Pole Replacements

Business Case

22 January 2024

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DOCUMENT VERSION

Version Number	Change Detail	Date	Updated by
Draft v0.1	Draft	10/11/2023	Senior Asset Strategy Engineer
Draft v0.2	Draft Submitted to Reg team	14/11/2023	Manager Asset Strategy
V1.0	Finalised	20/11/2023	Manager Asset Strategy

RELATED DOCUMENTS

Document Date	Document Name	Document Type
JAN 2024	Asset Management Plan – Poles	PDF
NOV 2023	Pole Risk modelling	Docx & Excel
NOV 2023	Poles CBRM/CNAIM Model R-code	Excel
JUN 2023	RIN 2.2 Compare 2021-22 (Rosetta)	Excel
JUN 2023	Maintenance Acceptance Criteria (MAC) – Release 11	PDF
AUG 2023	Maintenance Activity Frequency (MAF) – Release 2	PDF
OCT 2023	Lines Defect Classification Manual	PDF
FEB 2021	Electrical Safety Code of Practice 2020 - Works	PDF
NOV 2023	Energex 2022-23 - Category Analysis - RIN Response - Consolidated - 24 November 2023 – PUBLIC (16063386.1)	Excel
OCT 2023	Australian Government, Department of the Prime Minister, and Cabinet (office of Best Practice Regulation) – Best Practice Regulation Guidance Note – Value of a Statistical Life	PDF
ND	Australian major national disasters.xlsx (a compendium of various sources)	Excel

1 SUMMARY

Title	Pole Replacements
DNSP	Energex
Expenditure category	☒ Replacement ☐ Augmentation ☐ Connections ☐ Tools and Equipment ☐ ICT ☐ Property ☐ Fleet
Purpose	The purpose of this Business Case is: • to evaluate the benefits of the proposed investment and volume of pole replacements/reinforcements for the AER regulatory period 2025-30 • to support the Energex forecast capital expenditure over the regulatory period via a cost benefit analysis.
Identified need	☒ Legislation ☒ Regulatory compliance ☒ Reliability ☐ CECV ☒ Safety ☒ Environment ☒ Financial ☐ Other Energex is committed to adopting an economic, customer value-based approach when it comes to ensuring the safety and reliability of the network. To substantiate the advantages of this approach for the community and businesses over the modelling period, we have employed Net Present Value (NPV) modelling. This commitment is in line with our efforts to minimize the impact on customer prices. Investment in the replacement/reinforcement of poles is required to manage legislative and regulatory compliance, reliability, financial, safety, and environmental risks as well as consequences that may arise due to the failure of a pole. Energex has a regulatory obligation as outlined in the Electrical Safety Code of Practice (ESCOP) 2020 Works Section 5.1 that states “An electricity entity should have a maintenance system that achieves a minimum three-year moving average reliability against the incidence of failure of 99.99 per cent a year. Special consideration should be given to poles in areas of higher risk, such as ‘cities and towns. The pole failure rate in Energex is tracking well below the ESCOP levels. Although, a small increase has been experienced last year but it is more due to age profile of the poles rather than due to any specific reason. Therefore, continuation of the counterfactual volumes is proposed for the regulatory period 2025-30 to maintain the current level of performance. A cost benefit analysis has been conducted to confirm that the pole replacements are prudent capital investments.

