm wall thickness, untreated/natural poles and for poles that have <50% remaining wood at groundline.

In 2014/15, a decision was made to adopt six and eight-year inspection cycles for specific pole subsets. Key impacts and considerations included:

- **Inspection Cycle Changes**: Approximately 180,000 poles moved to six or eight-year cycles, resulting in an average inspection cycle of 4.5 years, which allowed defective poles and other defects to remain in service up to four additional years.
- **Impact on Low-Strength Poles**: Many poles moved to a six-year cycle were in low-risk rural areas with low customer density, smaller conductors and tip load requirements, and installation of smaller, low-strength (3kN) poles. This decision contributed to an increase in unassisted failures among 3kN low-strength poles.

It should be noted that inspection volumes increased in FY21 due to the decision made to remove the six and eight-year cycles and revert to a consistent 5-year compliance target in accordance with the ESCOP, which contributed to a higher volume of unserviceable poles per year.

Figure 4 below shows the breakdown of the impact of the changes made to the serviceability criteria to pole replacements.

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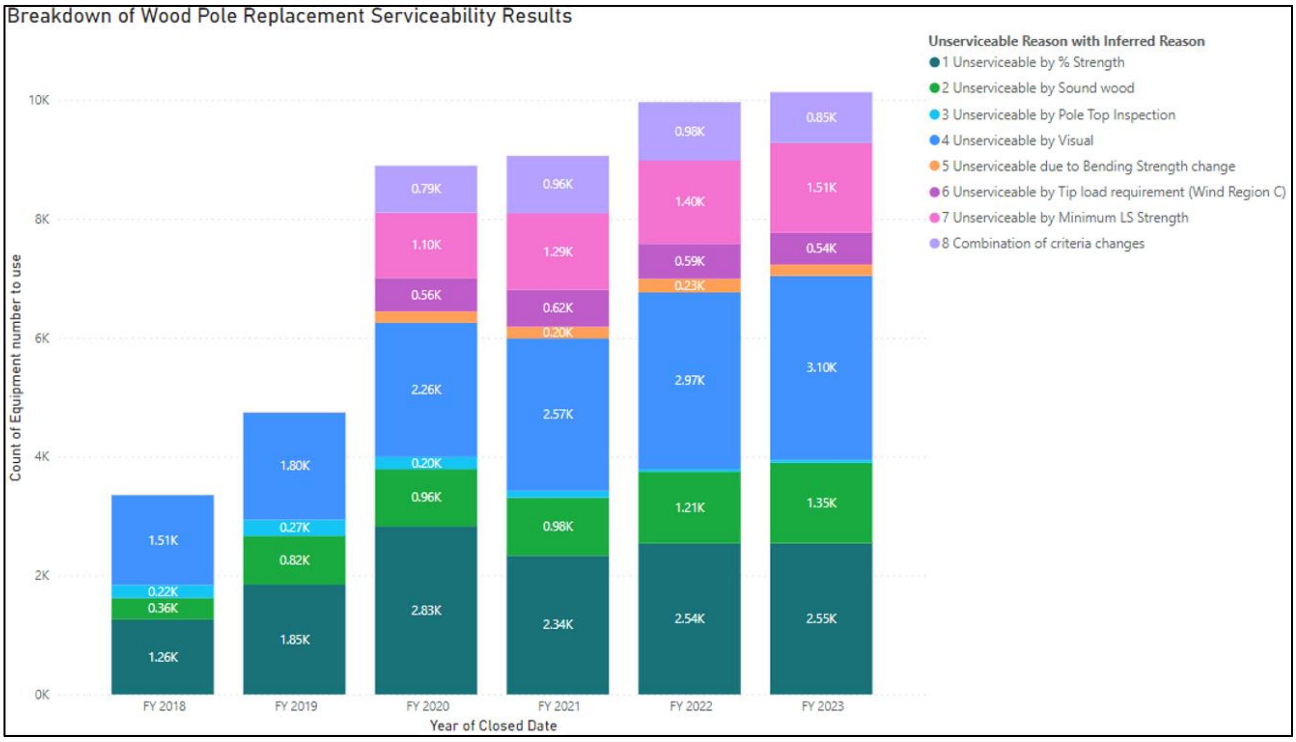
[1] Noting that Essential Energy also aligns with the requirements of AS/NZS7000:2010

Figure 4 : Impact of changes to serviceability calculation to unserviceable volumes



These efforts resulted in a significant rise in the number of defects identified, which required remedial actions, including replacement/reinforcement commencing 2018/19.

4. OPERATING ENVIRONMENT

4.1 Benchmarking and Comparison to Other DNSPs

4.1.1 Energex

Since the 2016 merger of Ergon Energy and Energex into the consolidated entity, Energy Queensland, Ergon Energy has streamlined some of our practices with Energex where it is prudent and efficient but also practical to do so based on our network characteristics. However, there are several differences in how we operate due to the size of the networks, climactic conditions, types of customers and types of assets installed.

While our review of our pole inspection process in 2018/19 led to a refreshed assessment methodology which aligns with best practice, and potentially is similar to Energex's approach, there are several key distinctions between the asset management approach for the two networks as outlined in Table 2 below.[2]

It should be noted that if Ergon Energy was to adopt Energex's asset management practices for pole assets, then unassisted failure rates would likely increase and the Ergon Energy SWER network would be severely impacted. Importantly, Energex network has very few 3kN rated poles as per legacy design and construction practices and has a different historical approach to pole management and pole replacement practices.

An update to Ergon's serviceability calculation in 2019 (refer to Attachment 5.5.02D) was to reduce pole failures, not achieve alignment with Energex's practices. Any future movement towards a common approach for assessment of poles would undergo testing of the impacts of implementing a consistent approach.

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[2] Poles - Comparison of Ergon Energy and Energex Pole Serviceability Approaches

Table 2 : Comparison between Ergon Energy and Energex asset management practices

	Ergon Energy	Energex
Mobility platform	FMC since 2002 (with update in 2019)	AIS since 2013
Condition monitoring measurements	• Location of weakest point (mandatory) • Pole girth (mandatory) • Total width of splits and cracks • Minimum/maximum depth of surface rot • Solid wood measurement, if drilled • Count of drill holes 75mm above and below weakest point External rot is automatically deducted from the pole girth and solid wood measurement by the mobile device.	• Pole diameter • Solid wood measurement, if drilled • Depth rot, if drilled External rot is not recorded in the mobile device. It is manually deducted from the pole diameter and solid wood measurement by the inspector
Calculation of degraded pole strength – bending	**Limit State calculation** Characteristic Bending Strength values used for each strength group are from **AS/NZS 7000:2010**.[3]	**Working Stress/Factor of Safety calculation** Characteristic Bending Strength values used for each strength group are from **AS/NZS 2878:2000**.
Bending result - % strength. ***Note: The calculated strength is divided by the load and expressed as a percentage.***	**Stage 1:** The calculated LS strength is divided by the nominal LS pole strength of the pole. **Stage 2**: Used if Stage 1 result less than 100% or there is no pole disc. Compare calculated LS strength to the pole load for pole structure and wind region. Pole Structures are defined with a tip load to represent all construction scenarios across the network.	Stage 1: The calculated WS strength is divided by the calculated pole load using nominal stringing tension. Circuit data downloaded from corporate systems. Stage 2: The calculated WS strength is divided by the calculated pole load using measured sag and conductor attachment heights.
Calculation of degraded pole strength – compression	Not calculated for poles in the Ergon Energy network.	Calculated for all poles where the attached transformer is greater than 50 kilovolt amperes (kVA).

Note: Red font indicates changes adopted in 2019.

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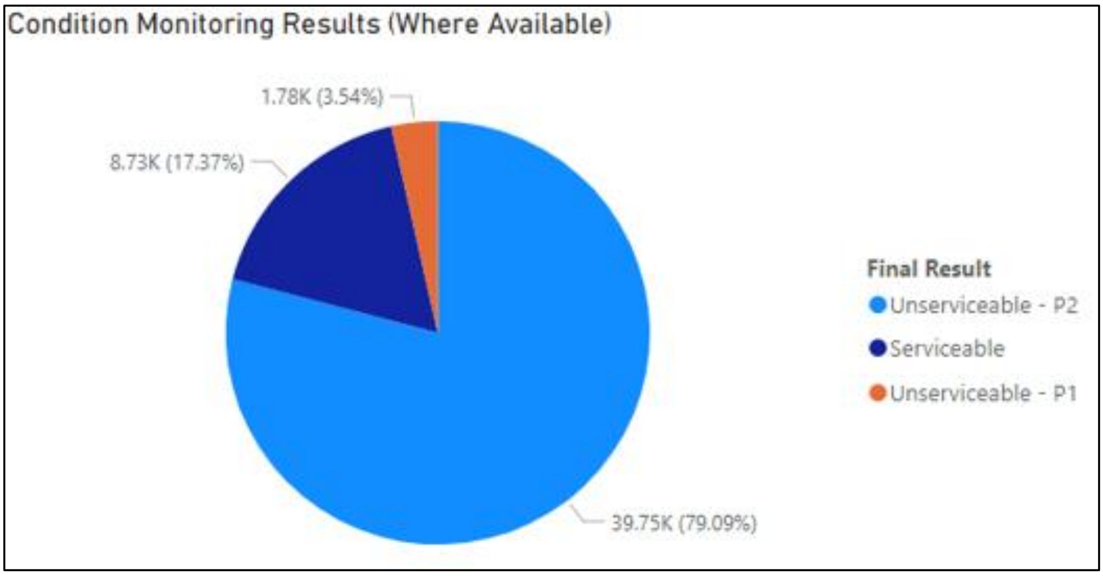
[3] Essential Energy also use AS/NZS7000 for their pole serviceability assessments

When serviceability assessments are completed in the field, the data from the serviceability assessments and the calculated values are returned to the Ellipse system. Figure 5 highlights that 82.63% of unserviceable poles are purely determined based on the results of the pole serviceability calculations. 17.37% of unserviceable poles are identified based on visual assessment of the condition of the pole.

