Pole Top Structure 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
5.5.03B	Ergon - 5.5.03B – Cost Benefit Analysis Pole Top Structure Examples - October 2024 – public	Excel
5.5.03C	Ergon - 5.5.03C - NPV Model - Pole Top Structure Replacement (Ex-Ante) - November 2024 - confidential	Excel
5.5.03D	Ergon - 5.5.03D – C3 Defect Information - October 2024 - public	Excel
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	PDF
5.5.01E	Ergon - 5.5.01E – Model validation- Reliability Cost Estimation – November 2024 - public	Excel

1 SUMMARY

Title	ERG Pole Top Structure 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: • Outline the drivers and need for the proposed investment in pole top structure replacements • Evaluate the benefits of the proposed volume and investment in, pole top structures (mainly crossarms) for 2025-30 regulatory period • Demonstrate that Ergon Energy's forecast capital expenditure over the regulatory period is efficient via a cost-benefit analysis (CBA).
Identified need	☐ Legislation ☒ Regulatory compliance ☒ Reliability ☐ CECV ☒ Safety ☒ Environment ☒ Financial ☐ Other Ergon Energy's current strategy for pole top structure replacements is driven by well-established inspection programs to identify observed structural degradation. Replacements of pole top structures are actively managed through a condition-based approach. However, the current strategy has not delivered the desired level of improvements to our service levels which our customers expect and require. Therefore, there is an identified need to implement a step-change in our replacement strategy, which includes introducing a proactive replacement approach in order to improve asset performance. Ergon Energy has identified approximately 80,000 pole top structures as being in a degraded condition. Moreover 30% of the in-service population is 35 years or older. Investment in the reactive and targeted replacement of pole-top structures (predominantly crossarms) is required to manage reliability, financial, safety, and environmental risks and consequences that may arise due to the failure of a pole top structure. It should be noted that approximately 20% of crossarm failures lead to conductors dropping or sliding down the pole which can cause significant safety risk to the community. While there is no change in the current trend in defect driven replacement of pole top structures, Ergon Energy has identified a need to take a proactive approach in replacing additional pole top structure replacements which have been classified as condition defects (C3 with emerging defects) that may result in a failure if left unattended and increased level of P2 defects that needs to be rectified within prescribed time that will apply pressure of deliverability and management of risk. This proposed program would be incremental to the defect replacement program. Ergon

Energy is proposing to address approximately 10% of the C3 defects in the 2025-30 period to examine whether this strategy will yield the necessary improvements to the service levels and reliability for our customers.

Summary of options considered

The counterfactual option is based on historical defect average (8,736 pole tops per annum). The historical average used in the counterfactual has been based on three-year actual defects averaged over the period 2020/21, 2021/22 and 2022/23.

Four options were considered and compared against the counterfactual replacement option in order to meet the identified need:

1. Option 1: Replace Only Failed Pole Top Structures | Total replaced units: 1,952
2. Option 2: Replace Defect + Targeted (3,500) | Total replaced units: 61,180
3. Option 3: Replace Defect + Targeted (7,000) | Total replaced units: 78,680 (recommended)
4. Option 4: Optimum Replacement Volume (34,528) | Total replaced units: 172,640

Post 2010, crossarms were replaced predominantly with composite and only with wood where composite usage is not feasible.

Expenditure of Proposed Program

Ergon Energy are proposing to pursue **Option 3 – Defect + Targeted** which will replace 15,736 pole top structures per annum based on the historical defect replacement program + 7,000 targeted pole top structures. This is approximately 10% of identified C3 defects and we will target replacements in high-risk areas such as schools, pools and highly densely populated areas.

This business case relates only to defective and targeted pole top structure replacements. Consequential investment under other programs are included in the respective business cases. (e.g. Poles Business case, attachment 5.5.02A)

Expenditure of the Preferred Option 3: Defect + 7,000 Targeted

Year $m, direct 2024-25	**2025-26**	**2026-27**	**2027-28**	**2028-29**	**2029-30**	**2025-30**
Defect	**27.4**	**27.5**	**27.7**	**27.9**	**28.1**	**138.6**
Targeted Replacement	**22.6**	**22.7**	**22.8**	**22.9**	**23.1**	**114.0**
Total	**50.0**	**50.2**	**50.5**	**50.8**	**51.2**	**252.6**

Preferred Option

Ergon Energy is committed to adopting an economically viable, customer value-based approach when it comes to ensuring the safety and reliability of the network. To demonstrate the advantages of this approach for the community and businesses, we have employed cost benefit analysis (CBA)modelling. This commitment is in line with our efforts to maximise the value for our customers.

After a thorough evaluation of all available options, it has been determined that **Option 3** is the optimum and most efficient option that addresses the identified need. This

	option has been chosen as it demonstrates that incorporating a proactive targeted replacement approach, along with the existing defect replacement strategy, provides the highest benefits to the customer and provides a positive net NPV of $170 million over the modelling period compared to counterfactual. The targeted 7,000 per annum will focus on 10% of the already identified 80,000 C3 pole top structure defects that are primarily located in coastal regions of the Ergon Energy network, where there is generally a higher level of rainfall and therefore a higher proportion of pole top structure deterioration. Furthermore, we will continue to focus on optimising existing processes and enhancing efficiencies where possible to deliver additional benefits through consequential replacements of pole top structures in other programs.

2 PURPOSE AND SCOPE

The purpose of this business case is to outline the drivers for the proposed replacement and expenditure associated with the pole top structure replacement program for the 2025-30 regulatory period. This business case covers only the defect-based and targeted replacements of pole top structures. Consequential replacement expenditure is included in their respective business cases. The document includes the analysis of different options to address this need to demonstrate prudency through NPV modelling.

This document is to be read in conjunction with the Repex Ex-Post and Ex-Ante Narrative attachment 5.5.01A.

