Business Case
Poles and Towers
Replacement Program

ERGON ENERGY NETWORK

Executive Summary

This document seeks funding for a program of Pole remediation activities in Ergon Energy to the total value of $375.8M. This initiative targets the highest risk poles through the inspection and remediation program and does not include replacements required due to damage incurred through bush fires.

Ergon Energy aims to minimise expenditure in order to keep pressure off customer prices, however understands that this must be balanced against critical network performance objectives. These include network risk mitigation (e.g. safety, bushfire), regulatory obligations (e.g. safety), customer reliability and security and preparing the network for the ongoing adoption of new technology by customers (e.g. solar PV). In this business case, compliance obligations, safety and customer reliability are strong drivers of the need for this work.

Under the Queensland Electrical Safety Act and associated regulations, Ergon Energy (Ergon) has an obligation to ensure that its works are electrically safe, are operated in a way that is electrically safe and to ensure the electrical safety of all persons and property likely to be affected by the electrical work. This includes a duty to ensure that it does all that is reasonably practicable - *including that which was reasonably able to be done at a particular time* - to ensure electrical safety risks are managed to the level so far as is reasonably practicable (SFAIRP). The pole remediation program is one important part of delivering an overall safe outcome for the community.

The historical approach to pole remediation in Ergon has been through periodic inspection and replacement or nailing of defective poles. An early 2019 review of the pole strength calculation algorithm in Ergon resulted in a change to this algorithm to align it with the methodology used in Energex, and in accordance with Australian Standards. This change led to an increase in defect rates for poles, and this proposal sets out a higher level of remediation in line with the revised quantities. Three options have been considered as follows:

- Counterfactual: Historical Replacement Volumes
- Option 1: Condition-based quantities, new algorithm (Proposed)
- Option 2: Condition-based replacement program (old algorithm)

Detailed quantitative risk analysis has shown an escalating trend of expected pole failures for the counterfactual case and customer safety and reliability risks increase over time.

The quantified economic value of the risks exceeds the costs of a significant replacement program as in Option 1 and as such Option 1 provides a preferable NPV to the counterfactual. The modelled result for option 1 shows that pole failure rates are likely to continue to breach the Code of Practice standard in future years, and hence increasing remediation programs will be required in future.

The proposed Option 1 also provides the least regret value of all options. This option includes a total proposed program of 64,797 poles to be remediated (nailing and replacement) at an estimated total cost of $375.8M over the 2020-25 regulatory control period. The direct cost of the project for each submission made to the AER is summarised in the table below. Note that all figures are expressed in 2018/19 dollars and apply only to costs incurred within the 2020-25 regulatory period for the preferred option.

Regulatory Proposal	Draft Determination Allowance	Revised Regulatory Proposal
$315.2M	Reduced Due to Modelled Repex	$375.8M

Contents

1. Introduction

This program is targeted at remediation of poles in order to comply with regulatory obligations, maintain service delivery performance including customer reliability standards and customer quality standards, and maintain the safety of the network for the Queensland community.

Poles are inspected periodically as required by Queensland legislation. Poles require very little maintenance except for removal of vegetation, and termite and bacteria barrier treatments, normally carried out during the inspection process. The majority of pole replacements are driven by well-established inspection programs to identify structural strength degradation. Structural strength is determined in accordance with AS/NZS 7000:2016 Overhead Line Design.

1.1 Purpose of document

The purpose of this document is to outline the forecast volumes of replacement and expenditure associated with poles and towers in accordance with the lifecycle management strategies detailed in the Asset Management Plan (AMP) – Poles and Lattice Towers. This document also provides a summary of the impact of the program in terms of performance and cost to demonstrate prudency and efficiency.

This is a preliminary business case document and has been developed for the purposes of seeking funding for the required investment in coordination with the Ergon Energy Revised Regulatory Proposal to the Australian Energy Regulator (AER) for the 2020-25 regulatory control period. Prior to investment, further detail will be assessed in accordance with the established Energy Queensland (EQL) investment governance processes. The costs presented are in $2018/19 direct dollars.

This document is to be read in conjunction with the AMP which contains detailed information on the asset class, populations, risks, asset management objectives, performance history, influencing factors, and the lifecycle strategy.

1.2 Scope of document

The scope of this forecast expenditure covers all poles and towers that are forecast to be replaced under several capital replacement programs, including Condition and Risk as well as Reactive programs. It does not include replacements required due to damage incurred from bush fires. The key programs which drive the volume forecast in the 2020-25 Regulatory Control Period are as follows, noting that only the poles components are included in this business case:

- Lines Pole Replacement Routine Program (Condition and Risk)
- Lines Low Voltage (LV) Overhead (OH) Reconductoring Program (Condition and Risk)
- Lines High Voltage (HV) OH Reconductoring Program (Condition and Risk)
- Lines AIDM1 P12 Defects Non-Routine Multi NAMP3 (Reactive)
- Lines AIDM P24 Defects Non-Routine Multi NAMP (Reactive)
- Lines Return To Service Non-Routine Multi NAMP (Reactive)
- Lines Conductor to Ground Clearance Routine Program (Reactive)

[1] Asset Inspection Defects Manual
[2] Serious deterioration or damage, which requires some specific action or indicates an unacceptable risk of failure in the short term or presents an imminent danger or risk of asset failure.
[3] Network Asset Management Plan.
[4] Moderate deterioration or damage, which requires some specific action or indicates an unacceptable risk to safety, environment, operations, or reliability in the medium term

- Lines Conductor to Structure Clearance Routine Program (Reactive)

1.3 Identified Need

Ergon Energy has some 868,007 poles in service, many of which are significantly aged, refer Figure 1. The in-service failure of poles can result in customer outages and present safety risks to staff and the public. As such, it is a part of Ergon's asset management approach that aged assets in poor condition are replaced proactively to reduce the risk of in-service failure. This proposal aligns with the CAPEX objectives and criteria from the National Electricity Rules (NER) as detailed in Appendix C.

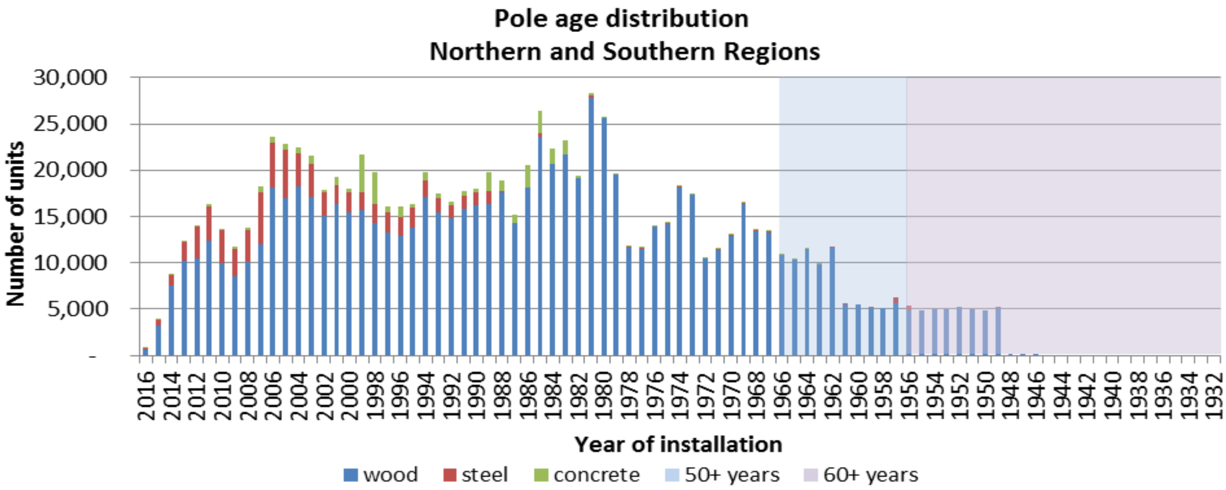


Figure 1: Pole Age Profile

Ergon Energy aims to minimise expenditure in order to keep pressure off customer prices, however understands that this must be balanced against critical network performance objectives. These include network risk mitigation (e.g., safety, bushfire), regulatory obligations (e.g., safety), customer reliability and security, and preparing the network for the ongoing adoption of new technology by customers (e.g., solar PV). In this business case, compliance obligations, safety and customer reliability are strong drivers of the need for this work.

1.4 Energy Queensland Strategic Alignment

Consistent with best practice asset management as per ISO55000, Table 1 below summarises how investment in the pole remediation program contributes to EQL's strategic objectives. The linkages between these Asset Management Objectives and EQL's Corporate Objectives are shown in Appendix D.