<table>
<tr><td>Summary of intervention option</td><td>Three different replacements/reinforcement intervention options were considered and compared along with the continuation of the counterfactual (Current defect rate - Average 4,026 poles/year) replacement/reinforcement option, as follows:
1. REPEX Model Cost Scenario – Avg 4,671 poles/year
2. REPEX Model Live Scenario – Avg 1,057 poles/year
3. CBRM Health Index (>=7.5) – Avg 8,550 poles/year.</td></tr>
<tr><td>Expenditure</td><td>This business case relates only to defect and targeted pole replacements / reinforcements based on serviceability criteria identifying imminent failures and consequential investment under other program and their respective benefit is included in the respective business cases such as the overhead conductor business case.
<table>
<tr><th>Year
$m, direct 2022-23</th><th>2025/26</th><th>2026/27</th><th>2027/28</th><th>2028/29</th><th>2029/30</th><th>Total</th></tr>
<tr><td>Defect & Targeted*</td><td>19.8</td><td>19.8</td><td>19.8</td><td>19.8</td><td>19.8</td><td>99.0</td></tr>
<tr><td>Pole-top (consequential)*</td><td>11.9</td><td>11.9</td><td>11.9</td><td>11.9</td><td>11.9</td><td>59.5</td></tr>
<tr><td>Services (consequential)*</td><td>2.2</td><td>2.2</td><td>2.2</td><td>2.2</td><td>2.2</td><td>11.0</td></tr>
<tr><td>Distribution TXs (consequential)*</td><td>1.9</td><td>1.9</td><td>1.9</td><td>1.9</td><td>1.9</td><td>9.5</td></tr>
<tr><td>Distribution SWs (consequential)*</td><td>6.1</td><td>6.1</td><td>6.1</td><td>6.1</td><td>6.1</td><td>30.5</td></tr>
<tr><td>Consequential*</td><td>22.0</td><td>22.0</td><td>22.0</td><td>22.0</td><td>22.0</td><td>110.0</td></tr>
<tr><td>Business Case Total Investment</td><td>41.9</td><td>41.9</td><td>41.9</td><td>41.9</td><td>41.9</td><td>209.5</td></tr>
<tr><td>Conductor Consequential #</td><td>6.8</td><td>6.8</td><td>6.8</td><td>6.8</td><td>6.8</td><td>34.0</td></tr>
</table>
* Expenditure considered for this business case.
# Expenditure included in other investment programs (Overhead Conductor)</td></tr>
<tr><td>Benefits</td><td>After a thorough evaluation of all available options, it has been determined that the ‘counterfactual’ option is the most optimum and prudent option. This option has been chosen over other options, as it provides the best balance of benefits and risks for the organisation and community. As such, the decision has been made to continue operations as usual to maintain the current performance, with a focus on optimizing existing processes and enhancing efficiencies where possible.</td></tr>
</table>

2 PURPOSE AND SCOPE

The purpose of this document is to outline the proposed volumes of replacement and expenditure for 2025-30 regulatory period associated with poles in accordance lifecycle management strategies detailed in the Asset Management Plan. A financial NPV modelling to evaluate and compare alternative options was used to validate that the expenditure incurred has been prudent.

This business case covers both the costs and benefits directly associated with defective poles as well as the cost and benefits for the consequential replacements of pole-top structures, service lines, transformers and distribution switchgear that will while replacing these defective poles. Costs and benefits of pole replacements that will occur as a part of other projects or programs, such as reconductoring, are included in their respective business case.

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

All dollar values in this document are based upon real 2022-23 dollars and exclude overheads.

3 BACKGROUND

Energex has a strategic objective to ensure a safe and reliable network for the community. Performance targets associated with these asset classes therefore aim to reduce unassisted failures to levels which deliver a safety risk outcome which is considered SFAIRP and as a minimum, meet legislative requirements. Current levels of performance are outlined in subsequent sections.

Energex continuously review pole inspection, serviceability assessment and methodologies to ensure that they align with industry best practice, are accurate and reliable and yield credible results consistent with expectations, enabling accurate modelling of pole health and serviceability and enable the provision of a safe and reliable electricity distribution network for consumers in South-East region of Queensland.

Additionally, over recent years there has been an effort to improve the management of data systems and quality of the data related to failures and the information gathered by pole inspectors in the field.

In addition to pole specific performance measures, Energex/EQL is 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)
- System Average Interruption Frequency Index (SAIFI).

Individual pole failures typically have moderate impact upon SAIDI and SAIFI, especially when part of radial supply infrastructure.

Energex has been successful in maintaining the asset performance historically so far and endeavour to continue as a minimum with consistent performance for regulatory period 2025-30 with continuation of counterfactual replacements program.