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

3 ASSET PORTFOLIO

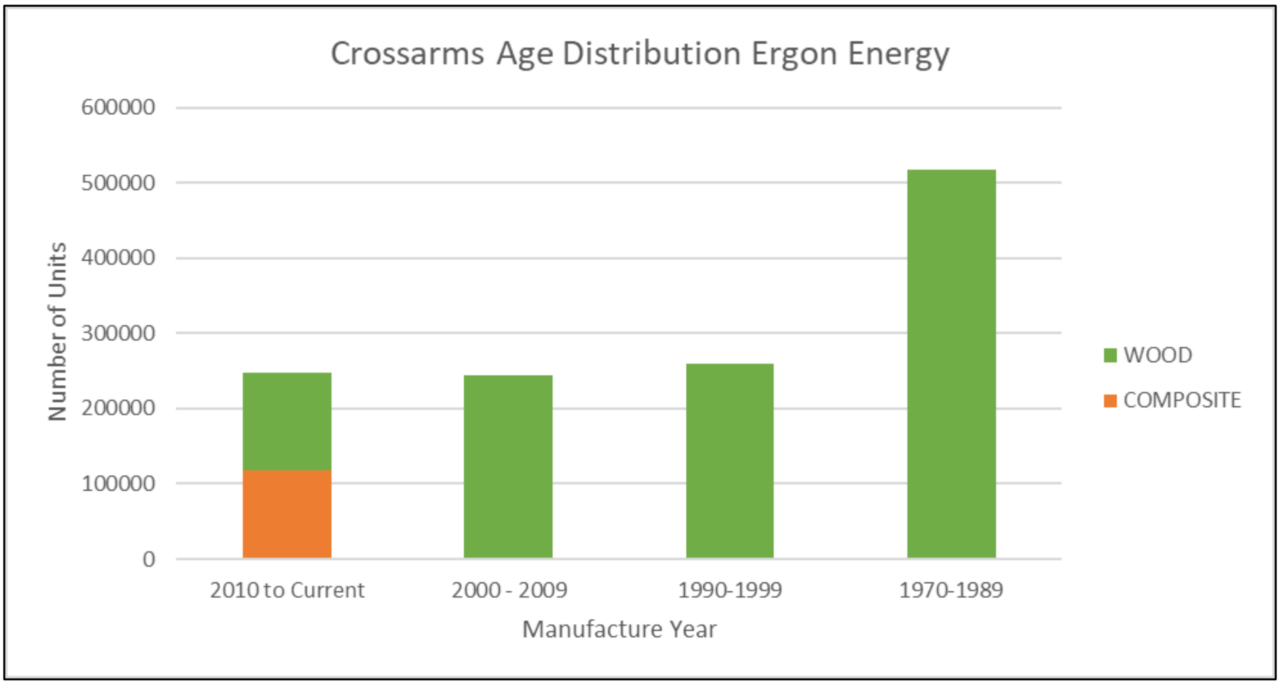
3.1 Asset Population

Ergon Energy's Network pole top structure of 1.2 million includes 1.15 million timber pole top structures with most of the remaining population being composite, as detailed in Figure 1. The age of pole top structures is inferred from the age of poles Our age profile of timber pole top structures shows that over 43% are operating beyond expected useful life, including over 500,000 older than 35 years old or their useful life.

Composite pole top structures were introduced from late 2000s and since then volumes have been increasing steadily. This increased uptake of composite pole top structures will provide significant benefits for asset longevity, electricity performance, and are more lightweight. They also deform or bend rather than break when conductors are damaged, which lowers their safety risk.

Timber pole top structures are susceptible to several life limiting factors including environmental stress such as high rainfall and extreme heat, termite and rotting impacts and splitting and a transition to composite pole top structures will minimise these impacts.

Figure 1 : Pole Top Structure Age Profile



3.2 Historical Asset Performance

Table 1 presents the two main functional failures of pole top structures.

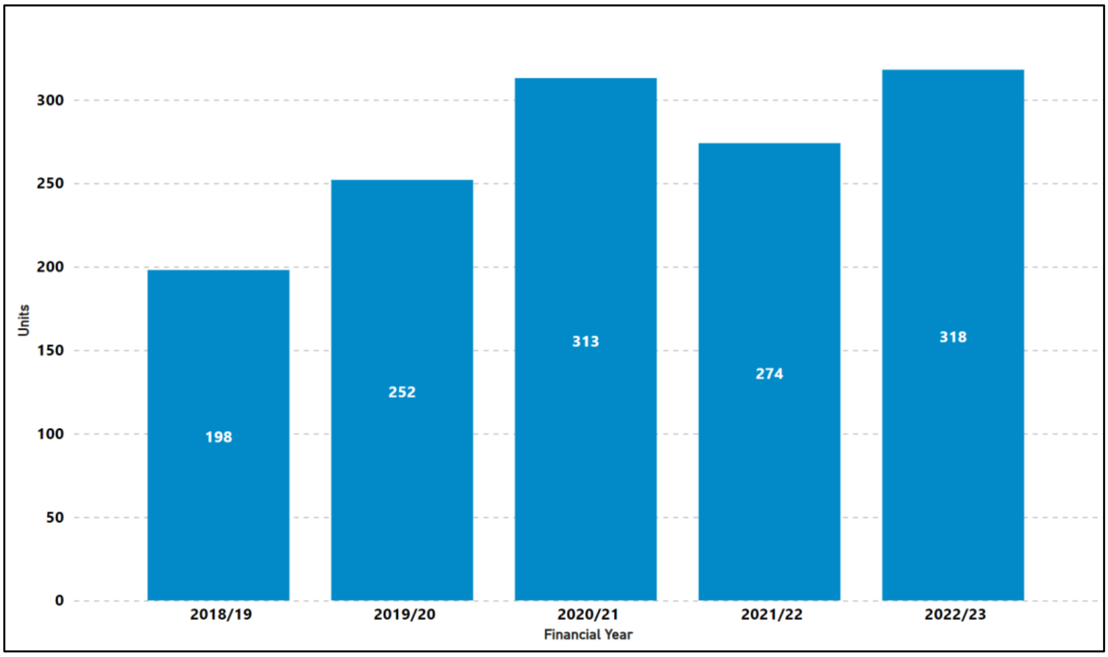
Table 1 : Description of Functional Failure

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

Figure 2 displays the number of unassisted pole top structure failures. All these failures are from wood pole top structures as there have been no reports of composite or steel pole top structure unassisted failures.

The main causes of failure are rot and decay, which make up 75% of failures. This unassisted failure data indicates a steady trend in recent three years, averaging around 300 failures per year.