Table 1: Asset Function and Strategic Alignment

Objectives	Relationship of Initiative to Objectives
Ensure network safety for staff contractors and the community	Poles and towers are critical assets supporting the overhead distribution and sub-transmission networks at all voltage levels. Given the regular proximity of poles to members of the public, plus the consequences of failure of these assets, this initiative manages the safety risks associated with asset failure.
Meet customer and stakeholder expectations	Failure of poles and towers will result in interruptions to customer supply and the unserved energy introduces many additional costs borne by those without supply as a result. This initiative reduces the costs associated with loss of supply due to pole failures.

Objectives	Relationship of Initiative to Objectives
Manage risk, performance standards and asset investments to deliver balanced commercial outcomes	The investment strategy for poles and towers employs a total lifecycle cost approach to promote a commercially sustainable direction to manage risk, cost and performance for this asset class.
Develop Asset Management capability & align practices to the global standard (ISO55000)	The initiative is aligned with the EQL Asset Management Plan for Poles and Lattice Towers. Refer to the AMP for further details of ISO55000 alignment.
Modernise the network and facilitate access to innovative energy technologies	Poles are a critical component of the shared electricity network. They are therefore critical as an enabling asset for customers to utilise the network for both demand from the network and generation power export into the distribution network.

1.5 Applicable service levels

Corporate performance outcomes for this asset are rolled up into Asset Safety & Performance group objectives, principally the following Key Result Areas (KRA):

- Customer Index, relating to Customer satisfaction with respect to delivery of expected services
- Optimise investments to deliver affordable & sustainable asset solutions for our customers and communities

Corporate Policies relating to establishing the desired level of service are detailed in Appendix D.

A key applicable service level for this business case relates to safety obligations in the Electrical Safety Act 2002. As a person in control of a business or undertaking (PCBU), Ergon Energy has an obligation to ensure that its works are electrically safe and are operated in a way that is electrically safe.[5] This duty also extends to ensuring the electrical safety of all persons and property likely to be affected by the electrical work.[6]

Ergon has a number of requirements under the Electrical Safety Code of Practice Works ('ESCOP – Works') 2010. The ESCOP – Works details some requirements for maintenance of supporting structures for lines. This document details expectations for supporting structure (poles) reliability, serviceability, and frequency of inspection, as well as timeframes to respond to unserviceable poles, and pole records to be kept. The ESCOP – Works is an approved code or practice under the *Work Health and Safety Act 2011* which requires Ergon Energy to comply with its content, or alternatively to follow another method provided it allows for an equivalent or higher standard of work health and safety as that which is stipulated in ESCOP – Works.

The following clauses from the ESCOP – Works are particularly relevant to the management of poles and are used to guide the EQL programs:

- ESCOP s5.1 – must achieve a minimum three-year moving average reliability of 99.99 % per annum. In practical terms this translates to a maximum of about 100 pole failures per year for Ergon, across the population of almost 1 million poles. This provision is particularly relevant at present due to Ergon's rising pole failure rate, which exceeded 100 pole failures in 2018/19.
- ESCOP s5.2.1 – 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.

[5] Section 29, *Electrical Safety Act 2002*
[6] Section 30 *Electrical Safety Act 2002*

- ESCOP s5.3.4 – A suspect pole must be assessed within three months; An unserviceable pole must be replaced or reinstated within 6 months.

Ergon Energy is also expected to employ all reasonable measures to ensure it does not exceed minimum service standards (MSS) for reliability, assessed by feeder types as

- System Average Interruption Duration Index (SAIDI), and;
- System Average Interruption Frequency Index (SAIFI).

MSS performance information is publicly reported annually in the Distribution Annual Planning Reports (DAPR). MSS performance is monitored and reported within EQL daily.

1.6 Compliance obligations

Table 2 shows the relevant compliance obligations for this proposal.

Table 2: Compliance obligations related to this proposal

Legislation, Regulation, Code or Licence Condition	Obligations	Relevance to this investment
QLD Electrical Safety Act 2002 **QLD Electrical Safety Regulation 2013**	We have a duty of care, ensuring so far as is reasonably practicable, the health and safety of our staff and other parties as follows: • Pursuant to the Electrical Safety Act 2002, as a person in control of a business or undertaking (PCBU), Ergon Energy has an obligation to ensure that its works are electrically safe and are operated in a way that is electrically safe.[7] This duty also extends to ensuring the electrical safety of all persons and property likely to be affected by the electrical work.[8]	This proposal is a key component in the management of safety for electricity customers. Pole failures are a safety risk and this risk could escalate if appropriate remediation is not carried out. Recent pole failure and inspection defects increases indicate the need for larger remediation quantities.
Distribution Authority for Ergon Energy issued under section 195 of *Electricity Act 1994* (Queensland)	Under its Distribution Authority: • The distribution entity must plan and develop its supply network in accordance with good electricity industry practice, having regard to the value that end users of electricity place on the quality and reliability of electricity services. • The distribution entity will ensure, to the extent reasonably practicable, that it achieves its safety net targets as specified. • The distribution entity must use all reasonable endeavours to ensure that it does not exceed in a financial year the Minimum Service Standards (MSS)	Fundamentally, this proposal aims to ensure poles are remediated at an adequate rate to effectively manage safety risks and customer outages. Some reliability consequences arise from pole failures and these have been factored into the analysis contained in this proposal.

1.7 Limitation of existing assets

Poles and towers are inspected periodically as required by Queensland legislation. Poles require very little maintenance except for removal of vegetation and termite and bacteria barrier treatments, normally carried out during the inspection process. The majority of pole replacement is driven by

[7] Section 29, *Electrical Safety Act 2002*
[8] Section 30 *Electrical Safety Act 2002*

well-established inspection programs to identify severe structural strength degradation. Structural strength is determined in accordance with AS 7000.

The historical approach to pole remediation in Ergon has been through the periodic inspection and replacement or nailing of defective poles. In early 2019 a review of the pole strength calculation algorithm in Ergon resulted in a change to this algorithm. This change was made to align with the methodology used in Energex, and in accordance with Australian Standards. This led to an increase in failure rates for poles and this proposal sets out a higher level of remediation in line with the revised quantities. Further details on the changes made are shown in Appendix J.

The inspection failure rates are shown in the figure below and the change in inspection algorithm is apparent from May 2019. This failure rate has contributed to a significant step-change increase in pole remediation requirements with total quantities estimated to increase from approximately 8,316 poles/year to 12,959/year based on the new inspection criteria.

Appendix H provides details of Ergon Energy's pole inspection process. Appendix I contains some information regarding pole life expectations for timber poles in various parts of Australia.

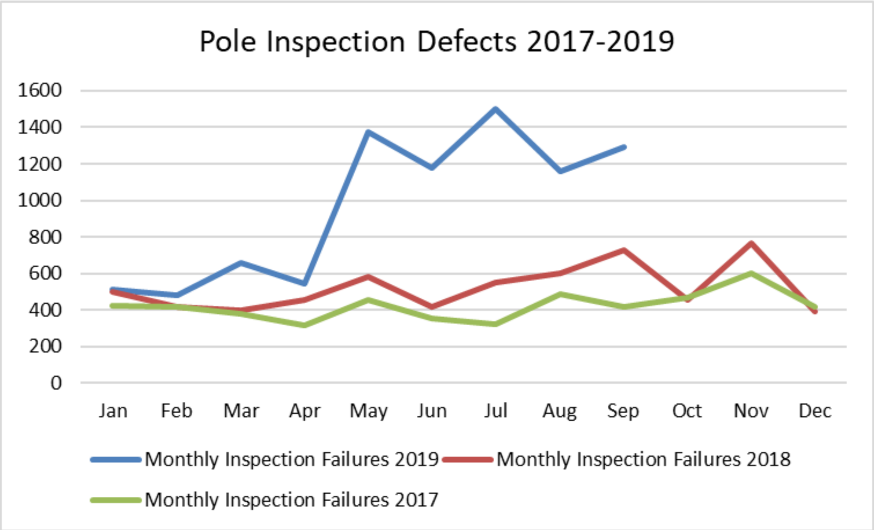


Figure 2: Ergon Energy Pole Inspection Failure Trends

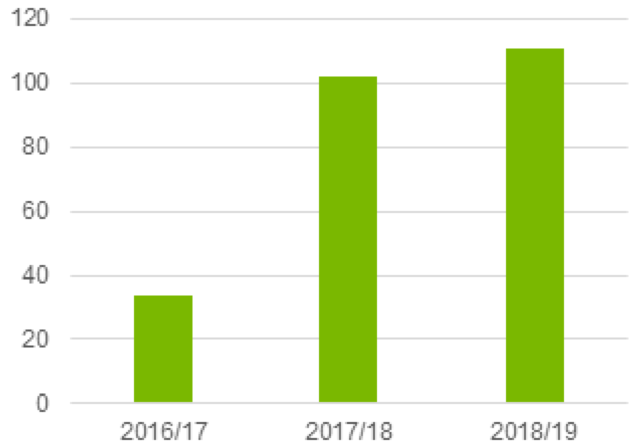


Figure 3: Ergon Energy Pole Failure Trends

Ergon's pole failure trend is further highlighted in the figure below that shows the various Energy Queensland 3 year rolling average failure trends. It is clear from this figure that pole failures are increasing in Ergon and will consistently breach the Code of Practice standard in future years, and hence increasing remediation programs are required.