Figure 5 : Pole serviceability breakdown



Source: Root Cause Analysis Figure 26 October 2024

4.1.2 Benchmarking Against Essential Energy

Ergon Energy operates in a uniquely challenging environment, encompassing diverse and extreme climatic conditions, including high humidity, significant rainfall, cyclonic winds, and legislated performance requirements for pole reliability under the ESCOP. These factors, along with a population of legacy low-strength poles, faster growth timber poles with shorter lifespans and a lower historical design safety factor, materially impact pole degradation rates and the frequency of replacements.

The AER has suggested benchmarking against Essential Energy, because of the similar challenges with age and condition of poles. We consider the comparison is not valid nor appropriate for the following reasons provided in Table 3 and as supported by the Aurecon Report[4].

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[4] Validity of Ergon Energy versus peer comparisons for pole replacements October 2024

Table 3 : Comparison between Ergon Energy and Essential Energy operating environment

Category	Difference between DNSPs	Impact on the comparison
Climactic reasons	Essential Energy operates in less severe climates with non-cyclonic conditions. Whereas Ergon Energy has eight bio-diversity regions and a prevalence of termites in the north of its network.	The prevalence of termites as well as higher humidity and rainfall conditions experienced in the Ergon Energy network can increase degradation, rot and decay which can reduce pole life and impact pole foundations.
Safety	Ergon Energy has a design Factor of Safety of 2.5, while Essential Energy have a factor of 4. This means an 8kN Essential Energy pole would have an ultimate strength of 36.86kN, while an 8kN Ergon Energy pole would have an ultimate strength of 20kN.	Essential Energy poles have higher strength and are less susceptible to degradation over time. Poles in the Ergon Energy network may also be deemed unserviceable earlier due to the faster degradation and lower strength.
Pole type	Ergon Energy has 94,000 3kN wood poles in service, comparatively, Essential Energy do not have any 3kN poles.	These lower strength poles disproportionately contribute to almost 30% of annual pole failures, average 25% failure rate over five years and 16% unserviceability/defect rate and are likely to experience an accelerated level of degradation.
Pole materials	Ergon Energy poles are sourced from Queensland and grow faster, however have lower strength.	Ergon Energy's lower strength poles can lead to increased maintenance issues and shorter lifespans.
Legislative obligations	Ergon Energy must comply with the Queensland ESCOP which has a three-year moving average pole reliability target of 99.99% per annum. Essential Energy are not subject to the same legislated mandates or challenges with low-strength poles as Ergon Energy.	Essential Energy replacement volumes are not based on the similar pole reliability targets.

Ergon Energy's asset portfolio to support its network characteristics is unique and the asset management practices have been developed specifically for Ergon Energy's asset population. This means it is not appropriate in all instances to compare Ergon Energy's asset management practices against its peers, such as Essential Energy and Energex.

5. PROBLEM STATEMENT

From 2015 onwards, Ergon Energy has experienced an increasing level of unassisted pole failures. As a result, during the ex-post period, we reviewed our asset management practices and, following an extensive analysis, it was identified that our serviceability calculation needed to change to better reflect the likelihood of our poles failing in-service. It also identified a need to change our inspection frequency to five years to identify and remediate defects earlier as per ESCOP compliance requirements.

These changes resulted in an increased rate of pole defects being identified through our inspection and maintenance process, resulting in an increase in pole replacements over recent years.

Failure data indicates that pole failures have been averaging 105 poles per year, which is above the three-year moving average limit of 97 poles per year set by ESCOP (refer to Figure 3 above). Replacement of poles at a minimum three-year rolling average rate of replacement based on defect identification and management of failures will be needed into the 2025-2030 period to maintain the current service levels for our customers. Further justification for the replacement volumes proposed for 2025-2030 (based on the prudent decisions implemented during the ex-post period) is provided in Section 6.

6. JUSTIFICATION FOR THE VOLUME OF DEFECT POLE REPLACEMENTS IN THE EX-POST PERIOD

6.1 Chronology

Over previous regulatory periods, several decisions have been made that have impacted the volume of poles being replaced during the ex-post period. Figure 6 shows the chronology of these decisions that have driven the need for investment, with some more than others having a significant impact on the replacement of pole assets (those decisions are flagged as red).

Figure 6 : Chronology of decisions impacting pole replacement volumes

🟩 Implementation of Variable Inspection Cycles – 2013/14 (4, 6, 8 year)
🟥 Low Strength Pole Working Group Recommendations Memo – Aug 18
🟩 Failed Pole Initiates System and Process Review – Dec 18
🟩 Unserviceable Pole Audit – Sep 19
🟥 Revised Proposal for Pole Replacements Submitted – Dec 19
🟥 Unserviceable Poles Update Board Paper – Dec 19
🟥 Paper Recommending Removal of 6 and 8 Year Pole Inspection Cycles – Dec 19
🟩 AER 2020-25 Final Determination – Jun 20
🟩 Legal Advice for Risk Exposure of Unserviceable Poles – Aug 20
🟥 Ergon CAPEX Investment Forecast 2020-25 Board Paper – Dec 2020
🟩 Independent Review of Pole Assessment and Classification (EA Technology) – Jul 21

Source: Presentation to the AER October 2024

The historical approach to pole remediation has been periodic inspection and replacement or nailing of defective poles. Concerns with increasing pole failures led to an improvement in data collection of defective poles in 2017/18 followed by a review of the pole strength calculation (also called serviceability calculation) in early 2019 leading to the following changes:

- reduced the pole inspection cycles to five years in alignment with the ESCOP requirements (refer to Section 6.5 below)
- improved field staff training in data capture and collection
- improved pole inspection serviceability calculations to increase the accuracy in the estimation of residual pole strength, the classification of unserviceable poles and the estimation of pole health and probability of failure in current and future years.

These changes and decisions that impacted the asset management practices for poles led to an increase in defect rates being detected, resulting in a higher level of investment in pole remediations during the ex-post period. The decisions outlined below demonstrate that Ergon Energy took prudent measures to ensure that the network was being maintained to continue to meet safety and reliability obligations.

In July 2021, an independent review was commissioned in relation to the pole inspection and assessment processes and methodologies to ensure that they align with industry best practice, are accurate and reliable, yield credible results consistent with expectations and accurately model pole serviceability and pole health. This review concluded, amongst other things, that:

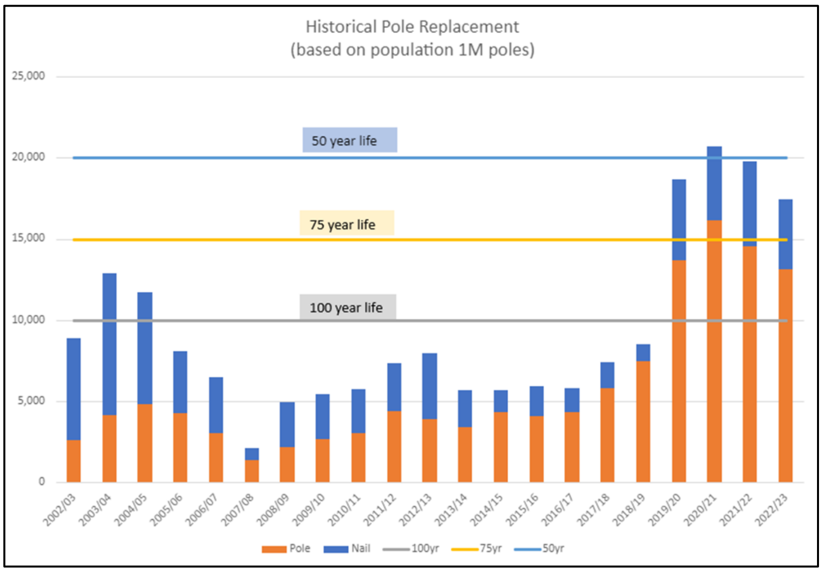
> *"Ergon Energy is performing pole inspections diligently. The algorithm used in pole inspections is aligned with industry best practice both in Australia and in other comparable countries. The volumes of poles being condemned are in line with expectations. The number of unassisted pole failures is currently in excess of the ESCOP levels and is expected to fall over the coming years as appropriate volumes of poles are reinforced and replaced. This demonstrates the effectiveness of the response that Ergon has made to its current situation over the past few years."*

6.2 Historical Pole Replacements

As shown in Figure 7, historical pole replacements were very low from the period 2002/03 through to 2016/17, with an average of about 3,500 poles replaced or nailed over this period. When considering the accepted useful life of a pole is 50 years, this is well below the reasonable replacement rate required to manage the asset.

As a result of this period of very low replacement or nailing, Ergon Energy is now experiencing a period of 'catch up' due to a backlog of defective poles that require replacement. It is expected that the replacement volume is expected to remain at this rate until all 3kN poles are replaced, which would take 30 years based on the current rate of replacement of 2,700 poles per annum. However, as the poles continue to age and deteriorate, the defect volume may increase.

Figure 7 : Historical pole replacements and pole nailing population in 2002/03 – 2022/23



In 2017/18, Ergon Energy introduced new contracts and focused on training and retraining to ensure that pole inspectors could accurately identify unserviceable poles, resulting in a slight increase in the number of poles identified as unserviceable. During the same period, changes were made to the pole nailing criteria due to safety concerns raised by operational staff and supported by unions. This adjustment contributed to an increased ratio of pole replacements to nailing from 2017/18 onward.

Figure 3 above illustrates the trend of unassisted pole failures since 2013/14. Ergon Energy conducts analyses of all unassisted failures, with full investigations initiated in cases of concern regarding inspection integrity, unusual scenarios, or safety and legal requirements. Monthly reports on unassisted pole failures support Asset Maintenance in understanding failure modes and identifying opportunities for improvement. These insights are provided to the Executive and Board to inform them of the volumes and causes of unassisted failures and the ongoing work to address them.

Each investigation into a pole failure involves a comprehensive review of the circumstances, including inspection and maintenance history, condition monitoring results, and any other relevant observations that might reveal the root cause. Photographic evidence and commentary from the field crew are documented, and physical evidence is retained whenever possible to enable a more in-depth understanding of failure modes. In instances where the pole had been inspected within the 12 months preceding the failure, a formal postmortem by a pole inspection auditor compares recent inspection results. This comparison helps identify issues related to inspection quality, inspector training requirements, process or system challenges, and reporting inconsistencies, ultimately leading to recommendations for improvement.

Given the increasing trend in pole defects from 2017/18, we considered there was a genuine need to address this increasing trend during the ex-post period.