3.1 Asset Population

Energex Network have a total of 654,309 poles including 438,445 wood poles, as detailed in Figure 1. Approximately 19% of the current Energex pole population is older than 50, with another 5% of the population due to reach this age in the next 5 years.

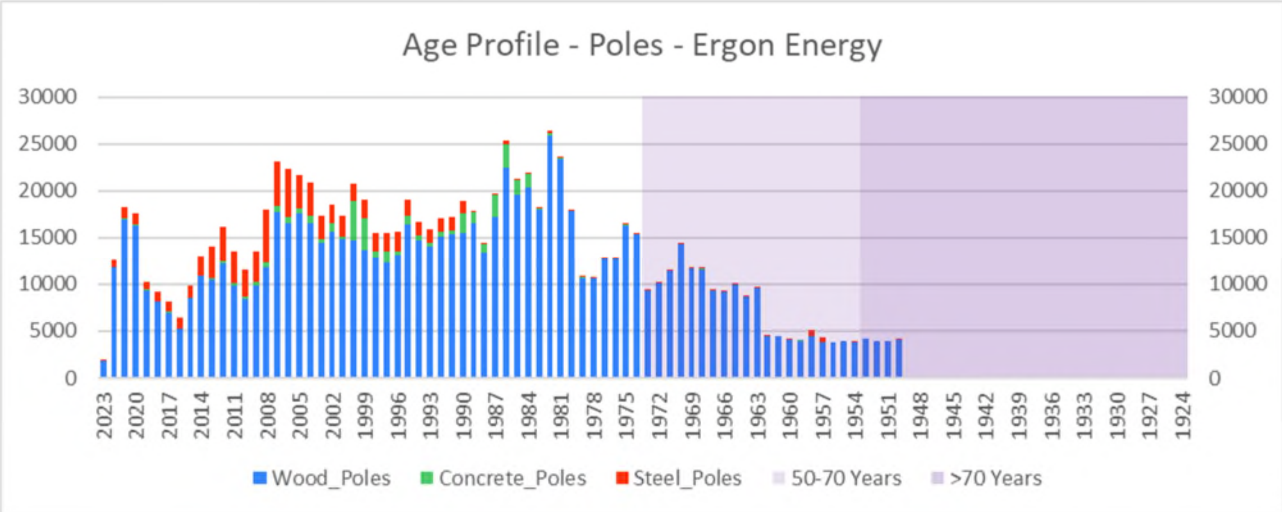

Figure 1: Energex Network Pole Age Profile

3.2 Asset Management Overview

Poles are very high volume, relatively low individual cost asset, and are managed on a population basis through periodic inspection for condition and serviceability. Poles are currently inspected and tested every five years and assessed for serviceability based on clear criteria set out in the Network Schedule of Maintenance Activity Frequency Master 2024-25 in compliance with our Poles and Towers Asset Maintenance Strategy. Pole serviceability is driven by well-established inspection programs which identify severe structural strength degradation. Structural strength is determined in accordance with AS/NZS7000:2016.

All poles reinforcements or replacements are based on their condition failing to meet the acceptance criteria through visual inspection assessment or serviceability calculation and are classified as defective as per descriptions in Standard for Classifying the Condition of Network Assets. Pole reinforcement through nailing/staking is considered effective to prevent failure and replacement due to decay caused by the soil and hostile ground conditions and hence providing a life extension of 10-15 years. Under the Electrical Safety Code of Practice 2020 Works, poles identified as defective require rectification with standard timeframes as set out in Section 5.3.4 of the ESCOP.

3.3 Asset Performance

The two main functional failures considered in this Business case and the associated modelling are defined in Table 1.

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

Table 1: Description of Functional Failure

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

The total number of unassisted pole failures is shown in Figure 2. The majority is contributed by wood poles which make up approximately 89% of the pole population but represent 99.7% of the unassisted pole failures, mainly due to degradation caused by rot and termites. The failure data indicate a consistent low failure rate with minor yearly variations possibly due to age profile of the poles.