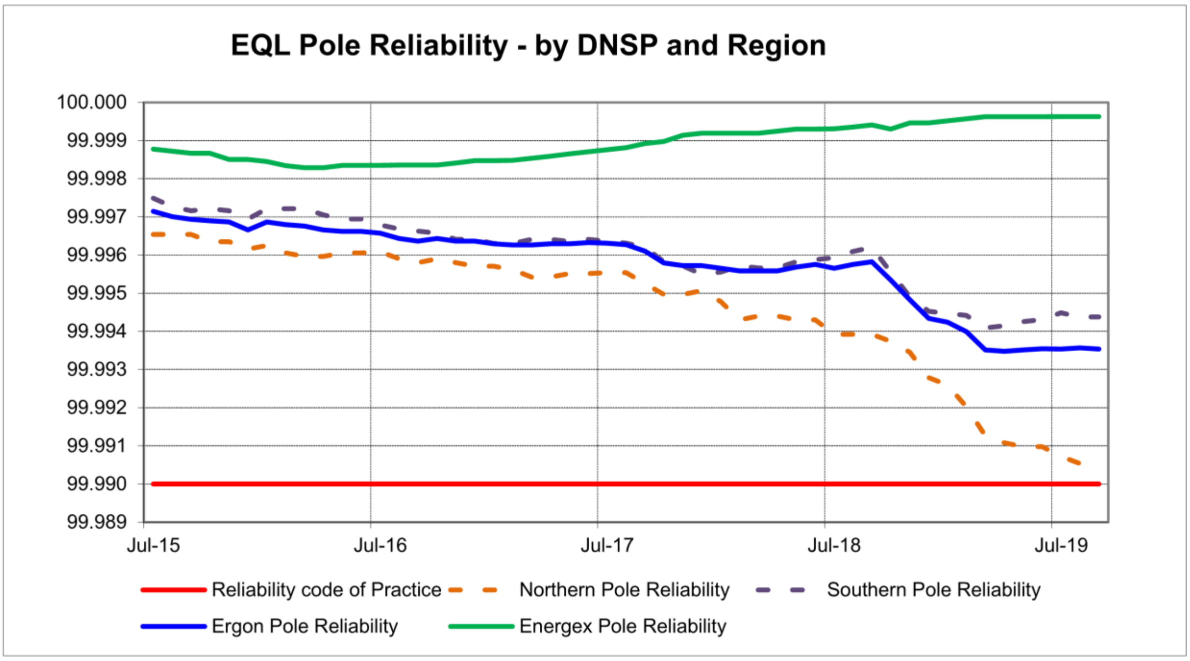


Figure 4: Energy Queensland Regions 3 Year Rolling Pole Reliability

A number of poles are also replaced when undertaking reconductoring programs as an efficient means of work delivery. Poles replaced under reconductoring programs will be either identified as approaching end of life based on asset criteria, or as a result of mechanical design requirements to support the new conductor. Forecasts for pole replacement associated with reconductoring have been based on a sample of historical actuals which equates to an average of 4 poles per kilometre.

Targeted pole replacement programs make up the small remainder of the proposed program. This program is estimated based on a combination of criteria that identify assets approaching end of life and that present a risk in the event of in-service failure. The criteria used are a combination of pole type, age, location, previous strength assessment and/or the period the pole has been nailed. Risk is largely determined by the location, with priority being given to replacement in high risk areas such as the vicinity of schools and public amenities.

2 Counterfactual Analysis

2.1 Purpose of asset

Poles are critical components of the Ergon overhead distribution network. Their integrity is critical for safety as well as for continuity of supply to deliver services to the standards expected by the community.

2.2 Business-as-usual service costs

The ongoing costs for these assets are related to inspection and remediation of defective assets. However, significant costs also arise through failures, requiring emergency response, incident investigation, replacement works, and reporting to the Safety Regulator.

2.3 Key assumptions

The counterfactual case assumes that historical replacement volumes of poles are carried out in the Ergon network over the 2020-25 regulatory control period.

Refer to **Error! Reference source not found.**for the methodology and input assumptions associated with quantification of risk of failures due to condition associated with the Pole population.

2.4 Risk assessment

Figure 5 provides the results of a quantitative forecast of emerging risk associated with Ergon's pole asset population failure due to condition related failure modes. This counterfactual risk is based on known failure rates now and escalated failure rates based on current trends.

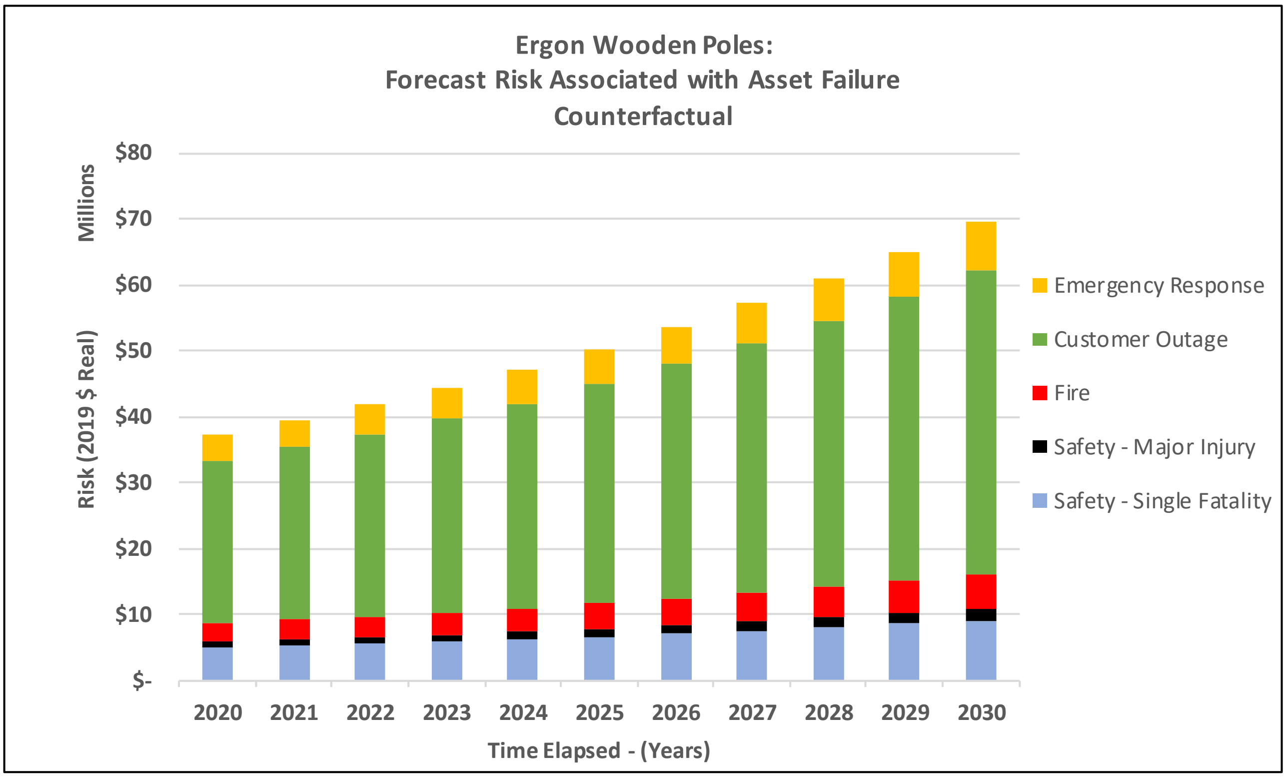


Figure 5: Counterfactual quantitative risk assessment

Significant risk costs arise in the counterfactual, due to safety risks, fire risks and reliability of supply associated with pole failures. The cost of these risks increases substantially over the 10-year period shown, driven mainly by the age profile of the existing population and expected failure rate increases in the absence of any remediation. Modelled pole failures rise from 263 in 2020 to 488 by 2030.

A semi-quantitative risk assessment has also been conducted in accordance with the EQL Network Risk Framework and the Risk Tolerability table from the framework is shown in Appendix E. It should be noted that this risk assessment is based on current pole failure rates with relatively low quantities of failures due to the ongoing remediation program. Absent such ongoing remediation, modelling shows that the failure rates will rise rapidly. This is likely to produce much higher risk likelihood scores and total risk scores in the table below.