6.3 Compliance Requirements

A key driver for repex investment is ensuring compliance with electrical safety obligations. The *Electrical Safety Act* (Qld) s29 imposes an obligation that Ergon Energy (as a prescribed Electrical Entity) has a duty of care to ensure that works are electrically safe and that our network is operated in a way that is electrically safe. Further, the ESCOP details requirements for maintenance of supporting structures for lines including the expectations for supporting structure (for example, poles) reliability, serviceability, and frequency of inspection, as well as timeframes to rectify unserviceable poles, and for pole records to be kept.

In relation to the management of poles, ESCOP specifies the following:

- a minimum three-year moving average reliability of 99.99 % per annum or an average pole failure rate of 1 per 10,000 poles
- each pole should be inspected at intervals deemed appropriate by the entity. In the absence of documented knowledge of pole performance, poles should be inspected at least every five years
- a suspect pole must be assessed within three months; an unserviceable pole must be replaced or reinstated within six months under the ESCOP.

6.4 Low Strength Poles

In 2018/19, significant analysis, research and risk assessments was completed due to the concerns surrounding field crews working on low strength poles (i.e. ≤5kN) and the increasing failure rate of this size of pole. This led to significant changes being made to the pole serviceability calculations and a range of other components of the asset management approach for low strength wood poles.

The network currently has around 94,000 3 kilonewton (kN) poles, with approximately 16% of those inspected being deemed unserviceable. In contrast, the network contains about 322,000 5kN poles, of which approximately 6.5% are found to be unserviceable. Different kN poles might be used based on the operational needs of each location. For example, a lower kN pole might be used when there are mild environmental conditions or lighter load requirements, whereas a higher kN pole may be used when there is a heavy load requirement with more extreme weather conditions. Notably, 3kN poles currently make up 10% of the total pole population and 24 of unassisted pole failures. Figure 8 provides an overview of the unserviceable pole population across the different working strengths from 2017-2023.

Figure 8 : Unserviceable poles by working strength

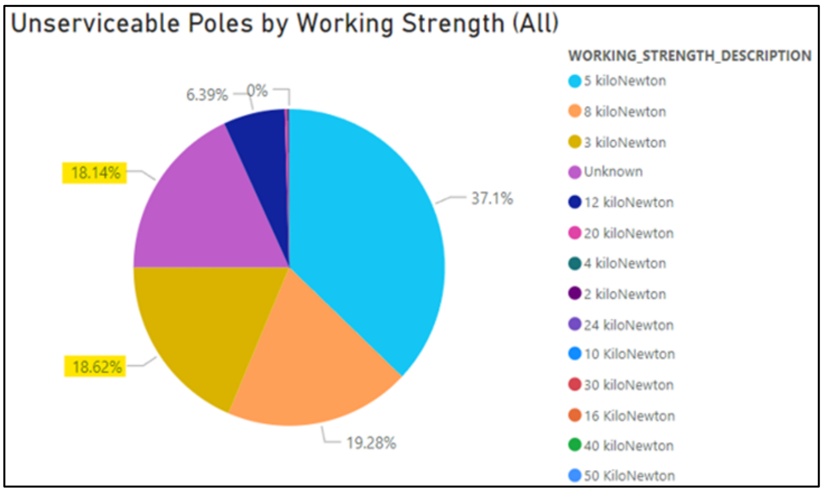
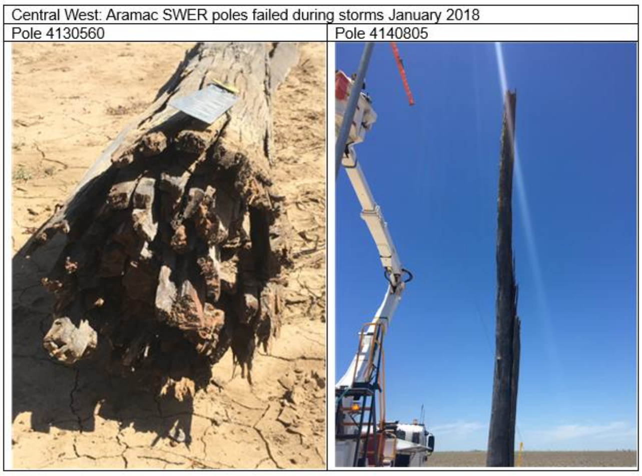


Figure 9 shows example of two 3kN unassisted pole failures. Based on analysis and investigation of pole failures, concerns were raised about the durability of 3kN poles in dry areas, ability to withstand lightning strikes and identification of defects outside of the “normal” inspection zone where serviceability assessments are generally undertaken.

Figure 9 : Examples of 3kN unassisted pole failures



Central West: Aramac SWER poles failed during storms January 2018

Pole 4130560

Pole 4140805

6.5 Changes to Inspection Cycles

In the 2014/15 financial year, the decision was made to implement six-year and eight-year inspection cycles for specific subsets of the pole population. This included:

- rural wood poles in low-risk locations.
- concrete poles.
- steel poles that aren’t direct buried.
- steel lattice towers.

These changes effectively moved approximately 180,000 poles to a six- or eight-year inspection cycle and resulted in an average inspection cycle of 4.5 years. As a consequence of this decision, it also meant that defective poles and other defects could remain in service for an additional four years than they would have previously. Modelling and risk assessments at the time assessed this decision to be a low risk given that the pole population was performing relatively well in terms of unassisted failures.

At the time of making this decision, the unassisted pole failure rates were particularly low and there was no evidence that low strength poles were an emerging issue. Unfortunately, many of the poles that were determined to be moved to a six-year cycle were in lower risk rural locations, generally with low customer numbers and therefore smaller conductors, small tip load requirements and therefore installation of small poles – many of the low strength 3kN poles were therefore moved to an extended six-year cycle. This decision, in part, has resulted in the increase in unassisted 3kN low strength pole failures.

6.6 Unserviceable (US) Pole Audit

In September 2019, as a response to an investigation into an unassisted pole failure that was not replaced when deemed unserviceable, Ergon Energy initiated a reinspection of a random sample of 800 poles that had previously been identified as unserviceable.

Due to the higher-than-expected volume of poles found not to have been replaced from the random sample, the decision was made to audit approximately 23,000 unserviceable poles from the previous three years.

Analysis of a sample of wood poles inspected was also completed in 2020. The aim was to understand the predominant failure mode for every pole which failed the calculated serviceability thresholds. As a result:

- changes were made to the nailing criteria to allow the nailing of poles that failed the minimum strength criteria and had a calculated LS strength between 4.5 to 5.0kN to enable increased nailing of 3kN poles.
- additional pole nails suitable for reinforcing the smaller diameter poles were introduced.

7. CONSEQUENTIAL REPLACEMENTS

Following the identification of a defective pole, Ergon Energy also conducts an evaluation of the condition of the equipment / assets that are affixed to the pole to determine whether it is feasible and cost-effective to replace the other assets at the same time (consequential replacements). This practice is known as bundling of consequential replacement and the equipment or assets relevant to pole replacements may include pole top structures/ crossarms, transformers, service lines, and switches. We have accepted the AER Draft Decision alternate reduced forecast repex allowance for transformers and switches.

Ergon Energy undertakes bundling of consequential replacements in accordance with its Bundling Guidelines (June 2019) (refer to Attachment 5.5.02D. The Guidelines require that when allocating work, where possible, Ergon Energy ensures bundling of consequential replacements occurs with work that has already been assigned to a particular area to avoid unnecessary travel and reduced scoping effort. It is for these reasons that Ergon Energy is including the Regulatory Proposal repex for pole top and service line consequential replacements in its Revised Regulatory Proposal.

8. BENEFIT AND RISK ANALYSIS

8.1 Overview

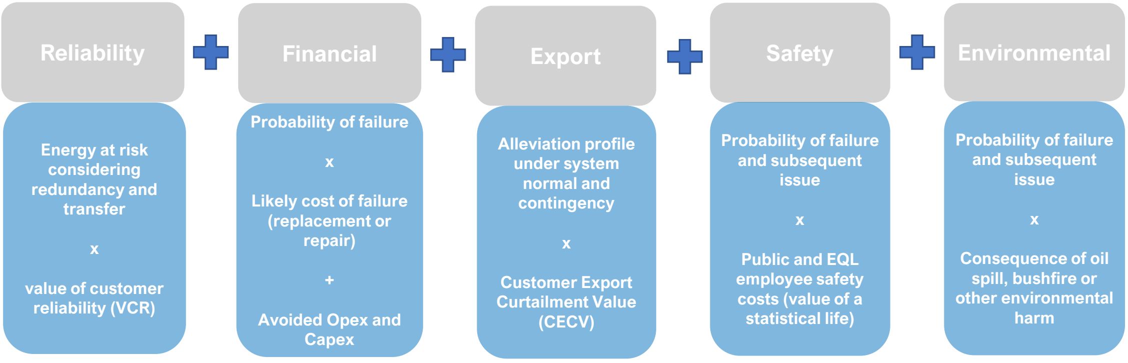
Following feedback from the AER on the CBA modelling used, we have revised our CBA and details are in Appendix B – Revised modelling approach. In evaluating the risks associated with our pole assets, we have modelled each pole individually, with location and condition data specific to each pole, while also factoring in, to the extent possible, other factors such as the electrical load of the feeder, the pole support carries and locational factors that are important to outcomes from an unassisted pole failure. As such, our cost benefit analysis is aimed at calibrating our serviceability calculation at the program level, so that on average we will be able to maximise the benefits to customers.

Following the cost benefit analysis and NPV modelling, the most positive NPV of the volumes considered will form the basis for selecting the preferred option. In the NPV modelling, the monetised risk is calculated as per the calculation in Figure 10.

Figure 10 : Monetised Risk Calculations

Ergon Energy broadly considers five risk streams for investment justifications for the replacement of widespread assets. These are shown in Figure 11. For poles, only four of the value streams have been considered as the ‘Export’ stream is not considered material.