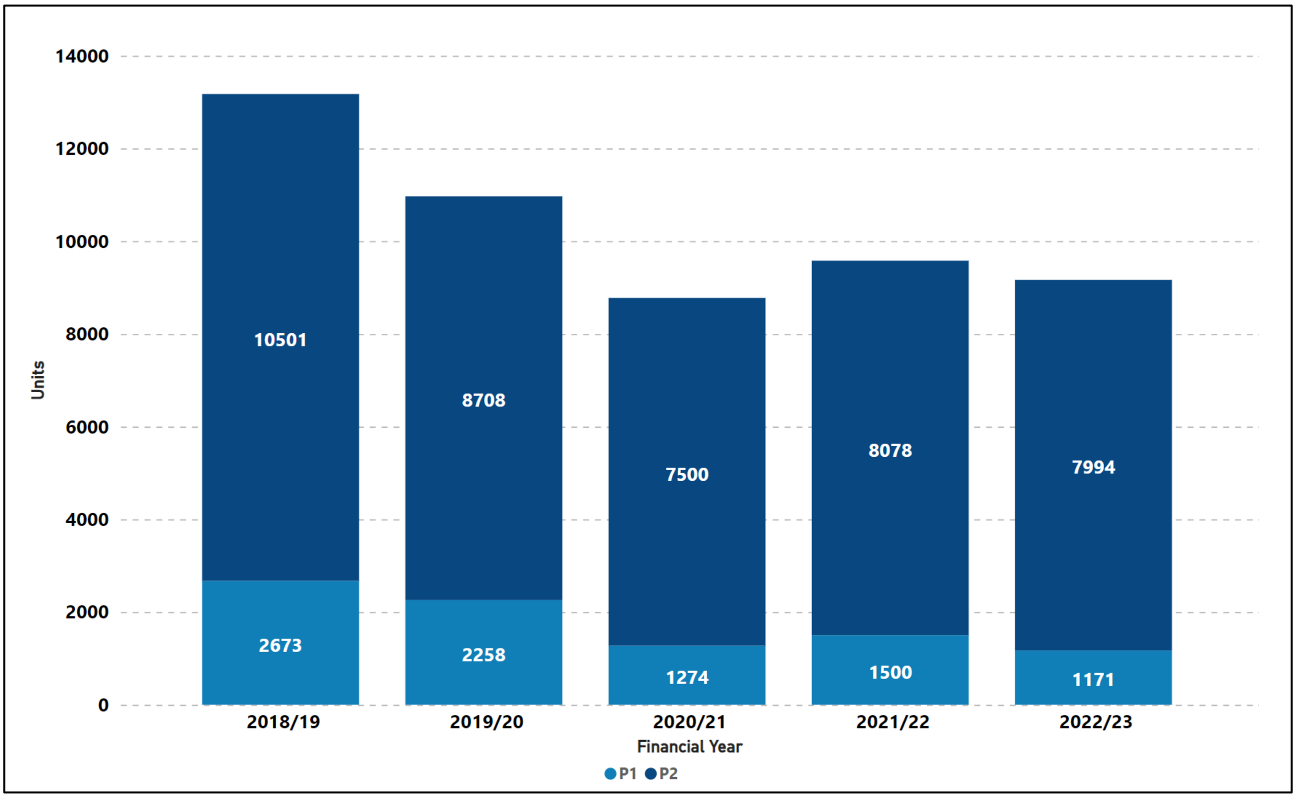
Figure 2 : Pole Top Structure Unassisted Failures



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 the priority of repair, which effectively dictates whether normal planning processes are employed (P2), or more urgent repair works are initiated (P1 and P0). C3 defects are identified from ground and aerial based inspections and are defined as minor deterioration or damage which requires no specific action or does not indicate an acceptable likelihood of failure or creation of a hazardous event in the medium term. This type of defect is the final step before the defect is classified as a P1 or P2 defect which means Ergon Energy has a responsibility to rectify within prescribed period.

Figure 3 contains the volume of pole top structure which have been identified as having P1 and P2 defects. The defect data indicates over 13,000 defects in 2018-19 followed by consistently high volumes averaging approximately 9,600 defects per year over the four subsequent years. The variation in defect volumes can be attributed to various interventional programs including proactive replacements, reconductoring, pole replacement, clearance to ground (CTG), clearance to structure (CTS), and the aerial inspection program.

Figure 3 : Pole Top Structure Defects



3.3 Asset Management

Pole top structure replacements are mostly driven by well-established inspection programs which identify severe structural strength degradation. Once identified, defects are addressed in a planned manner, aligned with defect policy time frames, to manage asset conditions. This approach helps mitigate risks and reduce the likelihood of unexpected failures by addressing potential issues before they escalate.

Ergon Energy's asset management practices include:

- Visual inspection of physical condition from ground level at approximately 270,000 sites per year on a 5-year compliance cycle;
- Aerial visual inspection carried out from helicopters/aircraft/drones at approximately 36,000 sites per year according to criteria; and
- Pole top structures inspection carried out from an elevated work platform or by climbing at approximately 6,000 sites per year on a 4- or 5-year cycle.

Physically defective pole top structures identified through inspection are replaced. They may also be proactively replaced based on risk assessment. Proactive replacement is typically undertaken with other work such as feeder refurbishment programs or bundled into logical groups for efficiency of delivery and cost. Safety risks associated with pole top structures aim to be eliminated so far as is reasonably practicable (SFAIRP) or mitigated SFAIRP. All other risks are managed as low as reasonably practicable (ALARP).

The current strategy is to transition away from timber pole top structures in favour of alternatives, such as composite pole top structures as composite pole top structures have a much longer lifespan and a lower safety risk. Since 2010, Ergon Energy predominately using composite material where possible.

We have also recently improved the quality of the collected field, population, and failure data for our pole top structure population. The improved data captured has indicated a flat rate in the past three years for unassisted pole top structure failures.

The statistical Weibull model is used for assets that only have inspection data, and no measured data to derive the Probability of Failure (PoF).

3.4 Compliance

Ergon Energy's pole top structure assets are subject to several legislative and regulatory standards. This includes:

- The Electrical Safety Act 2002 (Qld) - s29 imposes a specific duty of care on a prescribed Electrical Entity to ensure that its works are electrically safe; and operated in an electrically safe way. The duty includes the requirement that the electricity entity inspects, tests and maintains the assets and works.
- The Electrical Safety Regulation 2013:
  - details requirements for electric lines, specifically about safety clearances, of which pole top structures are classed as associated equipment. These include various general obligations related to the safety of works of an electrical entity.
  - The desired level of service for pole top structures in the Ergon Energy network is to achieve in-service pole top structure failure numbers which deliver a safety risk outcome which is considered SFAIRP.

4 PROBLEM STATEMENT

Ergon Energy's current strategy for pole top structure replacements is driven by well-established inspection programs to identify observed structural degradation. Replacements of pole top structures are actively managed through a condition-based approach.

However, the current strategy has not delivered the desired level of improvements to our service levels which our customers expect and require.

Due to our concerns with the risk of an ageing population and emerging C3 defective volumes, as well as to ensure the improvement of asset performance, we consider it important to introduce a step-change in our replacement strategy that includes a proactive and targeted replacement approach for this asset group. This will help us ensure our service levels for customers are improved.

- **Pole top structure performance has not improved**

Pole top structure risks are regularly assessed through asset inspection and defect identification processes. Our most recent analysis has revealed that unassisted failures continue to be trending upwards as shown in Figure 2.

- **Defective pole top structure presents a significant safety risk**

Currently, our pole top structure assets are ageing, presenting a growing safety risk. More than 30% of our pole top structures are operating beyond their expected useful life, increasing the risk of failure. This is a significant concern as an average of around 20% of pole top structure failures lead to a conductor falling to the ground, exposing a high safety risk to the community.

- **Growing number of C3 defects**

Our current approach is to replace the inspection-driven defective pole top structures, which is approximately 9,000 replacements per annum. However, in addition to this, we have approximately 80,000 pole top structures that have been identified as emerging C3 defects or having minor deterioration over the last 3 years. A few of these C3 defective assets will be addressed consequentially during pole and conductor replacements, at a volume similar to defect replacements, however the remaining C3 defects still present a growing risk to the network.