Table 3: Counterfactual risk assessment

Risk Scenario	Risk Type	Consequence (C)	Likelihood (L)	Risk Score	Risk Year
Due to pole strength failure, live conductors fall to the ground. A member of the public contacts a live conductor resulting in **a single fatality** due to electric shock.	Safety	5 *(Single Fatality)*	3 *(Unlikely)*	**15** ***(Moderate)***	2020
Due to pole strength failure, a pole falls to the ground. A member of the public is struck by the pole and/or pole top assets, resulting in **a single serious injury** due to the impact.	Safety	3 *(Single Serious Injury)*	3 *(Unlikely)*	**9** ***(Low)***	2020
Due to pole strength failure, a pole falls to the ground. Live conductors start a **house fire** resulting in significant property damage.	Business Impact	3 *(Business Impact of >$100,000)*	4 *(Likely)*	**12** ***(Moderate)***	2020
Due to pole strength failure, a pole falls to the ground. Significant **customer interruptions** occur due to the pole failure.	Customer	3 *(5000 customers)*	4 *(Likely)*	**12** ***(Moderate)***	2020

Further Details of the risk ratings and descriptions can be found in Energy Queensland's Network Risk Framework.

2.5 Retirement or de-rating decision

The life limiting factors for poles described in the Asset Management Plan are predominantly independent of the loading of the network. Derating would not reduce the risk profile for the asset class.

These assets are fundamental to customers' electricity supply and therefore retirement or de-rating are not considered as economical or practical solutions to managing lifecycle risk associated with the assets. Large amounts of the distribution network are considered for retirement when major network augmentation investments are being considered. In these instances, the retirement of groups of assets and provision of electricity supply with local generation is actively considered. However, in the case of individual pole replacements this option is unlikely to be viable.

3 Options Analysis

3.1 Options considered but rejected

Two alternate options were considered and rejected:

- The option to replace overhead assets with underground infrastructure was considered but rejected. The Ergon network includes large amounts of rural assets and the costs of undergrounding these assets are prohibitive.
- When major network augmentation investments are being considered, retirement of groups of assets is feasible in some cases. In these instances, the retirement of groups of assets and provision of electricity supply with local generation is actively considered. This has been carried out by Ergon in Busted Heads and Alpha, however, in the case of individual pole replacements this option is not viable.

3.2 Identified options

3.2.1 Network options

The identified network options are as follows:

Option 1: Condition-based quantities, new algorithm (Proposed)

This option applies predominantly a defect remediation approach based on the quantities calculated using the revised condition assessment algorithm, and includes the following quantities:

Table 4: Option 1 - Volumes and Costs

	20/21	21/22	22/23	23/24	24/25	Total Over 2020-25 period
Quantity Nailing	2,972	2,972	2,972	2,972	2,972	14,860
Quantity Replace	9,725	10,381	10,381	9,725	9,725	49,937
Cost	$74.0M	$74.6M	$77.8M	$79.6M	$69.8M	$375.8M

The increasing risk of pole failure associated with the counterfactual as time progresses is unacceptable, reflecting the growing ageing pole population in Ergon. This remediation program, while not fully addressing the pole failure trend, is considered to be the absolute minimum program required for the forward period, with further increases likely to be required in future periods. The modelled result shows that pole failure rates are likely to continue to breach the Code of Practice standard in future years, and hence increasing remediation programs will be required.

Option 2: Condition-based replacement program (old algorithm)

This option, shown for comparative purposes, addresses known defects based on the previous pole inspection algorithm, but not based on the revised approach. This approach has been used in the past and has resulted in escalating pole failure rates. Based on the failure modelling, this option would result in pole failures increasing from 263 in 2020, to approximately 461 in 2030. This increasing failure rate is not in line with the requirement to reduce safety risks SFAIRP.

Table 5: Option 2 - Volumes and Costs[9]

	20/21	21/22	22/23	23/24	24/25	Total Over 2020-25 period
Quantity Nailing	1,444	1,444	1,444	1,444	1,444	7,220
Quantity Replace	6,872	6,872	6,872	6,872	6,872	34,362
Cost	$63.0M	$63.0M	$63.0M	$63.0M	$63.0M	$315.2M

Non-network options

No non-network options have been considered in this report, although it is noted that when major network augmentation investments are being considered, retirement of groups of assets is feasible in some cases. In these instances, the retirement of groups of assets and provision of electricity supply with local generation is actively considered. However, in the case of individual pole replacements this option is not viable.

3.3 Economic analysis of identified options

3.3.1 Cost versus benefit assessment of each option

The Net Present Value (NPV) of each option has been determined by considering costs and benefits over a 20-year period relative to the counterfactual, discounted at the Regulated Real Pre-Tax Weighted Average Cost of Capital (WACC) rate of 2.62%, using EQL's standard NPV analysis tool.

Table 6 below contains the results of a 20-year NPV analysis of the identified options (2021-2040), outlining the Present Value (PV) of costs and benefits associated with each option as well as the total NPV of each option, compared to the counterfactual. This table confirms that the proposed Option 1: Condition based quantities (new algorithm) provides an NPV benefit of $8M compared to the counterfactual.

Table 6: Net present value of options

Option	NPV ($M)	PV of costs	PV benefits
Option 1: Condition based quantities (new algorithm)	$8M	-$153M	$162M
Option 2: Condition based replacement program (old algorithm)	-$45M	-$97M	$53M

3.4 Scenario Analysis

3.4.1 Sensitivities

A range of sensitivities on this analysis have been conducted as shown in Table 7. The sensitivities tested include the Weibull parameters (failure rates), Cost of Consequence (CoC), and Probability of Severity (PoS). While several sensitivities result in the counterfactual having a higher NPV, for the majority of sensitivities, Option 1 provides the best NPV.

[9] Uses Regulatory Proposal Quantities, pole replacement numbers smoothed for comparison purposes

Table 7: Variables Tested in Sensitivity Analysis

Sensitivity	Baseline	Applied Parameter	Preferred Option	Relative NPV of Preferred Option 1
Weibull β (Low)	6.5	5.5	Option 1	$44M
Weibull β (High)		7.5	Counterfactual	-$22M
Weibull η (Low)	118	113	Option 1	$41M
Weibull η (High)		123	Counterfactual	-$37M
Pole unit rate (Low)	$5,800	$5,400	Option 1	$32M
Pole unit rate (High)		$6,200	Counterfactual	-$16M
CoC single fatality (Low)	$49M	$45M	Option 1	$7M
CoC single fatality (High)		$54M	Option 1	$11M
PoS single fatality (Low)	0.05%	0.03%	Counterfactual	$-1M
PoS single fatality (High)		0.1%	Option 1	$26M

3.4.2 Value of regret analysis

In terms of selecting a decision pathway of 'least regret', Option 1 presents an economically efficient, balanced approach to investment by targeting replacement works based on asset criticality and assessed condition and reducing risk to the greatest extent without bringing forward unnecessary expenditure.

The key regret identified in this business case is the fatality of a customer through a pole failure. The economic value of this risk has been quantified as part of the analysis. Although Option 1 is the preferred approach based on the economic analysis, it is instructive to consider the impact of each option on the key regret scenario. The value of this key risk (cost of fatality) is shown for each option in the table below.

Table 8: Risk Costs

Option	Fatality Risk Cost 2021 ($M)	Fatality Risk Cost 2030 ($M)	Total 2021-2030 Risk Cost ($M)
Counterfactual: Historical Volumes	$5.2M	$9.1M	$69M
Option 1: Condition-based quantities, new algorithm	$4.9M	$7.6M	$59M
Option 2: Condition-based quantities, old algorithm	$5.1M	$8.6M	$66M

Option 1 produces the lowest risk cost in relation to fatality risk. It has a $10M lower fatality risk cost over the 10-year period compared to the counterfactual. This makes Option 1 clearly the least regret option.

3.5 Qualitative comparison of identified options

3.5.1 Advantages and disadvantages of each option

Table 9 details the advantages and disadvantages of each option considered.

Table 9: Assessment of options

Option	Advantages	Disadvantages
Option 1: Condition based quantities (new algorithm)	• Provides a positive NPV • Appropriate option for expected defect quantities • Provides the highest safety and customer risk reduction benefits • Removes known low strength poles from the population • Reduces delivery and financial risks associated with aging asset population • Increases overall population resilience to severe weather events • Deliverable within resource constraints*	• Increased resource requirements
Option 2: Condition based replacement program (old algorithm)	• Provides some safety and customer risk reduction benefit • Deliverable within resource constraints* • Provides a positive NPV (although lower than option 2)	• Risk reduction benefit inadequate compared to option 2 • Does not address known defects based on revised pole strength algorithm • Known lower strength poles remain in service
Counterfactual: Condition based replacement program (old algorithm)	• Provides some safety and customer risk reduction benefit • Deliverable within resource constraints • Provides a positive NPV (although lower than option 2)	• Risk reduction benefit inadequate compared to option 2 • Does not address known defects based on revised pole strength algorithm • Known lower strength poles remain in service

*It should be noted that Ergon Energy has taken steps to proactively increase its field resources to enable the timely and efficient delivery of this and other related distribution programs.