Figure 11 : Benefit and Risk Stream for Assets



8.2 Health Index and Probability of Failure (PoF)

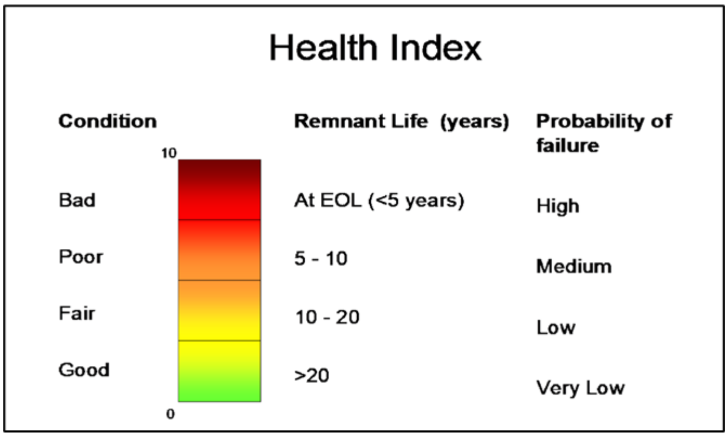
Ergon Energy utilises Condition Based Risk Management (CBRM) and Common Network Asset Indices Methodology (CNAIM) principles to determine the condition of our pole population. These models utilise condition data such as observed ground level deterioration and pole rot condition and measured condition data such as strength ratio and sound wood measurement to determine the Health Index (HI) of a pole asset. The condition data is collected through our inspection program.

Each pole in our population has an individual HI score, which means that the type of pole, location and condition is factored into the HI calculations.

The CBRM combines asset information, engineering knowledge and practical experience to define the current and future condition and performance for network assets. The HI is calculated on a scale of 0.5 to 10 (Figure 12) which represents the extent of condition degradation:

- 0.5 indicating best condition or a new pole
- 10 indicating the worst condition.

Figure 12 : Health Index



Condition	Remnant Life (years)	Probability of failure
Bad	At EOL (<5 years)	High
Poor	5 - 10	Medium
Fair	10 - 20	Low
Good	>20	Very Low

The relationship between HI and PoF is not linear (Figure 13). An asset can accommodate significant degradation with very little effect on the risk of failure. Conversely, once the degradation becomes significant or widespread, the risk of failure rapidly increases. A HI of 7.5 is typically used as the point at which assets are identified as candidates for requiring intervention.

Figure 13 : HI and PoF Relationship Graph

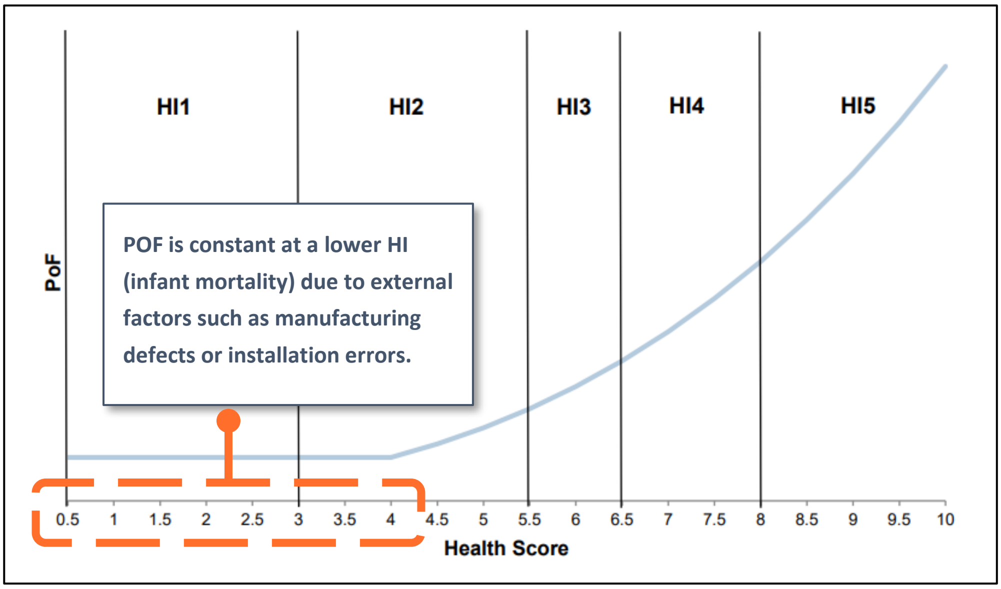
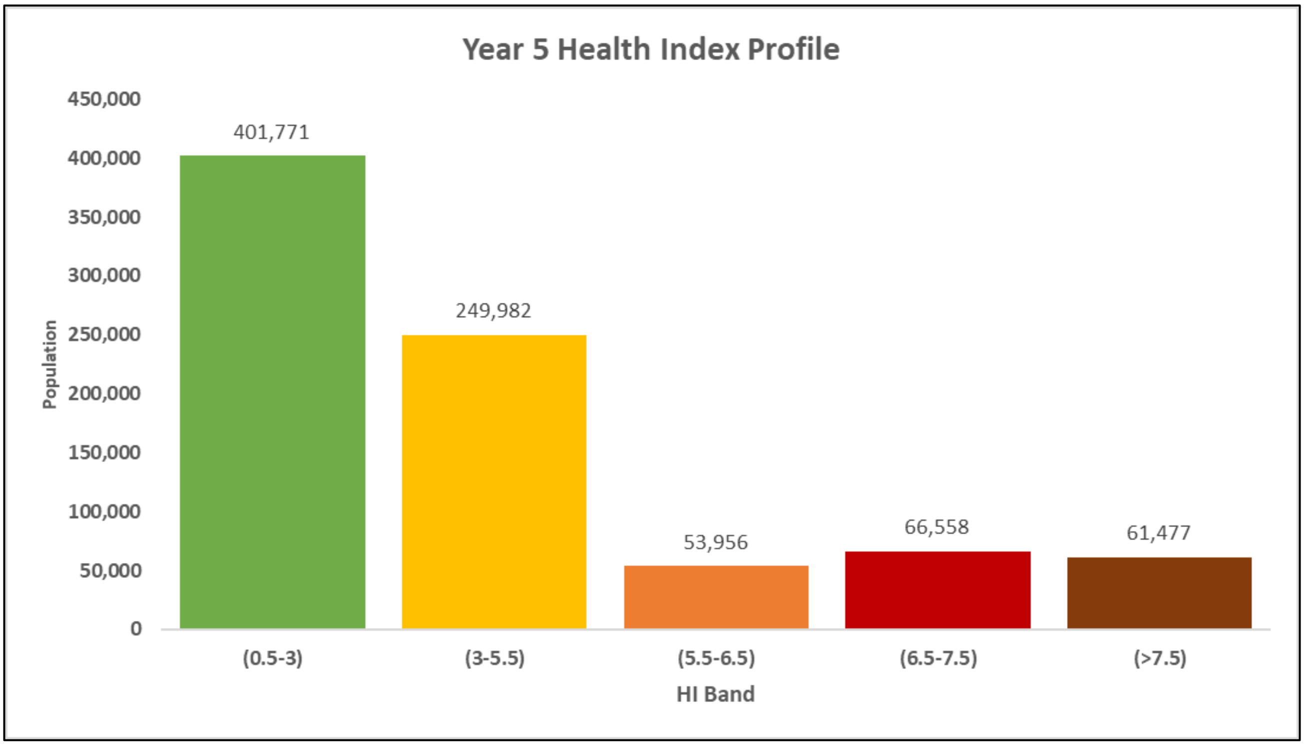


Figure 14 shows that without any intervention, Ergon Energy anticipates that as of 2030, the number of poles beyond HI of 7.5 would be 61,477 as predicted by the CBRM using the ‘below ground’ condition monitoring measurements.

Figure 14 : Health index of pole population as at 2030 (without intervention)



In reviewing the actual defect history (unserviceable poles), it is noted that 70% is below ground degradation, which can be predicted by CBRM as we take measured data such as sound wood measurement, as part of our inspections. The remaining 30% of defects are from above-ground degradation, where we don't take measured data, and which cannot be predicted by CBRM. Therefore, CBRM prediction values are around 70% of US pole forecast prediction.

8.3 Condition and Risk Based Modelling

Ergon Energy uses the CNAIM and CBRM to help forecast targeted / proactive replacements and to support the inspection driven defect forecasts developed for its repex program. The CBRM approach has been adopted to prove the benefit of forecasted volumes (based on defects) by obtaining the PoF and the Consequence of Failure (CoF) to derive the Net Present Value (NPV).

The CBRM/CNAIM involves a site-specific assessment of asset condition, consideration of the type and size of load supplied by the network, and safety and environmental risk exposure to the community and our staff in order to justify the benefit of the investment.

The benefits we typically expect to see from repex programs include:

- **Reliability** - unserved energy to our customers following an in-service failure of an item or plant. This generally forms a large part of the customer benefit from our sub-transmission repex. It should be noted that these programs are targeted at maintaining our existing network reliability and ensures that we do not experience an increase in unplanned outages from asset failures as the condition of our assets deteriorates over time.
- **Safety** - risk of injury(ies) or fatality(ies) to the community and our staff associated with a catastrophic or defective failure of equipment. Unlike our substation assets which are installed inside a fenced, secure site, most of our distribution assets are in publicly accessible areas. As such, proactively replacing assets in poor condition reduces the likelihood of these types of failures resulting in safety incidents in the community.
- **Environmental (bushfire)** – risk of the fire following an in-service failure of electrical equipment that eventuates to a bushfire. Proactively replacing equipment will reduce the likelihood of these events being caused by our assets.
- **Financial** – remediation of failed and defective distribution assets. By proactively replacing degraded assets, not only will potential catastrophic failures be reduced, but also the financial risks associated with in-service catastrophic failures.

The CBRM approach has been adopted to prove the benefit of forecasted volumes (based on defects) by obtaining the PoF and the CoF) to derive the NPV.

Figure 15 and Figure 16 provide an overview of the predictive modelling process and how the CBRM/CNAIM model is used to confirm the optimised replacement timing.