5 BENEFIT AND RISK ANALYSIS

5.1 Overview

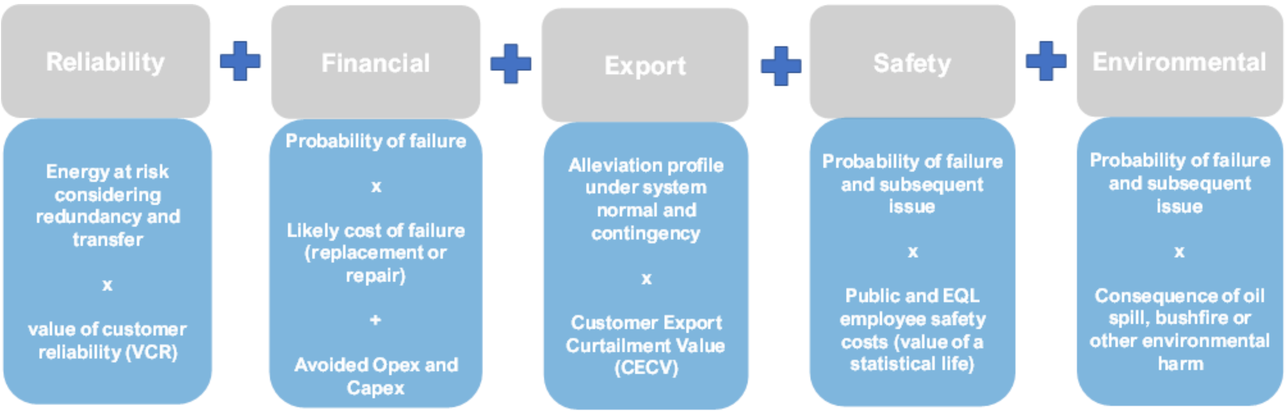
Following feedback from the AER on the CBA modelling used, we have revised our CBA and details are in Appendix B – Revised modelling approach. Our cost-benefit analysis aims to optimise our risk calculation at the program level, so that on average we will be able to maximise the benefits to our customers.

After conducting a cost-benefit analysis using net present value (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 by as per the calculation in Figure 4.

Figure 4 : Monetised Risk Calculations

Ergon Energy broadly considers five risk streams for investment justifications for the replacement of widespread assets. These are shown in Figure 5.

Figure 5 : Benefit and Risk Stream for Assets



5.2 Probability of Failure

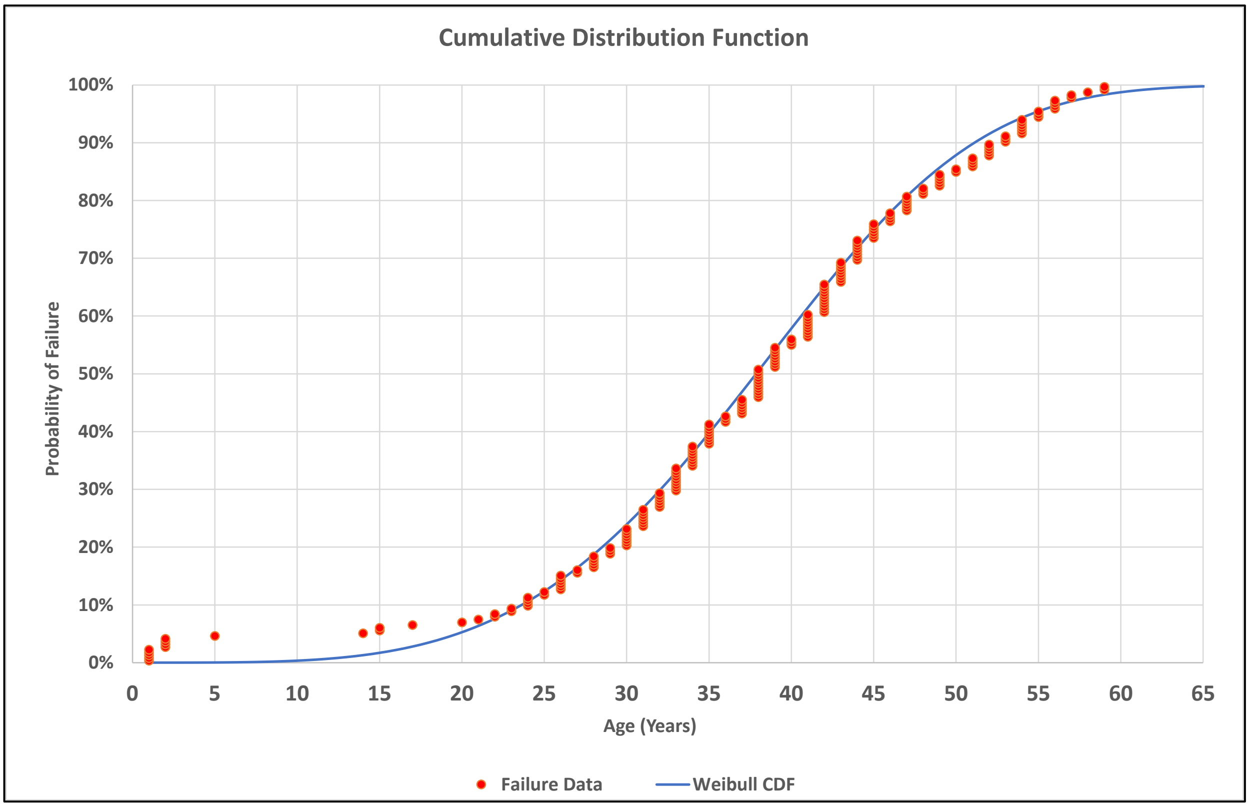
Typically, Ergon Energy uses an Asset Health Index (HI) to assess the probability of failure of an asset. However, due to the limited condition data available for pole top structures, the Weibull distribution model is used instead. The Weibull distribution is widely used due to its flexibility and ability to model skewed data. Its ability to work with an extremely small number of sample (less than 20 samples) makes it the best choice, if not the best practice.

It is a versatile distribution that can take on the characteristics of other types of distributions, based on the value of the shape parameter, beta (β) and the scale parameter, eta (η). Shape parameter eta defines the average period when 63.2% of asset population is expected to fail. The other parameter represents the failure rate behaviour, if beta is less than 1, then the failure rate decreases with time; if beta is greater than 1, then the failure rate increases with time. When beta is equal to 1, the failure rate is constant.

The function used to determine the probability of failure from a particular asset's age is the Cumulative Distribution Function (CDF). By modelling historical pole top structure failures and age at the time of failure, a Weibull curve can be derived which can then be used to estimate the probability of failure (PoF) for each age group.

Figure 6 shows the Weibull cumulative distribution function for pole top structures.

Figure 6 : Pole top structure failure plot against Weibull CDF Curve



The resulting Weibull parameters are outlined in Table 2.

Table 2 : CDF Weibull Variables

Weibull Variables	Value
Beta β	4
Eta η	41.5

5.3 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 a failure event (such as a bushfire) were to occur.