3.5.2 Alignment with network development plan

The preferred option aligns with the Asset Management Objectives in the Distribution Annual Planning Report. In particular it manages risks, performance standards and asset investment to deliver balanced commercial outcomes while modernising the network to facilitate access to innovative technologies. Ongoing monitoring of pole replacements will be necessary to ensure that "edge of grid" assets are not unnecessarily replaced when future retirement is possible.

3.5.3 Alignment with future technology strategy

This program of work does not contribute directly to EQL's transition to an Intelligent Grid, in line with the Future Grid Roadmap and Intelligent Grid Technology Plan. However, it does support EQL in maintaining affordability of the distribution network while also maintaining safety, security and reliability of the energy system, a key goal of the Roadmap. This is a distribution asset population-based replacement program driven by defects associated with the deteriorating condition of assets. Ongoing monitoring of pole replacements will be necessary to ensure that "edge of grid" assets are not unnecessarily replaced when future retirement is possible based on new technology developments.

3.5.4 Risk Assessment Following Implementation of Proposed Option

Table 10: Risk assessment showing risks mitigated following Implementation

Risk Scenario	Risk Type	Consequence (C)	Likelihood (L)	Risk Score	Risk Year
Due to pole strength failure, live conductors fall to the ground. A member of the public contacts a live conductor resulting in **a single fatality** due to electric shock.	Safety	*(Original)* 5 *(Single Fatality)* (Mitigated) 5 *(Single Fatality)*	 3 *(Unlikely)* 2 *(Very Unlikely)*	 **15** ***(Moderate)*** **10** ***(Low)***	2025
Due to pole strength failure, a pole falls to the ground. A member of the public is struck by the pole and/or pole top assets, resulting in **a single serious injury** due to the impact.	Safety	*(Original)* 3 *(Single Serious Injury)* (Mitigated) 3 *(Single Fatality)*	 3 *(Unlikely)* 2 *(Very Unlikely)*	 **9** ***(Low)*** **6** ***(Low)***	2025
Due to pole strength failure, a pole falls to the ground. Live conductors start a **house fire** resulting in significant property damage.	Business Impact	*(Original)* 3 *(Business Impact of >$100,000)* (Mitigated) 3 *(Business Impact of >$100,000)*	 4 *(Likely)* 3 *(Unlikely)*	 **12** ***(Moderate)*** **9** ***(Low)***	2025
Due to pole strength failure, a pole falls to the ground. Significant **customer interruptions** occur due to the pole failure.	Customer	*(Original)* 3 *(5000 customers)* (Mitigated) 3 *(5000 customers)*	 4 *(Likely)* 3 *(Unlikely)*	 **12** ***(Moderate)*** **9** ***(Low)***	2025

The risk reduction benefits are illustrated in the figures below.

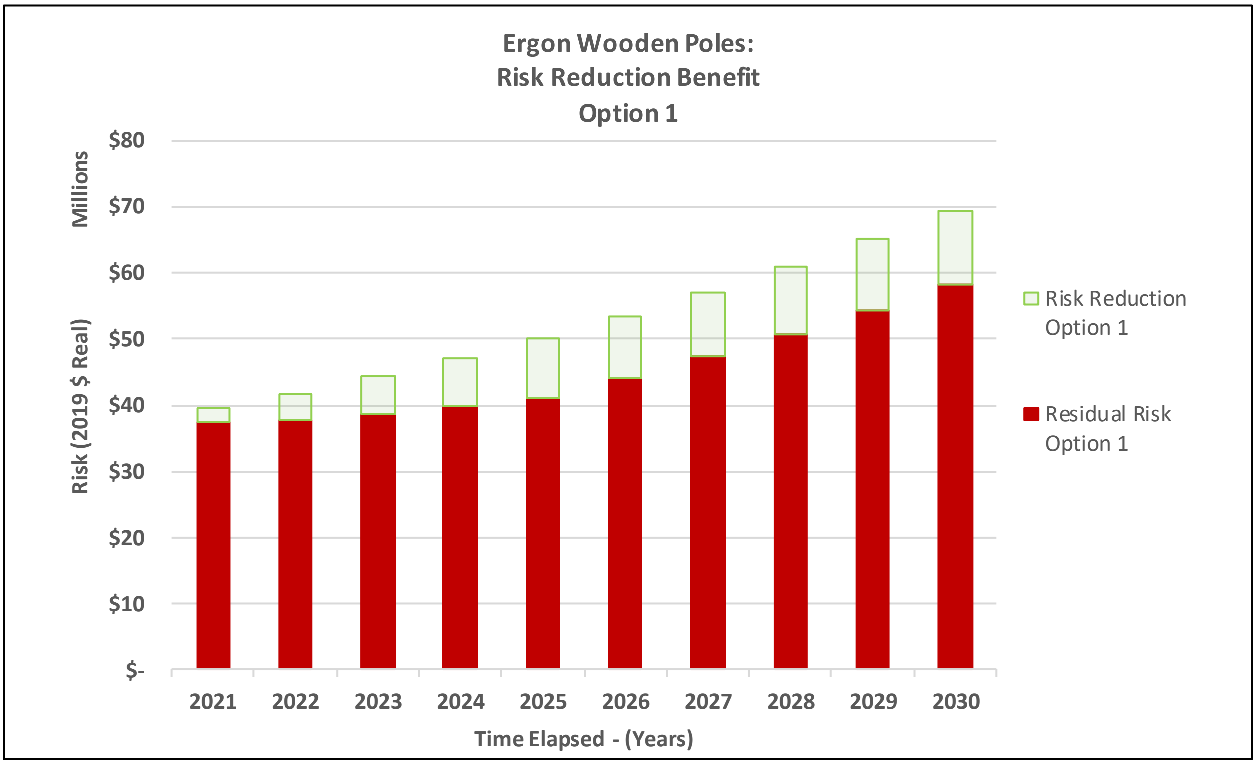


Figure 6: Risk Reduction from proposed Option 1

From the above chart the relative merits of the proposed option can be seen. Option 1 provides the preferred economic outcome plus a significantly improved risk reduction outcome compared to the counterfactual. It does not fully address the increasing risk which is driven by the large volume of ageing poles.

4 Recommendation

4.1 Preferred option

Based on the analysis contained in this report, the preferred option is Option 1: Condition based quantities (new algorithm).

4.2 Scope of preferred option

Table 11 outlines the scope of the preferred option, with regards to volume and cost of works over the next regulatory control period (2020-25). The replacement figures include poles replaced during reconductoring activities and other targeted pole replacement programs (refer to Section 1.7). The total cost associated with the program over the 2020-2025 regulatory period is estimated at $375.8M (real $2018/19).

Table 11: Proposed Option - Volumes and Costs

	20/21	21/22	22/23	23/24	24/25	Total Over 2020-25 period
Quantity Nailing	2,972	2,972	2,972	2,972	2,972	14,860
Quantity Replace	9,725	10,381	10,381	9,725	9,725	49,937
Cost	$74.0M	$74.6M	$77.8M	$79.6M	$69.8M	$375.8M

The expenditure information in this business case is represented in the same manner as the Reset RIN Repex template. For example, if a project/program contains multiple assets (e.g.: OH conductor, poles & pole top structures), the total expenditure is apportioned to respective RIN assets individually as per the Ergon Energy RIN expenditure allocation methodology.

Appendix A. References

Note: Documents which were included in Energy Queensland's original regulatory submission to the AER in January 2019 have their submission reference number shown in square brackets, e.g. Energy Queensland, *Corporate Strategy [1.001], (31 January 2019).*

AEMO, *Value of Customer Reliability Review, Final Report,* (September 2014).

Energy Queensland, *Asset Management Overview, Risk and Optimisation Strategy [7.025]*, (31 January 2019).

Energy Queensland, *Asset Management Plan, Poles and Lattice Towers [7.037]*, (31 January 2019).

Energy Queensland, *Corporate Strategy [1.001],* (31 January 2019).

Energy Queensland, *Justification Statement – Poles and Towers [7.069]*, (31 January 2019).

Energy Queensland, *Network Risk Framework*, (October 2018).

Ergon Energy, *Distribution Annual Planning Report (2018-19 to 2022-23) [7.049]*, (21 December 2018).

Appendix B. Acronyms and Abbreviations

The following abbreviations and acronyms appear in this business case.