Figure 15 : Overview of the predictive modelling process

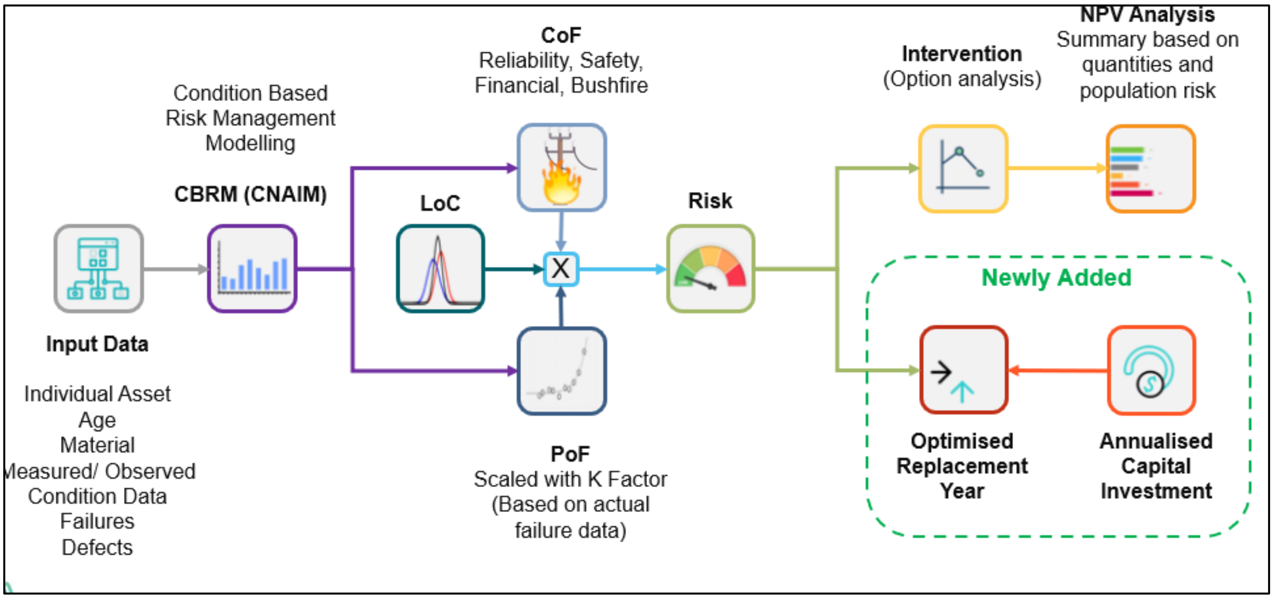
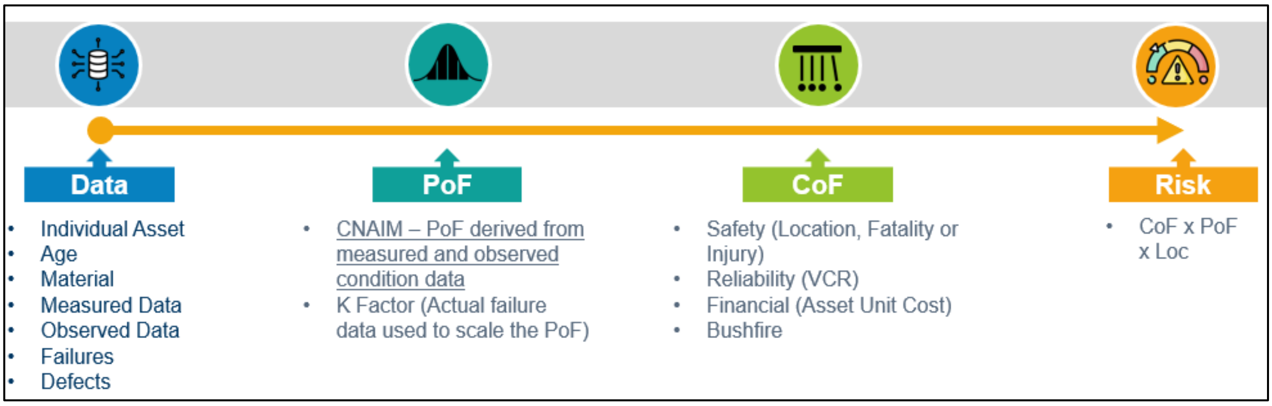


Figure 16 : Overview of the optimised pole model



Ergon Energy has implemented the following improvements to the CBA and CBRM/CNAIM model since the Regulatory Proposal and feedback received from the AER at our October workshops:

- introduced prioritisation using risk-based approach.
- applied the benefit analysis periods based on asset expected useful life (50 years benefit for poles, 35 years benefit for pole top structures)
- compared feasible interventions.
- undertaken data quality validation.
- validated modelled risk value using actual data.

Additionally, during a workshop with the AER in October 2024, we were advised that we were required to develop a CBA for any step-change from the current business as usual strategy.

Therefore, we have submitted revised CBA modelling for the ex-post forecast for poles and to support our ex-ante for pole top structures.

8.4 Consequence of Failure (CoF) and Likelihood of Consequence (LoC)

The consequence categories that have been modelled are reliability, financial, safety and environmental. The CoF refers to the economic outcomes if an event (such as a bushfire) were to occur.

The LoC refers to the probability of a particular outcome or result occurring because of a given event or action. This could include the probability of an identified defect (outcome or result) due to decay of the asset (event or action). To estimate the LoC, Ergon Energy has used a combination of historical performances and researched results. Ergon Energy has analysed past events, incidents, and data to identify patterns and trends that can provide insights into the likelihood of similar outcomes occurring in the future. Additionally, Ergon Energy also has conducted extensive research to gather relevant information and data related to the respective risk category.

To the extent possible, the identified CoF and LoC are pole specific. This is particularly the case for the reliability and benefits stream, where the site-specific load and bushfire risk informs the benefits calculations for preventing unassisted pole failures.

8.4.1 Reliability

Reliability represents the unserved energy cost to customers impacted by network outages and is based on an assessment of the amount of Load at Risk during three stages of failure: fault, initial switching, and repair time. The following assumptions are used in developing the risk cost outcome for a pole failure:

- **Lost Load:** Each pole in our network is modelled individually, with the relationship developed between a pole and the feeder that it is connected to. The historical average load on each feeder in our network is utilised to determine the kilowatt (kW) that would on average be lost following a pole failure. We have utilised half of the historic average load on the feeder, which represents the most likely outcome, as the data regarding the exact electrical location of the pole in a feeder is not available. We have assumed 50% of load is lost for each outage.
- **Load transfers and Restoration Timeframe:** the average loss of supply has been estimated for a period of average 6 hours to 24 hours based on the locality, with respective staged restoration periods, based on historical data for outages/durations. This is based on the average load on our fleet of feeders, divided under five categories from Rural Short, rural long, urban, sub-transmission and transmission in between.

- **Value of Customer Reliability Rate:** We have used the Queensland average Value of Customer Reliability (VCR) rate from the Australian Energy Regulator 2023 Values of Customer Reliability Annual Adjustment.[5]
- **Probability of Consequence:** all in-service pole failures result in an outage to customers.

8.4.2 Financial

The financial cost of failure is derived from an assessment of the likely replacement costs incurred by the failure of the asset, which is replaced under emergency. The following assumptions have been used in developing the financial risk costs for a pole failure:

- **Pole replacement:** different unit cost of pole replacement has been taken based on voltage level and type of pole at approximately $6,237.
- **Pole Reinforcement:** Unit cost of pole reinforcement (nailing) has been taken as $1,843 per pole.
- **Pole Nailing:** has been assumed as 30% of total pole remediation program (Replacement + Reinforcement) for modelling purposes.
- **Probability of Consequence:** all in-service pole failures result in a need to replace the pole under emergency.

8.4.3 Safety

The primary safety risk for a pole failure is that a member of the public is in the presence of a fallen conductor which was caused by pole failure. This could result in a fatality or injury. For our modelling, we have used the Best Practice Regulation Guidance Note[6] from the Australia Government Department of Prime Minister and Cabinet with the following assumptions:

- **Value of a Statistical Life:** $5.4m
- **Value of an Injury:** $1.35m
- **Disproportionality Factor:** 6 for members of the public and 3 for members of staff
- **Probability of Consequence**: Following an unassisted pole failure, there is a 1 in 20-year chance of causing a fatality and 3 in 20-year chance of a serious injury based on historical data evidence. The average number of safety incidents has been derived by analysing 20 years of Significant Electrical Incident data comprising 4 incidents where unassisted pole failure has driven a safety incident of the appropriate severity.

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[5] Australian Energy Regulator, 2023 Values of Customer Reliability Annual Adjustment

[6] August 2022 document from the Australian Government, Department of the Prime Minister and Cabinet (Office of Best Practice Regulation) Best Practice Regulation Guidance Note - Value of a Statistical Life

8.4.4 Environmental (Bushfire)

The value of a Bushfire Event consists of the safety cost of a fatalities and the material cost of property damage following a failed pole causing downed conductor and fire. For our modelling we have used:

- **Value of Bushfire:** $22.3m – which is the average damage to housing and fatalities following a bushfire starting. [7]
- **Safety Consequence of Bushfire:** Safety consequences are evaluated on the same assumptions as safety incident consequence with a frequency of 0.5 per incident as there has been 6 fatalities recorded across those 12 bushfire incidents in Queensland.
- **Probability of Consequence:** Following the failure of a pole, we have estimated that there is a 0.0260 chance of causing a fire. This is based on a historical full year when there were 22 fires recorded due to electrical asset failures in Ergon Energy. In that year there were 114 pole failures, 265 cross-arm failures and 467 conductor failures that had potential to cause fire ignition, giving a probability of 0.0260 (22/846). Also, bushfire consequence weighting and probability of containing/non-containing the fire has been incorporated into calculations along with % number of days considerations during no-forecast to extreme/catastrophic danger rating forecasts.

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[7] Calculated using data from *Australian Major Natural Disasters.xlsx* (a compendium of various sources). The source shows that in Queensland there were 122 homes and 309 buildings lost during bushfires between 1990 and 2021 across 12 significant fire records. Homes were estimated at an average cost of $400,000 while the buildings were estimated at an average cost of $80,000

9. COUNTERFACTUAL ANALYSIS

Ergon Energy has taken the AER's Draft Decision feedback into consideration when developing the counterfactual option for this business case and has also taken into consideration the AER's *Industry practice application note for asset replacement planning.*[8] In particular, the counterfactual option has been represented as the costs that consumers would incur if the asset continued to be operated under the standard operating and maintenance practices or, 'do nothing materially different' under its usual asset management practices. Ergon Energy's usual asset management practice for poles is to replace the assets when identified as defective.