Steel poles and concrete poles make up 8%, and 3%, respectively, of the population while contributing only 0.1% to pole failures.

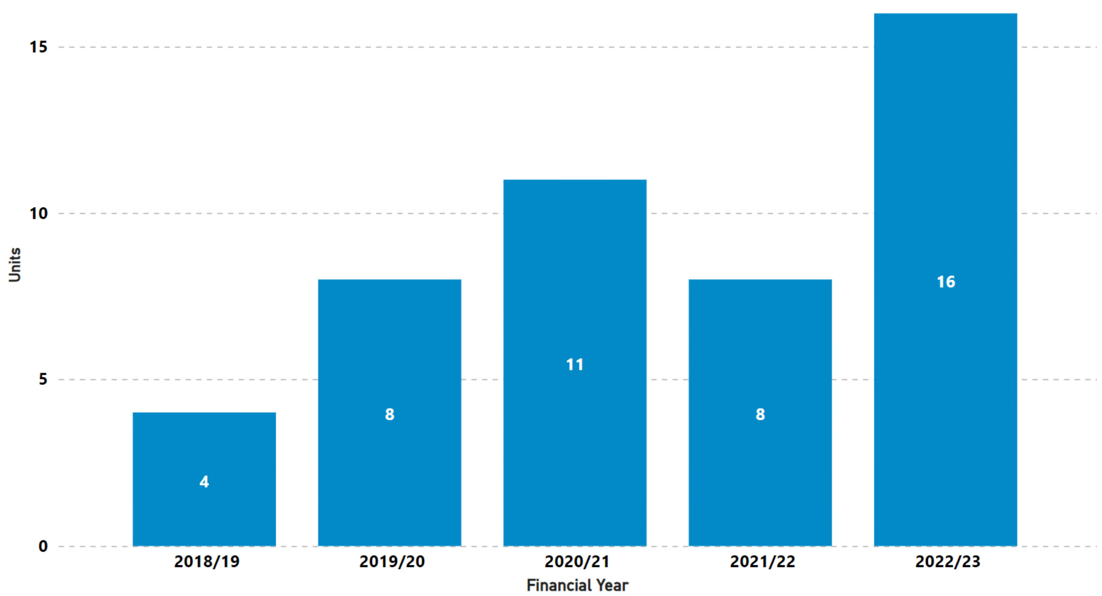

Figure 2: Energex Network Unassisted Pole Failures

Figure 3 provides the quantity of defects for wood poles resulting in pole replacement and Figure 5 provides the quantity of defects for wood poles resulting in pole reinforcement. The defect data also indicate consistency similar to failure rate with around 1,050 defects per year.

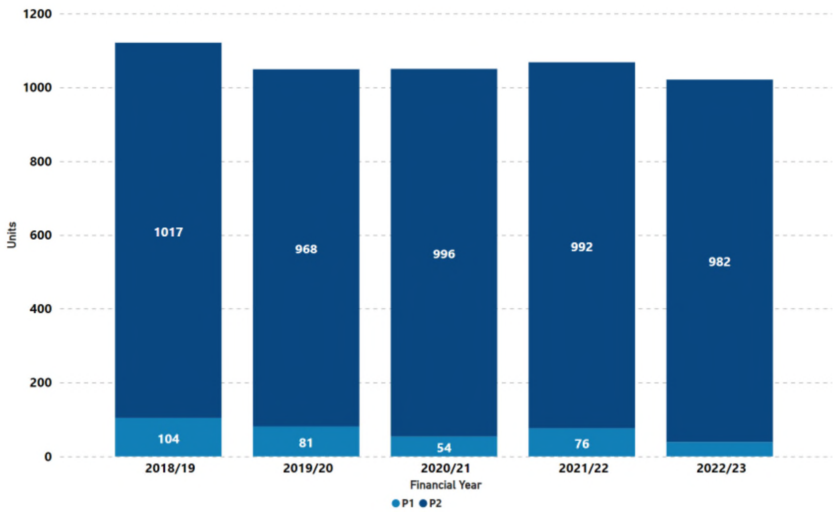

Figure 3: Energex Pole Defects - Unserviceable Wood Poles

Figure 4 provides the quantity of defects for steel poles. The significant variation in the data is possibly caused by the improved recording of the defects and failures in correct categories.