The LoC refers to the probability of a particular result (e.g. an outage or fatality) occurring because of a failure event (e.g. ageing of the asset). 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 top structure age-band specific. This is particularly the case for the reliability and benefits stream, where the site-specific location and bushfire risk informs the benefits calculations for preventing unassisted pole top structure failures.

5.3.1 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 top structure failure:

- **Lost load:** Each pole top structure in our network is modelled individually, with the relationship developed between a pole top structure and the pole and feeder/conductor that it is supporting. The historical average load on each feeder in our network is used to determine the kilowatt (kW) that would on average be lost following a pole top structure failure. We have used half of the historic average load on the feeder, which represents the most likely outcome. This is because a pole top structure is not a uniquely identified asset and therefore the data regarding the exact electrical location of the pole top structure in a feeder is not feasible to obtain.
- **Load transfers and Restoration time frame:** The average loss of supply has been estimated for a period of average 4 to 9 hours based on locality, staged restoration

approach, and historical data for outages/durations. This is based on the average load on our fleet of feeders, divided under rural short, rural long, urban, and sub-transmission.

- **Value of Customer Reliability Rate:** We have used the Queensland average Value of Customer Reliability (VCR) rate.
- **Probability of Consequence:** For modelling purposes, any pole top structure failure that results in a conductor drop has been assumed to cause an outage to customers.

5.3.2 Financial

The financial cost of failure is derived from an assessment of the likely replacement costs incurred by the failure of an asset that is replaced under emergency. The same unit cost has been taken for replacement in both planned and unplanned circumstances. Historical average cost has been used for this purpose and is approximately $2,800.

5.3.3 Safety

The primary safety risk for a pole top structure failure is that a member of the public could be in the presence of a fallen conductor which was caused by pole top structure failure. This could result in a fatality or injury. For our modelling, we have used the Best Practice Regulation Guidance Note[1] 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 internal staff
- **Probability of Consequence:** Following an unassisted pole top structure failure, there is a 1 in 20-year chance of causing a fatality and 25 in 20-year chance of a serious injury based on historical data evidence.[2]

[1] 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

[2] The average number of safety incidents has been derived by analysing 20 years of significant electrical incident data comprising 26 incidents where unassisted asset failure has driven a safety incident of the appropriate severity. Historically, the data shows that pole top structure have not been the cause of fatality, therefore the fatality incident due to a conductor asset unassisted failure has instead been considered for modelling purpose.

5.3.4 Environment (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 top structure and conductor. For our modelling, we have used:

- **Value of Bushfire:** $22.3m – which is the average damage to housing and fatalities following a bushfire starting.[3]
- **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 top structure, 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 pole top structure 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. A fire is also only considered to be possible if the conductor has dropped and made contact with the ground due to the failure of a pole top structure. In 2021, a total of 56 conductors dropped in the 274 failures recorded. Therefore a 20.4% factor has been considered as part of the probability of consequence.

[3] 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

6 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. 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.

The counterfactual considered in this business case is continuing with the existing strategy of replacing pole top structures based on historical defect average of 8,736 pole tops per annum. This is representative of the three-year actual defects averaged over the period 2020/21, 2021/22 and 2022/2023.

6.1 Counterfactual Costs and Volumes

The estimated volume and expenditure for the counterfactual option are shown in the tables below. Table 4 shows that, although the volume remains constant each year, the cost varies. This is due to the differing unit costs associated with each voltage category.

Table 3 : Counterfactual Option – Volumes

Year	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Volume	8,736	8,736	8,736	8,736	8,736	**43,680**

Table 4 : Counterfactual Option – Costs

Year	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Costs ($m) *	35.2	30.2	31.1	29.1	30.6	**156.3**

*Variation in cost is due to the differing unit costs associated with each voltage category.

6.2 Counterfactual Risk and Benefit Quantification

Ergon Energy has determined the risk and benefits over a thirty-five-year time horizon as a period representative of the expected period of realisable benefits from any interventions. Figure 7 and Figure 8 provides the results of the counterfactual failure forecast and quantitative forecast of emerging risk associated with Ergon Energy pole top structure asset population failure. The risk increases substantially due to a large number of poor condition (end of service life) pole top structures over 35 years still being in service requiring intervention and posing safety and reliability risk to community.

Figure 7 : Unassisted Failures Forecast: Counterfactual

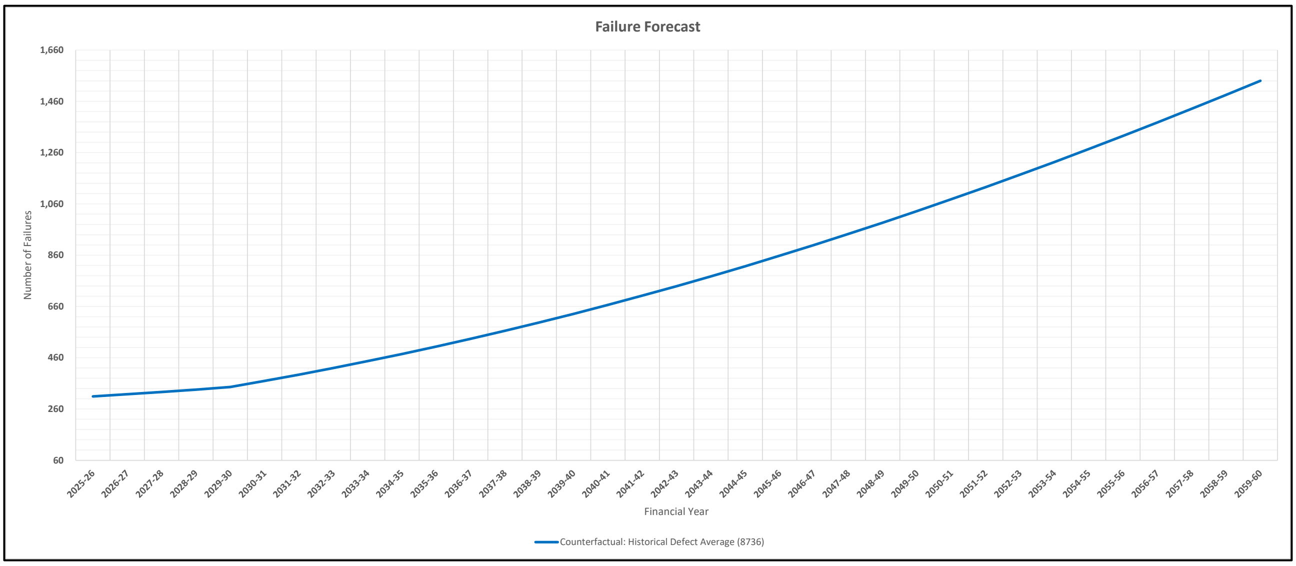
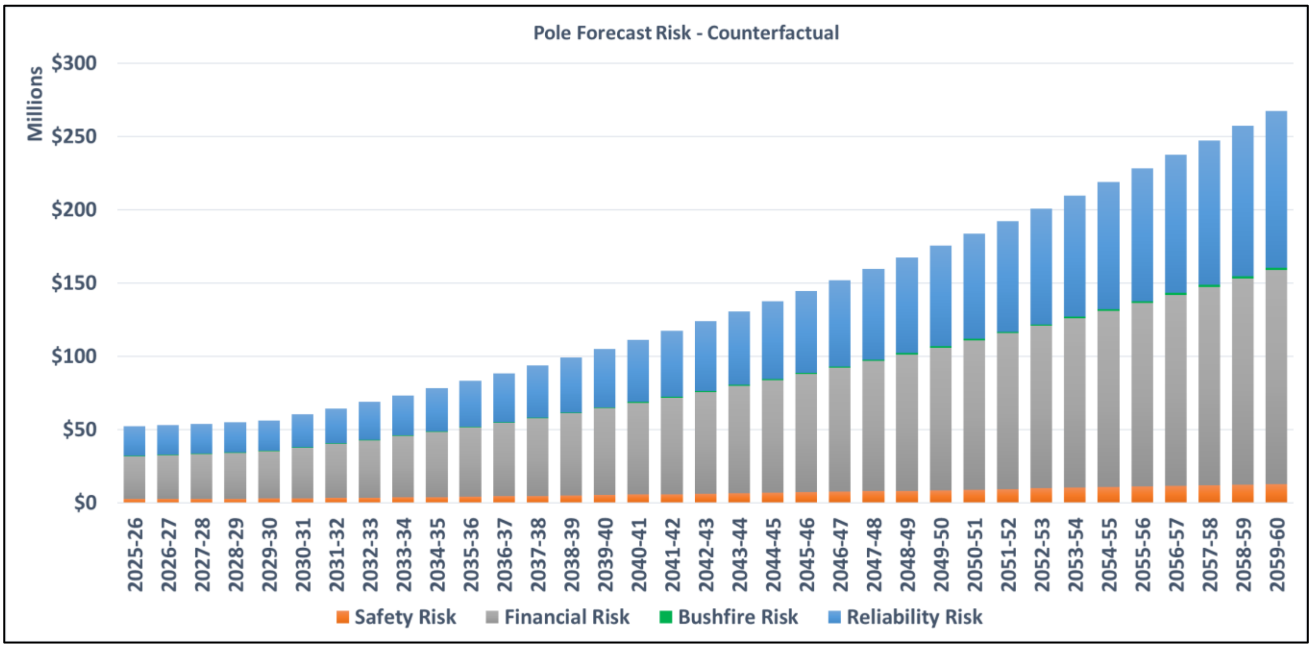