The counterfactual considered in this business case has been updated from the Regulatory Proposal to reflect the BAU volumes and rate of replacements undertaken prior to the ex-post period (i.e. 2018-23). The counterfactual option assumes the BAU approach of replacing defective poles with like-for-like wood poles at the pre 2018/19 volumes (i.e. 8,000 poles per annum). This period is prior to the ex-post period and reflects the volumes of replacements prior to changes made to the serviceability criteria.

Table 4 : Counterfactual Volume

Counterfactual Volume Pole (Ex Post period)	2018-19	2019-20	2020-21	2021-22	2022-23
Pole Replacement & Reinforcement Total	8,000	8,000	8,000	8,000	8,000

9.1 Counterfactual Risk and Benefit Quantification

Ergon Energy has determined the risk and benefits over a fifty-year time horizon as a period representative of the expected period of realisable benefits from any interventions. Figure 17 provides an overview of failure forecast if we continued with counterfactual options.

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[8] Australian Energy Regulator, Industry practice application note Asset replacement planning

Figure 17 : Unassisted Failures Forecast: Counterfactual

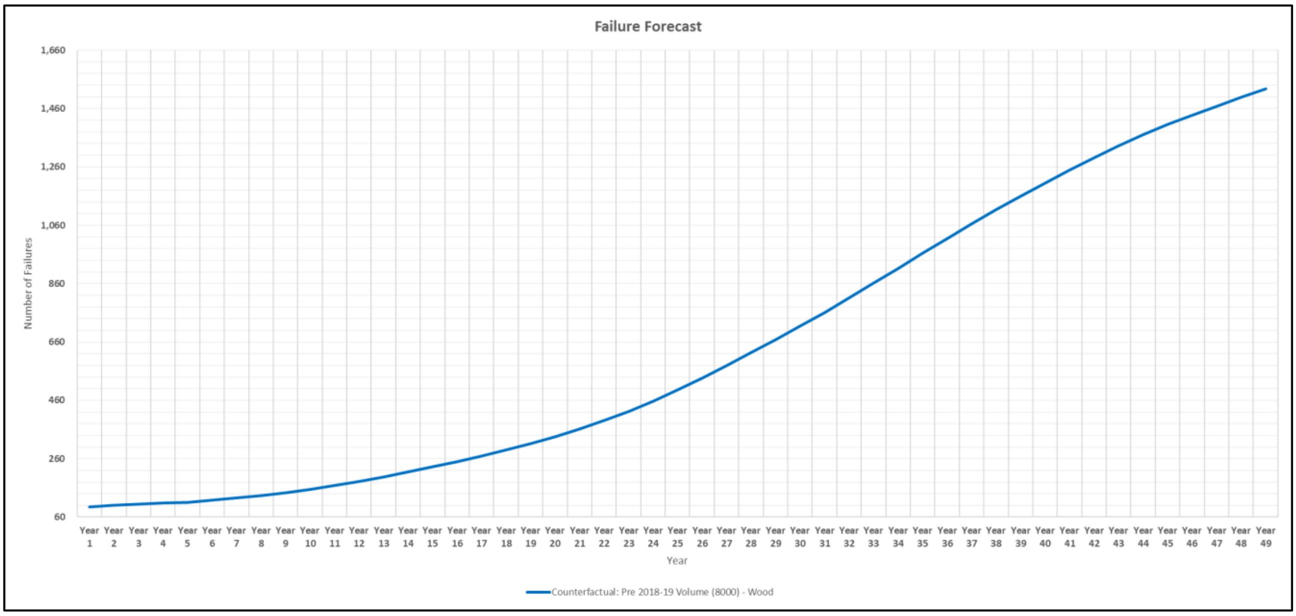
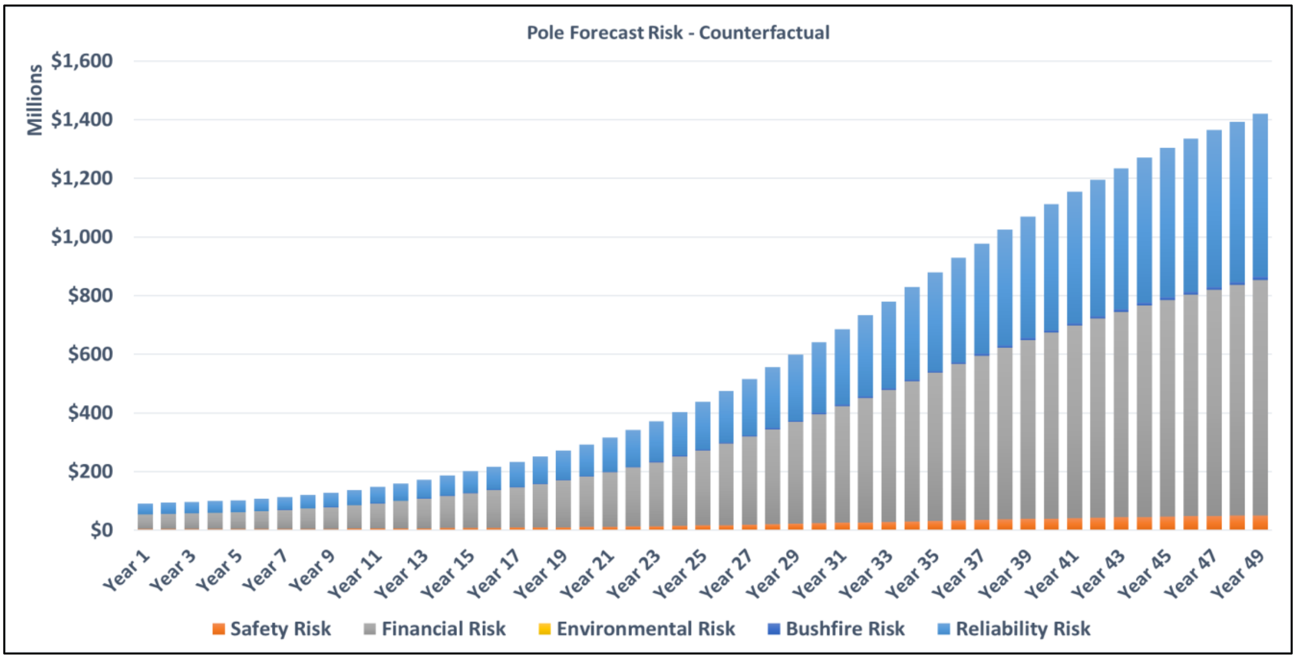


Figure 18 provides the results of the counterfactual quantitative forecast of emerging risk associated with Ergon Energy pole asset population. The reliability and finance risk dominates the risk profile as expected. In Section 10, the counterfactual options are compared against other feasible options to prove the benefit of step change required in our ex-post period.

Figure 18 : Counterfactual quantitative risk assessment



10. OPTIONS AND ECONOMIC ANALYSIS

10.1 Overview of Options

We have considered and compared a range of potential options against the counterfactual (pre ex-post period) and have sought to identify technically feasible, alternative options that satisfy the identified need and problem statement in a timely and efficient manner. The tables below provide an overview of the costs and volumes for each of the options considered.

The options considered include:

- Option 1 – replacing failed poles with wood poles (modelled failed poles 114 per annum)
- Option 2 – replacing 5,000 poles per annum with wood poles (to show a lower volume option)
- Option 3 – actual delivered 3 year historical average 16,600 poles per annum with wood poles (which reflects the step change due to the root cause analysis, revised serviceability calculations and changes to inspection cycles, for simplification model used 16,600 while the actual average is 16,631)
- Option 4 – as per option 3 (replacing 16,600 poles per annum) but with concrete poles
- Option 5 – as per option 3 (replacing 16,600 poles per annum) but with composite poles
- Option 6 – as per option 3 (replacing 16,600 poles per annum) with wood poles with an additional 10,000 low strength poles also being replaced.

Table 5 : Summary of Option Costs and Volumes over a 5-year period

Option	Counterfactual	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6
Costs ($m)	342.2	5.6	225.1	678.9	1,273.3	1,985.0	965.7
Volumes	40,000	570	25,000	83,000	83,000	83,000	133,000

Table 6 shows that, although the volume remains constant each year for most interventions, the cost varies. This is due to the differing unit costs associated with each voltage category.

Table 6 : Costs for each option over a 5-year period

Costs ($m)	Year 1	Year 2	Year 3	Year 4	Year 5
Counterfactual – Pre 2018-19 volumes (8,000)	67,246,540	66,328,548	69,282,910	71,046,024	68,279,770
Option 1 – Replace failed poles only (wood)	1,337,438	1,413,224	1,242,465	830,859	788,057
Option 2 – Low volume (wood)	48,875,350	50,311,428	43,990,350	43,018,224	38,913,524
Option 3 - Actual 3 Year Avg - (wood)	133,399,050	139,914,190	135,884,690	134,030,900	135,684,620
Option 4 - Actual 3 Year Avg – (concrete)	263,381,730	255,345,040	248,638,320	254,534,180	251,419,140
Option 5 - Actual 3 Year Avg – (composite)	397,737,200	384,591,650	409,643,230	398,067,800	394,984,800
Option 6 – Actual 3 Year Avg + 10k low strength (3kN) poles	199,057,120	196,886,640	189,849,940	191,833,140	188,041,200

Table 7 : Volumes for each option over a 5-year period

Volumes	Year 1	Year 2	Year 3	Year 4	Year 5
Counterfactual – Pre 2018-19 volumes (8,000)	8,000	8,000	8,000	8,000	8,000
Option 1 – Replace failed poles only (wood)	100	106	114	121	129
Option 2 – Low volume (wood)	5,000	5,000	5,000	5,000	5,000
Option 3 - Actual 3 Year Avg - (wood)	16,600	16,600	16,600	16,600	16,600
Option 4 - Actual 3 Year Avg – (concrete)	16,600	16,600	16,600	16,600	16,600
Option 5 - Actual 3 Year Avg – (composite)	16,600	16,600	16,600	16,600	16,600
Option 6 – Actual 3 Year Avg + 10k low strength (3kN) poles	26,600	26,600	26,600	26,600	26,600

10.2 NPV and Economic Analysis

The risk cost for each of the options considered are provided in Table 8. Figure 19 provides an overview of failure forecast if we continued with all options.