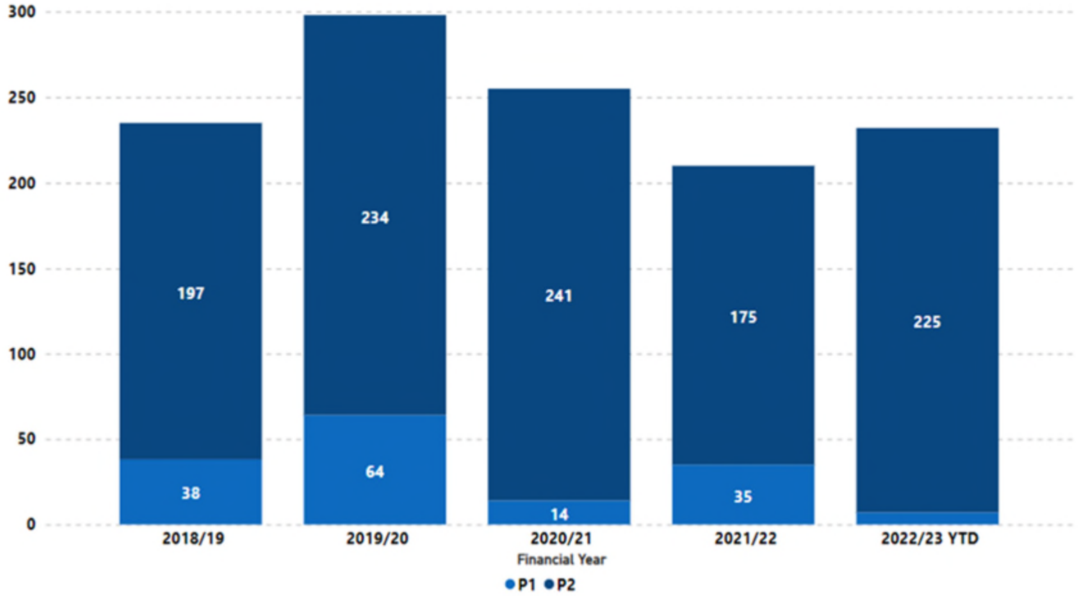

Figure 4: Energex Network Defects - Steel Pole Defects

Figure 5 provides the quantity of defects for concrete poles which is negligible at this stage in comparison to steel and wood poles.