Figure 8 : Counterfactual Quantitative Risk Assessment



7 OPTIONS AND ECONOMIC ANALYSIS

7.1 Overview of Options

We have considered and compared a range of potential options against the counterfactual / business-as-usual approach 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 that have been considered include:

- Option 1 – replace only those pole top structures that have failed
- Option 2 – replace those pole top structures that have been identified as defective as well as a low volume 3,500 (5% of C3) of targeted / proactive pole top structures that have been identified as a C3 emerging defect
- Option 3 - replace those pole top structures that have been identified as defective as well as a 7,000 (10% of C3) targeted / proactive pole top structures that have been identified as a C3 emerging defect
- Option 4 – replace 172,640 in 5 years estimated from CBA analysis has been deemed the optimal replacement volume.

Table 5 : Summary of Options costs and volumes

Option	Counterfactual – Historical Defect Average (8736)	Option 1 – Replace Failed Pole Top Structures	Option 2 – Defect + Targeted (3,500)	Option 3 – Defect + Targeted (7,000)	Option 4 – Optimal replacement volume
Costs ($m)	156.3	9.0	210.3	263.9	549.7
Volumes	43,680	1,952	61,180	78,680	172,640

Table 6 : Costs for each option over 2025-30 period

Costs ($m)	2025 – 2026	2026 – 2027	2027 – 2028	2028 – 2029	2029 – 2030
Counterfactual – Historical Defect Average (8736)	35,192,324	30,203,478	31,145,244	29,156,664	30,619,490
Option 1 – Replaced Failed Pole Top Structure	1,688,792	1,358,541	1,938,965	1,971,696	2,070,349
Option 2 – Defect + Targeted (3500)	47,120,990	42,184,012	41,251,430	42,319,556	37,434,724
Option 3 – Defect + Targeted (7000)	59,919,636	53,674,136	50,825,068	50,772,916	48,710,904
Option 4 – Optimum Replacement Volume (34528)	122,886,856	110,074,580	106,523,340	105,215,010	105,016,630

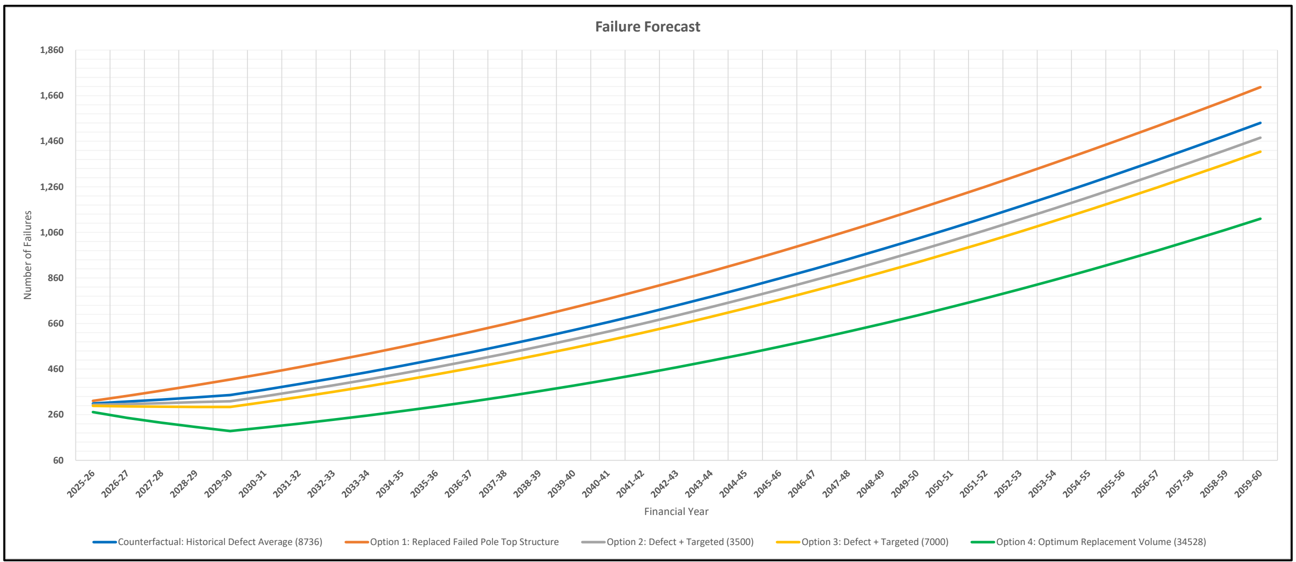
Table 7 : Volumes for each option over 2025-30 period

Volumes	2025 – 2026	2026 – 2027	2027 – 2028	2028 – 2029	2029 – 2030
Counterfactual – Historical Defect Average (8736)	8,736	8,736	8,736	8,736	8,736
Option 1 – Replaced Failed Pole Top Structure	343	366	389	414	440
Option 2 – Defect + Targeted (3500)	12,236	12,236	12,236	12,236	12,236
Option 3 – Defect + Targeted (7000)	15,736	15,736	15,736	15,736	15,736
Option 4 – Optimum Replacement Volume (34528)	34,528	34,528	34,528	34,528	34,528

7.2 NPV and Economic Analysis

The pole top structure failure forecast for all options is shown in Figure 9. In Option 1, where defects are left unattended, unassisted failures will escalate significantly to an unsustainable level. Option 2 and Option 3 (Preferred Option) are expected to produce better outcome than counterfactual, with Option 4 providing least failure rate among options considered but an expensive and delivery risk option.