Abbreviation or acronym	Definition
$M	Millions of dollars
$ nominal	These are nominal dollars of the day
$ real 2019-20	These are dollar terms as at 30 June 2020
2020-25 regulatory control period	The regulatory control period commencing 1 July 2020 and ending 30 Jun 2025
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
AIDM	Asset Inspection and Defects Manual
AMP	Asset Management Plan
Augex	Augmentation Capital Expenditure
BAU	Business as Usual
CAPEX	Capital expenditure
CoC	Cost of Consequence
Current regulatory control period or current period	Regulatory control period 1 July 2015 to 30 June 2020
DAPR	Distribution Annual Planning Report
DC	Direct Current
DNSP	Distribution Network Service Provider
EQL	Energy Queensland Limited
ESCOP	Electrical Safety Code of Practice Works
HV	High Voltage
IT	Information Technology
KRA	Key Result Areas
LV	Low Voltage
MSS	Minimum Service Standard
NAMP	Network Asset Management Plan
NEL	National Electricity Law
NEM	National Electricity Market
NEO	National Electricity Objective
NER	National Electricity Rules (or Rules)
Next regulatory control period or forecast period	The regulatory control period commencing 1 July 2020 and ending 30 Jun 2025

Abbreviation or acronym	Definition
NPV	Net Present Value
OPEX	Operational Expenditure
OH	Overhead
PCBU	Person in Control of a Business or Undertaking
PoS	Probability of Severity
Previous regulatory control period or previous period	Regulatory control period 1 July 2010 to 30 June 2015
PV	Present Value
Repex	Replacement Capital Expenditure
RIN	Regulatory Information Notice
RIT-D	Regulatory Investment Test – Distribution
RTS	Return to Service
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SAMP	Strategic Asset Management Plan
SCADA	Supervisory Control and Data Acquisition
SFAIRP	So Far as Is Reasonably Practicable
WACC	Weighted average cost of capital

Appendix C. Alignment with the National Electricity Rules (NER)

Table 12 details the alignment of this proposal with the NER capital expenditure requirements as set out in Clause 6.5.7 of the NER.

Table 12: Alignment with NER

Capital Expenditure Requirements	Rationale
6.5.7 (a) (2) The forecast capital expenditure is required in order to **comply with all applicable regulatory obligations or requirements** associated with the provision of standard control services	Pursuant to the Electrical Safety Act 2002, as a person in control of a business or undertaking (PCBU), Ergon Energy has an obligation to ensure that its works are electrically safe and are operated in a way that is electrically safe.[10] This duty also extends to ensuring the electrical safety of all persons and property likely to be affected by the electrical work.[11] This proposal addresses Ergon's key obligation in relation to ensuring that it works are electrically safe.
6.5.7 (a) (3) The forecast capital expenditure is required in order to: (iii) maintain the **quality, reliability and security of supply** of supply of standard control services (iv) maintain the **reliability and security of the distribution system** through the supply of standard control services	While the primary purpose of this program is the delivery of safe outcomes for customers, it does also address reliability issues associated with pole failures.
6.5.7 (a) (4) The forecast capital expenditure is required in order to maintain the **safety of the distribution system** through the supply of standard control services.	Pursuant to the Electrical Safety Act 2002, as a person in control of a business or undertaking (PCBU), Ergon Energy has an obligation to ensure that its works are electrically safe and are operated in a way that is electrically safe. This duty also extends to ensuring the electrical safety of all persons and property likely to be affected by the electrical work. This proposal addresses Ergon's key obligation in relation to ensuring that it works are electrically safe.
6.5.7 (c) (1) (i) The forecast capital expenditure reasonably reflects the **efficient costs** of achieving the capital expenditure objectives	The Unit Cost Methodology and Estimation Approach sets out how the estimation system is used to develop project and program estimates based on specific material, labour and contract resources required to deliver a scope of work. The consistent use of the estimation system is essential in producing an efficient CAPEX forecast by enabling: • Option analysis to determine preferred solutions to network constraints • Strategic forecasting of material, labour and contract resources to ensure deliverability • Effective management of project costs throughout the program and project lifecycle, and • Effective performance monitoring to ensure the program of work is being delivered effectively. The unit costs that underpin our forecast have also been independently reviewed to ensure that they are efficient (Attachments 7.004 and 7.005 of our initial Regulatory Proposal).
6.5.7 (c) (1) (ii) The forecast capital expenditure reasonably reflects the costs that **a prudent operator** would require to achieve the capital expenditure objectives	The prudency of this proposal is demonstrated through the options analysis conducted and the quantification of risk and benefits of each option. The prudency of our CAPEX forecast is demonstrated through the application of our common frameworks put in place to effectively manage investment, risk, optimisation and governance of the Network Program of Work. An overview of these frameworks is set out in our Asset Management Overview, Risk and Optimisation Strategy (Attachment 7.026 of our initial Regulatory Proposal).

[10] Section 29, *Electrical Safety Act 2002*
[11] Section 30 *Electrical Safety Act 2002*

Appendix D. Mapping of Asset Management Objectives to Corporate Plan

This proposal has been developed in accordance with our Strategic Asset Management Plan. Our Strategic Asset Management Plan (SAMP) sets out how we apply the principles of Asset Management stated in our Asset Management Policy to achieve our Strategic Objectives.

Table 1: "Asset Function and Strategic Alignment" in Section 1.4 details how this proposal contributes to the Asset Management Objectives.

Table 13 provides the linkage of the Asset Management Objectives to the Strategic Objectives as set out in our Corporate Plan (Supporting document 1.001 to our Regulatory Proposal as submitted in January 2019).

Table 13: Alignment of Corporate and Asset Management objectives

Asset Management Objectives	Mapping to Corporate Plan Strategic Objectives
Ensure network safety for staff contractors and the community	EFFICIENCY ***Operate safely as an efficient and effective organisation*** Continue to build a strong safety culture across the business and empower and develop our people while delivering safe, reliable and efficient operations.
Meet customer and stakeholder expectations	COMMUNITY AND CUSTOMERS ***Be Community and customer focused*** Maintain and deepen our communities' trust by delivering on our promises, keeping the lights on and delivering an exceptional customer experience every time
Manage risk, performance standards and asset investments to deliver balanced commercial outcomes	GROWTH ***Strengthen and grow from our core*** Leverage our portfolio business, strive for continuous improvement and work together to shape energy use and improve the utilisation of our assets.
Develop Asset Management capability & align practices to the global standard (ISO55000)	EFFICIENCY ***Operate safely as an efficient and effective organisation*** Continue to build a strong safety culture across the business and empower and develop our people while delivering safe, reliable and efficient operations.
Modernise the network and facilitate access to innovative energy technologies	INNOVATION ***Create value through innovation*** Be bold and creative, willing to try new ways of working and deliver new energy services that fulfil the unique needs of our communities and customers.

Appendix E. Risk Tolerability Table

<table>
<tr><th colspan="5">Network Risks - Risk Tolerability Criteria and Action Requirements</th><th></th></tr>
<tr><th>Risk Score</th><th>Risk Descriptor</th><th colspan="3">Risk Tolerability Criteria and Action Requirements</th><th></th></tr>
<tr><td>30 – 36</td><td colspan="4">Intolerable
(stop exposure immediately)</td><td></td></tr>
<tr><td>24 – 29</td><td>Very High Risk</td><td rowspan="5">*ALARP
Risk in this range managed to As Low As Reasonably Practicable</td><td>Executive Approval
(required for continued risk exposure at this level)</td><td>May require a full Quantitative Risk Assessment (QRA)
Introduce new or changed risk treatments to reduce level of risk
Periodic review of the risk and effectiveness of the existing risk treatments</td><td rowspan="6">SFAIRP
Risks in this area to be mitigated So Far as is Reasonably Practicable</td></tr>
<tr><td>18 – 23</td><td>High Risk</td><td>Divisional Manager Approval
(required for continued risk exposure at this level)</td><td>Introduce new or changed risk treatments to reduce level of risk
Periodic review of the risk and effectiveness of the existing risk treatments</td></tr>
<tr><td>11 – 17</td><td>Moderate Risk</td><td rowspan="2">Group Manager / Process Owner Approval
(required for continued risk exposure at this level)</td><td rowspan="2">Introduce new or changed risk controls or risk treatments as justified to further reduce risk
Periodic review of the risk and effectiveness of the existing risk treatments</td></tr>
<tr><td>6 – 10</td><td>Low Risk</td></tr>
<tr><td>1 to 5</td><td>Very Low Risk</td><td>No direct approval required but evidence of ongoing monitoring and management is required</td><td>Periodic review of the risk and effectiveness of the existing risk treatments</td></tr>
</table>

Figure 7: A Risk Tolerability Scale for evaluating Semi-Quantitative risk score

Appendix F. Quantitative Risk Assessment Details

Data Input			
		Description/Justification	**Source**
Asset Class	Ergon Poles	-	-
Asset Median Life (years)	111.5	Calculated from Weibull parameters	-
NPV Period (years)	20	-	-
Historical Unit Rate ($)	7,579	Average historical expenditure on wooden poles and nailing within the 2015-2020 regulatory period.	Attachment 7.069 of our initial regulatory proposal.
Forecasted Unit Rate ($)	5,800	Expenditure on proposed wooden poles and nailing within the 2020-2025 regulatory period.	Input data provided by EQL