Figure 19 : Unassisted Failures Forecast: All Options

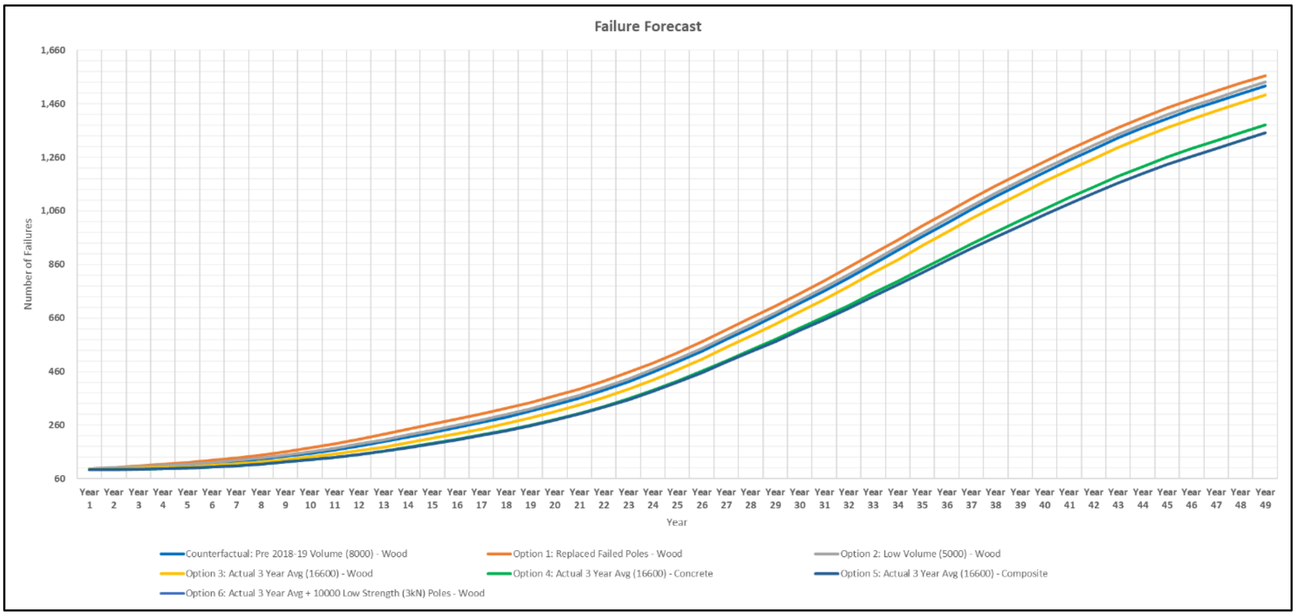


Table 8 : Total Risk Costs: All Options

Options	Year 1 Risk	Year 5 Risk	Year 50 Risk
Counterfactual – Pre 2018-19 volumes (8,000)	$90,854,594	$102,277,021	$1,421,217,027
Option 1 – Replace failed poles only (wood)	$91,520,377	$111,016,947	$1,464,522,572
Option 2 – Low volume (wood)	$91,509,380	$105,365,778	$1,441,813,307
Option 3 - Actual 3 Year Avg - (wood)	$88,302,658	$92,046,153	$1,338,455,271
Option 4 - Actual 3 Year Avg – (concrete)	$131,717,366	$133,834,484	$2,022,275,705
Option 5 - Actual 3 Year Avg – (composite)	$178,040,937	$176,546,504	$2,747,727,419
Option 6 – Actual 3 Year Avg + 10k low strength (3kN) poles	$86,932,376	$88,676,670	$1,231,826,041

The NPV ranking and economic analysis of the options is summarised in Table 9 below, which demonstrates the following:

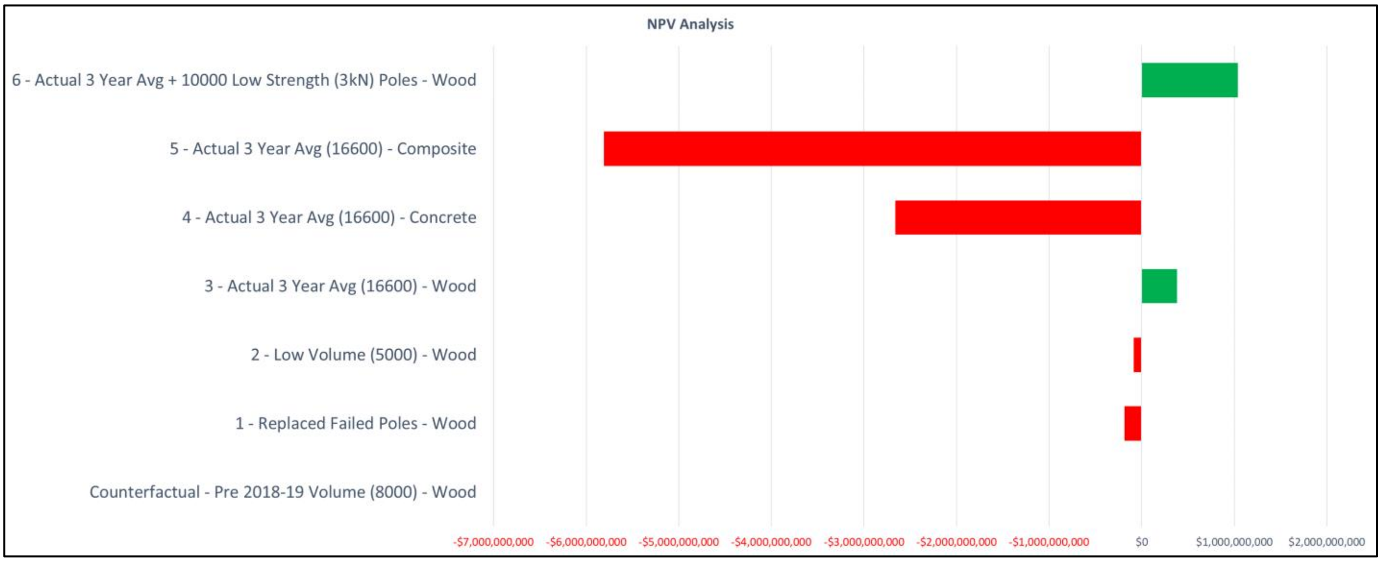
- Counterfactual option does not meet the identified need and problem statement
- Options 3 and 6 both provide a positive NPV outcome,
- Options 4 and 5 provide a negative NPV due to the much higher cost of concrete and composite material
- Option 6 will require additional resourcing and presents deliverability concerns
- **Option 3 is the preferred option** with NPV positive, meets the identified need and has no deliverability risks.

Table 9 : NPV Modelling and BCR Analysis Outcomes: All Options

	NPV and BCR Analysis to Counterfactual				
Intervention	**NPV Rank**	**BCR Rank**	**Net NPV**	**CAPEX (NPV)**	**Benefit (NPV)**
Counterfactual – Pre 2018-19 volumes (8,000)	3	3	$0	$0	$0
Option 1 – Replace failed poles only (wood)	5	4	-$187,889,627	$314,290,891	-$502,180,518
Option 2 – Low volume (wood)	4	5	-$86,177,397	$108,328,000	-$194,505,397
Option 3 - Actual 3 Year Avg - (wood)	2	2	$380,460,391	-$314,971,405	$695,431,796
Option 4 - Actual 3 Year Avg – (concrete)	6	6	-$2,658,890,817	-$871,281,199	-$1,787,609,618
Option 5 - Actual 3 Year Avg – (composite)	7	7	-$5,810,001,467	-$1,535,380,707	-$4,274,620,760
Option 6 – Actual 3 Year Avg + 10k low strength (3kN) poles	1	1	$1,039,131,613	-$583,812,502	$1,622,944,115

Figure 20 provides a visual overview of the NPV analysis of the options against the counterfactual.

Figure 20 : NPV analysis for Each Option Against Counterfactual



10.3 Assumptions and Variables

Table 10 below presents the relevant assumptions and variables that were considered in undertaking the NPV and economic analysis.

Table 10 : Assumptions and variables

Parameter	Value	Unit	Assumption
Discount rate (WACC)	3.5	%	
Value of customer reliability	53.47	$	Weighted Average AER 2023
Degraded Reliability cost	1	%	1% of feeder reliability cost

10.4 Validation of Modelled Risk Value

As part of development of the revised CBA models, Ergon Energy undertook a model validation exercise using actual outage analysis and risk estimation and disposed defective pole data. For validation against the actual outage data, this data was collected for each unassisted pole failure:

1. For all the outages, the unserved energy to the customer was obtained, including the restoration time.
2. The VCR $53.47/kWh value was derived from the weight average calculation based on the AER 2023 VCR publication.
3. Using the $53.47/kWh, the reliability cost was calculated for each unassisted failure.
4. This reliability cost was then compared with the predictive model’s reliability risk cost output.
5. In the FY23, the outage reliability cost due to unassisted pole failures of $20.7m is comparable with the year 1 predictive model output of $18.2m. (refer attachment 5.5.01E)

For validation against disposed defective pole data, a comparison of poles with a modelled HI greater than 8 against historical defect data showed that these poles had already been decommissioned, though this information was not promptly updated in the system due to delays in the decommissioning process. This proved the prediction from CBRM is a more accurate way of predicting “below ground” degradation unserviceability.

This finding confirms the model’s ability to consistently predict unserviceability for poles with an HI above 8, as expected. Consequently, these decommissioned assets have been removed from the model to align it more closely with the actual network conditions.

10.5 Sensitivity Analysis

To further test the effectiveness and prudency of the preferred option, a number of sensitivity analysis criteria have been applied, with ± 25% values, to compare the outcomes of the modelling in different scenario. The main sensitivity criteria are:

- Weighted Average Capital Cost (WACC)
- Risk/Benefit

In all sensitivity analysis outcomes, Option 3 (preferred option) and Option 6 had the highest NPV outcomes.