Figure 9 : Unassisted Failures Forecast: All Options



The risk cost for each of the options considered are provided in Table 8.

Table 8 : Total Risk Cost: All Options

Options	Year 1 Risk	Year 5 Risk	Year 10 Risk	Year 20 Risk	Year 35 Risk
Counterfactual – Historical Defect Average (8736)	$ 52,141,280	$ 56,338,972	$ 78,139,932	$ 137,550,499	$ 267,223,491
Option 1 – Replaced Failed Pole Top Structure	$ 55,385,816	$ 71,417,163	$ 96,882,694	$ 164,237,906	$ 305,098,696
Option 2 – Defect + Targeted (3500)	$ 50,952,521	$ 51,551,714	$ 72,189,143	$ 129,092,536	$ 255,296,194
Option 3 – Defect + Targeted (7000)	$ 49,831,284	$ 47,243,095	$ 66,769,164	$ 121,238,378	$ 243,979,738
Option 4 – Optimum Replacement Volume (34528)	$ 44,528,985	$ 29,777,474	$ 44,259,376	$ 87,365,065	$ 193,186,480

The NPV ranking and economic analysis is summarised in Table 9 which demonstrates that:

- Counterfactual option does not meet the identified need and problem

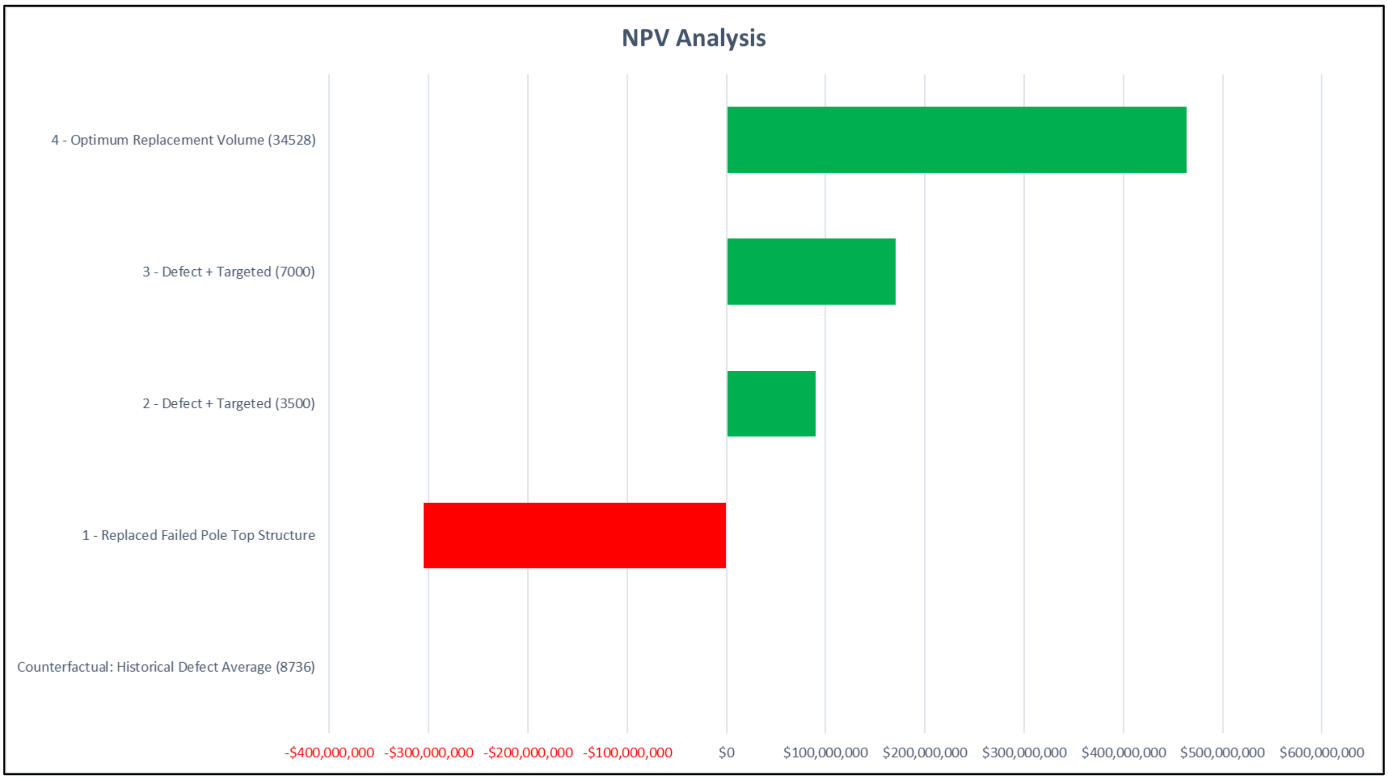
- Option 2, 3 and 4 demonstrate a positive NPV against the counterfactual, compared to Option 1 which provides a negative NPV
- Option 4 has the highest NPV to meet the identified need. However, it will require additional resourcing and presents deliverability concerns.
- **Option 3 is the preferred option** as it NPV positive, meets the identified need and has no deliverability risks. It also delivers a high benefit-to-cost ratio which indicates a substantial benefit over the costs. Whilst Option 2 is also NPV positive, it only addresses 5% of the identified C3 emerging defects and therefore does not fully address the identified need.

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 – Historical Defect Average (8736)	4	4	$0	$0	$0
Option 1 – Replaced Failed Pole Top Structure	5	5	-$304,876,523	$138,035,620	-$442,912,143
Option 2 – Defect + Targeted (3500)	3	1	$90,119,907	-$50,749,551	$140,869,458
Option 3 – Defect + Targeted (7000)	2	2	$170,307,005	-$101,037,845	$271,344,851
Option 4 – Optimum Replacement Volume (34528)	1	3	$463,961,423	-$368,664,018	$832,625,441

Figure 10 illustrates the NPV analysis of the options against the counterfactual.