Age Profile and Replacements			
		Description/Justification	**Source**
Total Population	868,007	Total amount of wooden poles owned by Ergon Energy. Age profile has been slightly modified by tapering off volumes of older profiles to better represent real word scenario.	Ergon Energy RIN
Replacements - Counterfactual	5,550	Average historical annual replacements within the 2015-2020 regulatory period.	Input data provided by EQ
Replacements - Option 1	-	Annual forecasted replacements of wooden poles and nailing within the 2020-2025 regulatory period.	Input data provided by EQ
Replacements - Option 2	8,316	Previous proposal annual replacements using the old algorithm.	Input data provided by EQ

Safety Risk Inputs				
Consequence	**Monetisation ($)**	**Disproportionality Factor**	**Description/Justification**	**Source**
Single Fatality	4,900,000	10	Cost of a single fatality scaled by factor of 10.	[1] The sources used to develop the Disproportionality Factors are as follows: Ausgrid - Revised Proposal - Attachment 5.13.M.4 - Low Voltage Overhead Service Lines program CBA summary - January 2019 https://www.pmc.gov.au/sites/default/files/publications/value-of-statistical-life-guidance-note_0_0.pdf https://www.hse.gov.uk/risk/theory/alarpcba.htm
Single Series Injury	490,000	8	Cost of a single serious injury scaled by a factor of 8.	
Fire	66,000	4	Cost of a fire scaled by a factor of 4.	
Emergency Response	1,750	1	Cost of an emergency response scaled by a factor of 1 as the DF is not relevant to this consequence.	

[1] Disproportionality factors are applied to the consequence monetisation to offset the gross disproportion (perceived point at which the cost of implementing a safety measure exceeds its expected benefits). The above factors are based on a review of peer organisations, as well as other industries, to identify a single factor within the approximate median of the range of factors identified in the review.

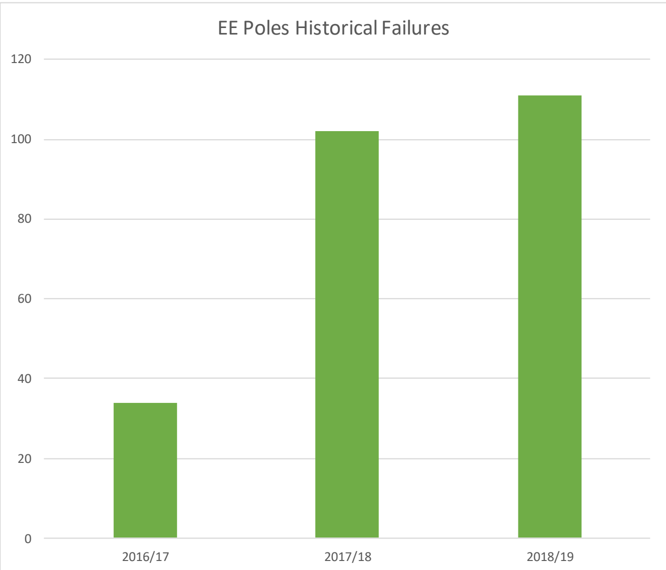
Customer Risk Inputs				
			Description/Justification	Source
Residential	VCR ($/MWH)	25,420	The value different types of customers place on having reliable electricity supplies under different conditions. Determined from survey results conducted by AEMO.	AEMO Value of Customer Reliability Fact Sheet
	Load (MVA)	1.61	Load lost per pole failure. Calculated as a weighted average of load data for wooden poles.	Input data provided by EQL
	Hrs to restore	14	Time taken to get a failed pole operating as usual. Based on typical travel and labour involved with wooden poles.	As agreed with EQL.
	Power Factor	0.85	The ratio which determines the real power used by EQL residential customers. Based on the typical uncompensated power factor for an EQL zone substation.	EQL 2018 DAPR – typical values
	Load Factor	0.2	A ratio of average load to peak load within a specific time. Acts as a measure of EQL's utilisation rate. Conservative value based on typical values for EQL residential load profiles.	As agreed with EQL.
	Percentage of Mix	88%	Percentage of EQL customers who are considered as residential loads. Based on the approximate mix of residential versus commercial customers in the EQL network as informed by customer type information.	As agreed with EQL.
Commercial	VCR ($/MWH)	44,390	The value different types of customers place on having reliable electricity supplies under different conditions. Determined from survey results conducted by AEMO.	AEMO Value of Customer Reliability Fact Sheet
	Load (MVA)	0.22	Load lost per pole failure. Calculated as a weighted average of load data for wooden poles.	Input data provided by EQL
	Hrs to restore	14	Time taken to get a failed pole operating as usual. Based on typical travel and labour involved with wooden poles.	As agreed with EQL.
	Power Factor	0.85	The ratio which determines the real power used by EQL commercial customers. Based on the typical uncompensated power factor for an EQL zone substation.	EQL 2018 DAPR – typical values
	Load Factor	0.6	A ratio of average load to peak load within a specific time. Acts as a measure of EQL's utilisation rate. Conservative value based on typical values for EQL commercial load profiles.	As agreed with EQL.

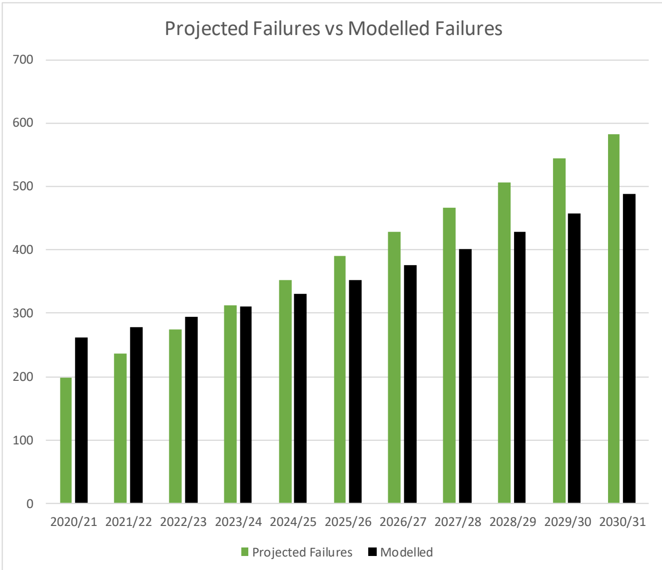
	Percentage of Mix	12%	Percentage of EQL customers who are considered as commercial loads. Based on the approximate mix of residential versus commercial customers in the EQL network as informed by customer type information.	As agreed with EQL.

Incident Conversion Rate (ICR) & Probability of Consequence (PoC)						
ICR		**PoC**				
Consequence	**Incidents Attr. to Cons.**	**Category**	**Risk Scale**	**Probability of Severity**	**Description/Justification**	**Source**
Single Fatality	77	Safety	5	0.05%	ICR - 70% of historical incidents involving wooden pole failures are considered to be dangerous. PoC - Calibrated to represent 1 fatality every 10 years. Based on EQL data which showcases 0 pole related fatalities within approximately the last 10 years.	ICR – Attachment 7.037 of our initial regulatory proposal. PoC – Input Data provided by EQL
Major Injury	77	Safety	4	0.14%	ICR - 70% of historical incidents involving wooden pole failures are considered to be dangerous. PoC - Calibrated to represent the historically expected 1 major injury every 4 years.	ICR – Attachment 7.037 of our initial regulatory proposal. PoC – Input data provided by EQL.
Fire	15	Fire	2	30%	ICR - 14% of incidents are attributed to fire. Calibrated based on the expected costs involved with fire risks relative to costs involved with safety in the case of Wooden Poles. PoC - 30% of incidents result in a fire. Based on the severity of the consequence being considered as moderate.	ICR – As agreed with EQL. PoC - Assumed based on EQL and peer organisation industry experience.
Customer Outage	110	Customer	1	100%	ICR – Assumes that 100% of incidents are attributed to a customer outage.	ICR - Assumed based on EQL and peer organisation industry experience.

					PoC - 100% of incidents result in a customer outage. Based on no redundancy within low to medium voltage (< 66kV) pole network.	PoC - Assumed based on EQL and peer organisation industry experience.
Emergency Response	110	Other	1	100%	ICR - 100% of incidents are attributed to emergency response PoC - 100% of incidents result in emergency response	ICR - Assumed based on EQL and peer organisation industry experience. PoC - Assumed based on EQL and peer organisation industry experience.
Total No. of Incidents	**110**	-	-	-	Based on known pole unassisted failures within the 2018/2019 period.	Attachment 7.037 of our initial regulatory proposal.