Table 11 : NPV Sensitivity Analysis with 25% Reduced Base WACC (3.5%)

2.63% Discount Rate				
Intervention	**Rank**	**Net NPV**	**CAPEX (NPV)**	**Benefit (NPV)**
Counterfactual – Pre 2018-19 volumes (8,000)	3	$0	$0	$0
Option 1 – Replace failed poles only (wood)	5	-$457,533,417	$319,578,796	-$777,112,213
Option 2 – Low volume (wood)	4	-$207,076,610	$110,400,426	-$317,477,036
Option 3 - Actual 3 Year Avg - (wood)	2	$850,255,088	-$320,136,890	$1,170,391,977
Option 4 - Actual 3 Year Avg – (concrete)	6	-$5,069,397,422	-$885,487,853	-$4,183,909,569
Option 5 - Actual 3 Year Avg – (composite)	7	-$11,219,809,700	-$1,560,887,361	-$9,658,922,339
Option 6 – Actual 3 Year Avg + 10k low strength (3kN) poles	1	$1,487,953,363	-$593,231,021	$2,081,184,384

Table 12 : NPV Sensitivity Analysis with 25% Increased Base WACC (3.5%)

4.38% Discount Rate				
Intervention	**Rank**	**Net NPV**	**CAPEX (NPV)**	**Benefit (NPV)**
Counterfactual – Pre 2018-19 volumes (8,000)	3	$0	$0	$0
Option 1 – Replace failed poles only (wood)	5	-$211,303,297	$309,177,612	-$520,480,908
Option 2 – Low volume (wood)	4	-$89,392,058	$106,326,188	-$195,718,246
Option 3 - Actual 3 Year Avg - (wood)	2	$382,961,702	-$309,975,466	$692,937,168
Option 4 - Actual 3 Year Avg – (concrete)	6	-$2,444,874,642	-$857,542,613	-$1,587,332,029
Option 5 - Actual 3 Year Avg – (composite)	7	-$5,374,340,309	-$1,510,714,367	-$3,863,625,942
Option 6 – Actual 3 Year Avg + 10k low strength (3kN) poles	1	$506,718,955	-$574,702,961	$1,081,421,916

Table 13 : NPV Sensitivity Analysis with 25% Reduced Risk/Benefit

-25% Risk/Benefit				
Intervention	Rank	Net NPV	CAPEX (NPV)	Benefit (NPV)
Counterfactual – Pre 2018-19 volumes (8,000)	3	$0	$0	$0
Option 1 – Replace failed poles only (wood)	5	-$147,081,995	$314,290,891	-$461,372,886
Option 2 – Low volume (wood)	4	-$66,786,904	$108,328,000	-$175,114,904
Option 3 - Actual 3 Year Avg - (wood)	2	$307,732,612	-$314,971,405	$622,704,017
Option 4 - Actual 3 Year Avg – (concrete)	6	-$2,360,159,294	-$871,281,199	-$1,488,878,096
Option 5 - Actual 3 Year Avg – (composite)	7	-$5,135,583,620	-$1,535,380,707	-$3,600,202,913
Option 6 – Actual 3 Year Avg + 10k low strength (3kN) poles	1	$401,858,310	-$583,812,502	$985,670,812

Table 14 : NPV Sensitivity Analysis with 25% Increased Risk/Benefit

+25% Risk/Benefit				
Intervention	**Rank**	**Net NPV**	**CAPEX (NPV)**	**Benefit (NPV)**
Counterfactual – Pre 2018-19 volumes (8,000)	3	$0	$0	$0
Option 1 – Replace failed poles only (wood)	5	-$454,663,918	$314,290,891	-$768,954,809
Option 2 – Low volume (wood)	4	-$183,530,173	$108,328,000	-$291,858,173
Option 3 - Actual 3 Year Avg - (wood)	2	$722,868,623	-$314,971,405	$1,037,840,028
Option 4 - Actual 3 Year Avg – (concrete)	6	-$3,352,744,691	-$871,281,199	-$2,481,463,493
Option 5 - Actual 3 Year Avg – (composite)	7	-$7,535,718,896	-$1,535,380,707	-$6,000,338,189
Option 6 – Actual 3 Year Avg + 10k low strength (3kN) poles	1	$1,058,972,185	-$583,812,502	$1,642,784,687

11. RECOMMENDATION

Ergon Energy is committed to adopting an economic, customer value-based approach to ensure the safety and reliability of the network.

The ex-post period saw identification and replacement of a higher volume of poles to reduce the failure rate within the prescribed threshold, manage defective pole volumes and maintain service and reliability levels to our customers. Option 3 - Actual 3 Year Average (Wood) is reflective of our commitment to provide maximum customer benefit at optimised customer price impacts. After evaluating all available options, Option 3 is the optimum and most beneficial option.

Table 15 : Actual delivered pole replacements in the ex-post period

Actual Delivery Volume Pole (Ex Post period)	2018-19	2019-20	2020-21	2021-22	2022-23	Total
Pole Replacement & Reinforcement Total	6,288	15,141	19,152	15,981	14,761	**71,324**

For our ex-ante 2025-30 period, we are proposing to replace poles with wood poles, and introduce composite material where possible (in bushfire and termite prone areas) and maintain supply chain management, at the optimised volume of 16,630 per annum. The preferred option will see the continuation of the ex-post period (3 year historical actual 2020-21 to 2022-23) approach into the 2025-30 period in order to maintain the current performance, with a focus on optimising existing processes and enhancing efficiencies where possible. It also reflects a tolerable risk position and balances the achievement of asset management objectives, deliverability concerns and customer service levels and ensures a level of investment that can be efficiently delivered.

Table 16 : Proposed pole replacements in the ex-ante period

Actual Delivery Volume Pole (Ex Post period)	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Pole Replacement & Reinforcement Total	16,630	16,630	16,630	16,630	16,630	**83,150**

Table 17 : Proposed pole replacements in the ex-ante period

Actual Delivery Volume Pole (Ex Post period)	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Pole Replacement & Reinforcement Total	16,630	16,630	16,630	16,630	16,630	**83,150**

12. APPENDIX A - OPTIONS COMPARISON

The analysis, presented in Table 18 :, compares the options considered that address the identified need .

Table 18 : Comparison of options considered

Criteria	Option 1 – Replace Failed Poles Only (wood)	Option 2 – Low volume (wood)	Preferred Option Option 3 – Actual 3 Year Avg (wood)	Option 4 – Actual 3 Year Avg (concrete)	Option 5 – Actual 3 Year Avg (composite)	Option 6 – Actual 3 Year Avg + 10k low strength (3kN) poles (wood)
Net NPV	-$187,889,627	-$86,177,397	$380,460,391	-$2,658,890,817	-$5,810,001,467	$1,039,131,613
Investment Risk	Very Low	Low	Medium	High	Very High	Medium
Benefits	Low	Medium	High	Very Low	Very Low	Very High
Delivery Constraint	Very Low	Low	Medium	Medium	Medium	High
Detailed analysis – Benefits	• Will remove constraints on delivery and provide resources for other requirements • Large cost saving of $314m • Do minimum.	• Reduce delivery constraint • Saving of $108m	• Positive NPV • Additional $695 customer benefit • Reduced failure rate	• Reduced failure rate • Installing a robust material compared to wood	• Reduced failure rate • Installing a robust material compared to wood	• Positive NPV • Highest additional customer benefit of $1,622m • Reduced failure rate
Detailed analysis – Costs	• Increased risks for community $502m • Highest failure rate	• Increased risk for community $195m • High failure rate	• Additional investment of $315m • Impact on delivery requirement.	• Additional investment of $871m	• Additional investment of $1,535m	• Additional investment of $584m

Criteria	Option 1 – Replace Failed Poles Only (wood)	Option 2 – Low volume (wood)	Preferred Option Option 3 – Actual 3 Year Avg (wood)	Option 4 – Actual 3 Year Avg (concrete)	Option 5 – Actual 3 Year Avg (composite)	Option 6 – Actual 3 Year Avg + 10k low strength (3kN) poles (wood)
				• Additional risk of $1,788m due to higher cost • Impact on delivery requirement.	• Additional risk of $4,275m due to higher cost • Impact on delivery requirement.	• High impact on delivery requirement.

13. APPENDIX B – REVISED MODELLING APPROACH

Following feedback from the AER on the CBA modelling used for the Regulatory Proposal, Ergon Energy modified our modelling approach for the Revised Regulatory Proposal. As a result of the improvements and updates, there has been a progression in the outputs for poles as reflected in Table 19 :.

Table 19 : Differences in model outputs for poles between the Regulatory Proposal and Revised Regulatory Proposal

Enhancements	Regulatory Proposal	Revised Regulatory Proposal
Individual Pole	Calculated health index	Calculated health index, estimated optimised timing
Benefit Analysis Period	20 years	50 years
Replacement Prioritisation	Based on health index	Risk Based
Data Quality Validation	Accepted given data	Validation against actual decommission, removed disposed poles (leads to reduction in optimised pole in first year from 50,000 to 22,248)
LV Feeder Reliability Cost	Based on upstream feeder - average load	Based on average LV feeder load (leads to more realistic risk value)
Degraded Reliability Cost	10% of feeder reliability cost	1% of feeder reliability cost
VCR Derivation	Average AER 2022: $47.27	Weighted Average AER 2023: $53.47
Year 1 Total Risk Cost (16,600pa Defective Pole Replacement Volume)	$266,025,735	$88,914,775
Risk Cost Validation	Compared intervention options	3 year historical actual unassisted pole failure outage ($20.7m) vs year 1 modelled reliability cost ($18.2m)

Enhancements	Regulatory Proposal	Revised Regulatory Proposal
Health Score Factor (CM4 and CM5)	0.8 – asset HI starts to reduce	1.0 – leads to minor increase in PoF causes increase in risk cost as well

14. GLOSSARY

Term	Meaning
AER	Australian Energy Regulator
BAU	Business-as-usual
Capex	Capital expenditure
CBRM	Condition Based Risk Management
CDF	Cumulative Distribution Function
CNAIM	Common Network Asset Indices Methodology
CoF	Consequence of Failure
DNSP	Distribution Network Service Provider
ESCOP	Electrical Safety Code of Practice
HI	Health Index
kN	Kilonewton
kVA	Kilovolt ampere
kW	Kilowatt
LoC	Likelihood of Consequence
LV	Low voltage
NER (or Rules)	National Electricity Rules
NPV	Net Present Value
PoF	Probability of Failure
Repex	Replacement capital expenditure
SFAIRP	So Far As Is Reasonably Practicable