Figure 10 : NPV Analysis for Each Option Against Counterfactual



7.3 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
Time period for calculating costs and benefits	35	Years	

7.4 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. 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 FY2022-23, the outage reliability cost due to unassisted pole failures of $11.6m is comparable with the year 1 predictive model output of $14.9m. (attachment 5.5.01E)

7.5 Sensitivity Analysis

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

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

Option 4 – Optimum Replacement Volume (34528) has been demonstrated as the most prudent option.

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 – Historical Defect Average (8736)	4	0	0	0
Option 1 – Replaced Failed Pole Top Structure	5	-375,766,173	140,232,079	-515,998,252
Option 2 – Defect + Targeted (3500)	3	112,481,748	-51,521,233	164,002,980
Option 3 – Defect + Targeted (7000)	2	213,483,606	-102,593,362	316,076,967
Option 4 – Optimum Replacement Volume (34528)	1	596,946,813	-374,536,258	971,483,071

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 – Historical Defect Average (8736)	4	0	0	0
Option 1 – Replaced Failed Pole Top Structure	5	-251,985,023	135,911,444	-387,896,466
Option 2 – Defect + Targeted (3500)	3	73,276,233	-50,002,246	123,278,479
Option 3 – Defect + Targeted (7000)	2	137,229,088	-99,532,716	236,761,804
Option 4 – Optimum Replacement Volume (34528)	1	355,741,617	-362,984,532	718,726,149

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

-25% Risk/Benefit				
Intervention	**Rank**	**Net NPV**	**CAPEX (NPV)**	**Benefit (NPV)**
Counterfactual – Historical Defect Average (8736)	4	0	0	0
Option 1 – Replaced Failed Pole Top Structure	5	-188,408,652	138,035,620	-326,444,272
Option 2 – Defect + Targeted (3500)	3	52,991,870	-50,749,551	103,741,421
Option 3 – Defect + Targeted (7000)	2	98,217,331	-101,037,845	199,255,176
Option 4 – Optimum Replacement Volume (34528)	1	236,350,647	-368,664,018	605,014,665

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

+25% Risk/Benefit				
Intervention	**Rank**	**Net NPV**	**CAPEX (NPV)**	**Benefit (NPV)**
Counterfactual – Historical Defect Average (8736)	4	0	0	0
Option 1 – Replaced Failed Pole Top Structure	5	-406,038,167	138,035,620	-544,073,787
Option 2 – Defect + Targeted (3500)	3	122,152,817	-50,749,551	172,902,368
Option 3 – Defect + Targeted (7000)	2	231,054,115	-101,037,845	332,091,960
Option 4 – Optimum Replacement Volume (34528)	1	639,693,758	-368,664,018	1,008,357,775

8 RECOMMENDATION

After a thorough evaluation of all available and feasible options, Option 3 is the optimum and most efficient option that addresses the identified need. This option has been chosen as it demonstrates that incorporating a proactive targeted replacement approach, along with the existing defect replacement strategy, provides the highest benefits to the customer and provides a positive net NPV of $170 million over the modelling period. The targeted 7,000 per annum will focus on 10% of the already identified 80,000 C3 pole top structure defects that are primarily located in coastal regions of the Ergon Energy network, where there is generally a higher level of rainfall and therefore a higher proportion of pole top structure deterioration.

Furthermore, we will continue to focus on optimising existing processes and enhancing efficiencies where possible to deliver additional benefits through consequential replacements of pole top structures in other programs.

Option 3 reflects a tolerable risk position which balances the achievement of asset management objectives and customer service levels and ensures a level of investment which avoids future consequences based on the uncertainty associated with the capability new technologies may bring.

APPENDIX A – OPTIONS COMPARISON

The analysis presented in Table 15 compares the options to the respective counterfactual alternative.

Table 15 : Comparison of options considered

Criteria	Option 1 – Replace Failed Pole Top Structure	Option 2 – Defect Volume + 3,500 targeted	Preferred Option Option 3 - Defect Volume + 7,500 targeted	Option 4 – Optimum replacement volume
Net NPV	-$304,876,523	$90,119,907	$170,307,005	$463,961,423
Investment Risk	Very Low	Medium	High	Very High
Benefits	Very Low	Low	Medium	High
Delivery Constraint	Very Low	Medium	High	Very High
Detailed analysis – Benefits	• Will remove constraints on delivery and provide resources for other requirements • Large cost saving of $138m • Do minimum.	• Positive NPV • Additional $140m customer benefit • Reduced failure rate • Targets high risk assets	• Positive NPV • Additional $271m customer benefit • Reduced failure rate • Targets high risk assets	• Positive NPV • Additional $833m customer benefit • Reduced failure rate • Replaces assets with the highest risk
Detailed analysis – Costs	• Increased risks for community $443m • Highest failure rate	• Additional investment of $51m • Impact on delivery requirement.	• Additional investment of $101m • High Impact on delivery requirement.	• Additional investment of $369m • Very high Impact on delivery requirement.

APPENDIX B – REVISED MODELLING APPROACH

Following feedback from the AER on the CBA modelling used for the Regulatory Proposal and the feedback from our workshops with the AER, we have modified our modelling approach for the Revised Regulatory Proposal. Due to the step change of replacements proposed for pole top structures, this is considered an ex-ante forecast. Table 16 provides the outputs as a result of this change.

Table 16: Differences in model outputs for pole top structures between the Regulatory Proposal and Revised Regulatory Proposal

Enhancements	Regulatory Proposal	Revised Regulatory Proposal
Analysis Period	20 years	35 years
Replacement Prioritisation	Probability of failure	Highest risk
Risk Cost (Safety, Financial, Reliability & Bushfire)	Grouped by age	Cost for each individual pole top structure
Degraded Safety Cost	5% of safety cost	Removed
Location Safety Factor	Not used	Yes
Degraded Reliability Cost	10% of feeder reliability cost	1% of feeder reliability cost
Degraded Bushfire Cost	10% of bushfire cost	Removed
VCR Derivation	Average AER 2022: $47.27	Weighted Average AER 2023: $53.47
Year 1 Total Risk Cost (8,736pa Defective Pole Top Replacement Volume)	$188,026,162	$52,141,280
Risk Cost Validation	Compared intervention options	3-year historical actual unassisted pole top failure outage vs year 1 modelled reliability cost ($11.6m vs $14.9m)

9 GLOSSARY

Term	Meaning
AER	Australian Energy Regulator
ALARP	As low as reasonably practicable
CBA	Cost Benefit Analysis
CBRM	Condition Based Risk Management
CDF	Cumulative Distribution Function
CNAIM	Common Network Asset Indices Methodology
CoF	Consequence of Failure
C3	Condition defects
DNSP	Distribution Network Service Provider
kVA	Kilovolt ampere
kW	Kilowatt
LoC	Likelihood of Consequence
LV	Low voltage
NPV	Net Present Value
PoF	Probability of Failure
Repex	Replacement capital expenditure
SFAIRP	So Far As Is Reasonably Practicable
VCR	Value of Customer Reliability