Statistical Calibration			
		Description/Justification	**Source**
Reliability Model Used	Weibull	Weibull parameters are calibrated to project the trend in historical failures as shown in the below charts	Attachment 7.037 of our initial regulatory proposal.
Shape parameter (β)	6.5		
Characteristic life (η)	118		
Guaranteed Min Life (γ)	0		





Appendix G. Reconciliation Table

Reconciliation Table Conversion from $18/19 to $2020	
Business Case Value	
(M$18/19)	$34.70
Business Case Value	
(M$2020)	$36.32

Appendix H. Overview of Pole Inspection and Remediation Processes

Risk Based Pole Inspection Program

The Ergon Energy pole inspection program is formulated on a risk prioritised basis as follows:

- **Four-Year Cycle** – for Urban areas, high risk rural areas, and for steel poles buried direct in ground, a four-year inspection cycle is utilised. This category includes the majority of poles (approximately 80%) and also accounts for the majority of failures at present.
- **Six-Year Cycle** – for low risk rural areas, a six-year inspection cycle is utilised.
- **Eight-Year Cycle** – for low risk assets including steel tower lines and concrete pole lines, an eight-year inspection cycle is utilised.

Inspection Process

It should be noted that pole failure rates in Ergon reflect the age of the pole population and the specific local factors which impact pole condition. The main causes of failure are wood rot and termite infestation. Appendix I below provides details of expected lives of timber poles in various geographic zones across Australia. Local conditions play a large role in the condition degradation and it should be noted that the majority of the Ergon area covers more onerous areas for pole life when compared to most other states.

When poles are part of the scheduled inspection program, a field-based inspector uses a hand-held computer to assess pole condition. The process includes:

- Visual Inspection of the pole condition including excavation below ground;
- "Sounding" of the pole to detect internal voids;
- Drilling of the pole to enable measurement of sound timber quantity
- Measurement of pole parameters

The pole inspection computer utilises the data collected from this inspection process to determine the serviceability of the pole. It should be noted that Ergon Energy has recently changed its pole inspection algorithm and the rationale and details of this change are detailed below in Appendix J. The analysis provides a classification of the pole as follows:

- Acceptable strength until next inspection;
- Priority 1 Defect – to be remediated within 30 days;
- Priority 2 Defect – to be remediated within 6 months.

The analysis also provides guidance on the basis for remediation including pole nailing and pole replacement. Pole replacement typically occurs where the pole condition is very poor or the top of the pole is also in poor condition such that remediation of the pole using a pole nail will not be effective.

Program Development

This process determines the number of poles to be remediated based on the above condition assessment process. For the AER 2020-25 period, it has been estimated, based on current defect rates, that on average some 7,021 poles will need to be replaced, and 2,972 poles will need to be nailed per annum based on defects. Further to these inspection-based quantities the program also allows for 200 poles per annum to be remediated proactively in high risk areas, a further 2,504 poles per annum to be remediated as part of other programs (eg. Reconductoring where poles are assessed as inadequate for the new conductors), plus a further 1,312 poles in total as part of the Childers to Gayndah project.

Code of Practice

Ergon has a number of requirements under the Electrical Safety Code of Practice Works ('ESCOP – Works') 2010. This document details expectations for supporting structure (poles) reliability, serviceability, and frequency of inspection, as well as timeframes to respond to unserviceable poles, and pole records to be kept. Under the ESCOP s5.1 – Ergon Energy must achieve a minimum three-year moving average reliability of 99.99 % per annum. In practical terms this translates to a maximum of about 100 pole failures per year for Ergon, across the population of almost 1 million poles. This provision is particularly relevant at present due to Ergon's rising pole failure rate, which exceeded 100 pole failures in 2018/19.

It should be noted that this measure is a lagging performance measure and is not used to determine pole remediation requirements. The current performance trends however do demonstrate the need for increasing pole remediation compared to historical quantities. This was one significant factor in the change of the pole inspection algorithm in 2019.

Long Term Removal of Assets

Ergon Energy notes that edge of network assets could ultimately be replaced with local generation and hence remove problematic populations of poles from the network. When major network augmentation investments are being considered, retirement of groups of assets is feasible in some cases. In these instances, the retirement of groups of assets and provision of electricity supply with local generation is actively considered. This has been carried out by Ergon in Busted Heads and Alpha, however, in the case of individual pole replacements this option is not viable. Ergon Energy will continue to explore this option.

Appendix I. Information Regarding Timber Pole Lives

The information below has been extracted from the Timber service life design guide from Forest & Wood Products Australia.

Figure 4.1: In-ground decay hazard zones for Australia.

Table 4.3: Typical service life of round poles against in-ground decay in Zone B.

Timber type	In-ground durability class[1]	Treatment[2]	Typical service life (years)		
			Pole diameter 200 mm	Pole diameter 300 mm	Pole diameter 400 mm
Treated softwood	4	H4	60	80	100
		H5	100	>100	>100
Treated hardwood	1	H4	50	80	90
		H5	80	>100	>100
	2	H4	50	70	70
		H5	80	100	>100
	3	H4	40	45	60
		H5	50	60	70
	4	H4	30	35	45
		H5	40	45	50
Untreated hard-wood[3]	1	—	45	60	80
	2	—	25	30	40

Notes:

1. See Table 4.1.

2. As per AS 1604.1. for CCA and creosote.

3. De-sapped poles.

Table 4.4: Typical service life of round poles against in-ground decay in Zone C.

Timber type	In-ground durability class(1)	Treatment(2)	Typical service life (years)		
			Pole diameter 200 mm	Pole diameter 300 mm	Pole diameter 400 mm
Treated softwood	4	H4	40	50	60
		H5	60	80	100
Treated hardwood	1	H4	35	50	60
		H5	60	80	90
	2	H4	35	45	50
		H5	50	70	70
	3	H4	25	30	35
		H5	40	45	50
	4	H4	20	25	30
		H5	30	35	40
Untreated hard-wood(3)	1	—	30	40	50
	2	—	15	20	25

Notes:
1. See Table 4.1.
2. As per AS 1604.1 for CCA and creosote.
3. De-sapped poles.

Table 4.5: Typical service life of round poles against in-ground decay in Zone D.

Timber type	In-ground durability class(1)	Treatment(2)	Typical service life (years)		
			Pole diameter 200 mm	Pole diameter 300 mm	Pole diameter 400 mm
Treated softwood	4	H4	35	45	50
		H5	60	70	80
Treated hardwood	1	H4	30	45	50
		H5	50	70	70
	2	H4	30	40	40
		H5	45	60	60
	3	H4	25	30	35
		H5	35	40	45
	4	H4	20	25	25
		H5	30	30	35
Untreated hard-wood(3)	1	—	25	30	40
	2	—	10	15	20

Notes:
1. See Table 4.1.
2. As per AS 1604.1 for CCA and creosote.
3. De-sapped poles.

The majority of the Ergon poles are located in Zones C and D. Other Australian distributors have the majority of their poles in Zones B and C. Based on this table Zone D poles would be expected to have in the range 25-40% lower lives when compared to Zones B and C.

Appendix J. Change in Pole Strength Algorithm

Historic Ergon Energy Wood Pole Serviceability Algorithm 2003 onwards:

- The Ergon Energy serviceability algorithm was introduced in 2003 using a template solution and the characteristic bending strengths used for each wood strength group were from AS/NZS 2878:2000 which was referenced in C(b)1, the ESAA/ENA Guidelines for design and maintenance of overhead distribution and transmission lines.
- At that time, Queensland standards were based on working strengths with a Factor of Safety of 2.5 for line design and a Factor of Safety of 2 for line maintenance where there was no load change for an existing pole. Where a load change was required for an existing pole, designers used FoS of 2.5.
- The wood pole serviceability threshold of 100% was equivalent to a Factor of Safety of 2.
- The wall thickness requirement for serviceability was ≥30mm. Poles which did not meet the wall thickness requirement were nailed.
- There was no minimum strength requirement.

Ergon Energy Design Standards:

- The first Ergon Energy overhead design standards were developed in 2004-2005, using Limit State rather than Factor of Safety to align with C(b)1.
- ENA C(b) 1 became AS/NZS 7000 which referenced the characteristic bending strengths in AS 3818.11. These values were lower than those in AS/NZS 2878:2000.
- Pole serviceability algorithms are generally hard coded because of the complexity of both the calculation and the logic. Updates to the coding must be carried out as part of a multi-stream project and there were no opportunities to update the algorithm.

FMC Update:

- The Field Mobile Computing System was upgraded in 2019 as it was no longer being supported by the vendor.
- The wood pole serviceability algorithm had to be redesigned and recoded as the vendor did not have the original code and it could not be reengineered to meet the upgraded system.
- The characteristic bending strength in the new algorithm was changed to be consistent with AS/NZS 7000 and design practices in Energy Queensland.
- The strength serviceability threshold remained at 100%.
- The wall thickness requirement remained at ≥30mm but poles were replaced rather than nailed to align with the Energex algorithm and to conform with EQL strategic direction.
- A minimum pole strength threshold was introduced to align with the Energex algorithm and to address safety concerns over increasing failures in service.