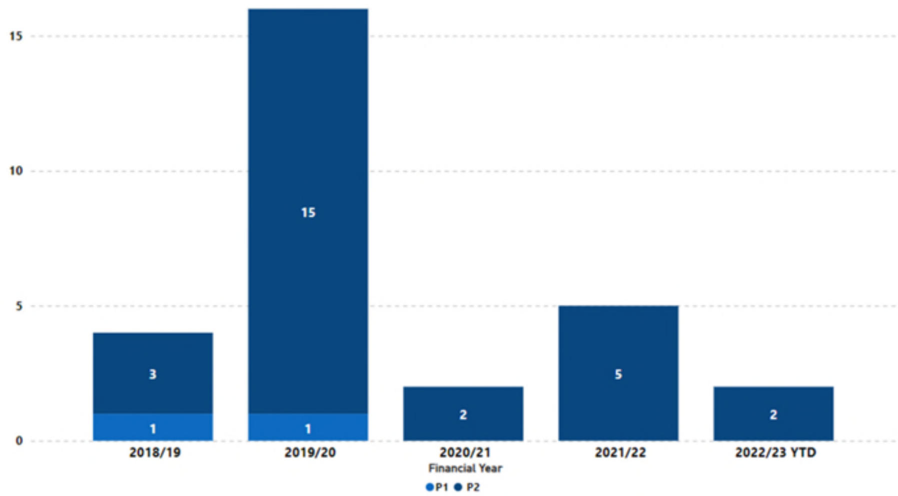

Figure 5: Energex Network Defects - Concrete Pole Defects

Figure 6 provides the quantity of defects for pole stays. Pole stays are an important part of the mechanical support system for poles and structures, used to balance the forces imposed at the top of a pole or structure, therefore ensuring the poles do not fail unexpectedly due to mechanical stress. In 2022, improvements have been made to stay inspections practices and identification of defective stays, to address an increasing failure rate and significant public safety concerns, resulting in the step change of stay defects in 2021-22 and 2022-23 YTD.

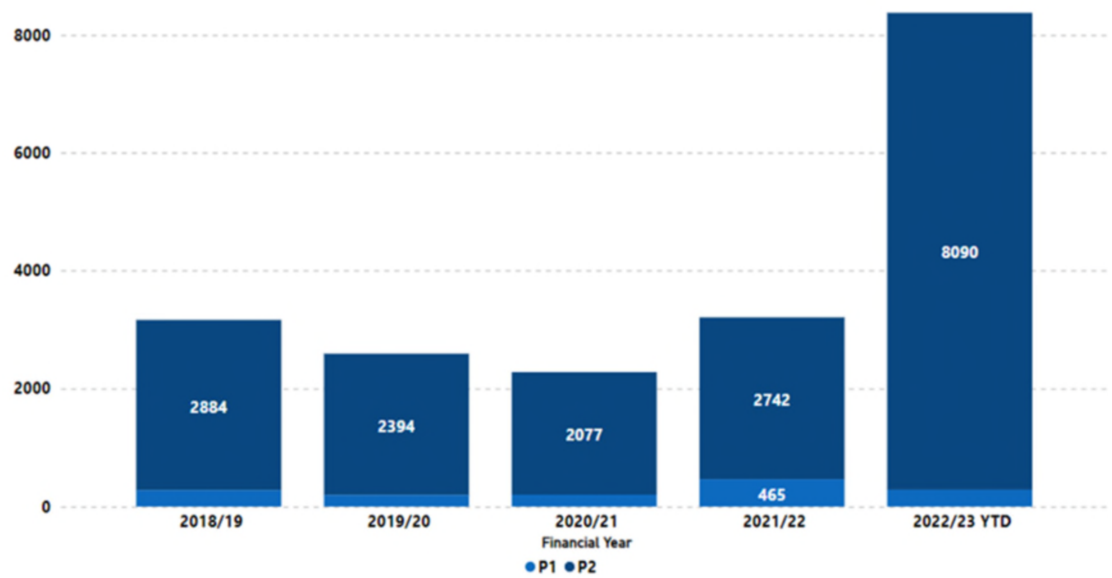

Figure 6: Energex Network Defects - Stay Defects

4 RISK ANALYSIS

In evaluating the risks associated with our pole assets, we model each pole individually, with location and condition data specific to each pole, while also factoring to the extent possible other factors such as the electrical load the feeder the pole support carries and locational factors that are important to outcomes from an unassisted pole failure.

As such, our cost benefit analysis is aimed at calibrating our serviceability calculation at the program level, so that on average we will be able to maximise the benefits to customers. As such, following the cost benefit analysis through NPV modelling, the most positive NPV of the volumes considered will form the basis for selecting the preferred option about reinforcement/replacement. In the case of this business case, the most positive NPV validates the volume of reinforcement/ replacement undertaken over the regulatory period is a prudent approach.

The monetised risk is simply calculated as per the calculation in Figure 7.

Figure 7: Monetised Risk Calculations

Energex broadly considers five value streams for investment justifications regarding replacement of widespread assets. These are shown in Figure 8. For poles, only four of the value streams are considered; the 'Export' is not material to poles.

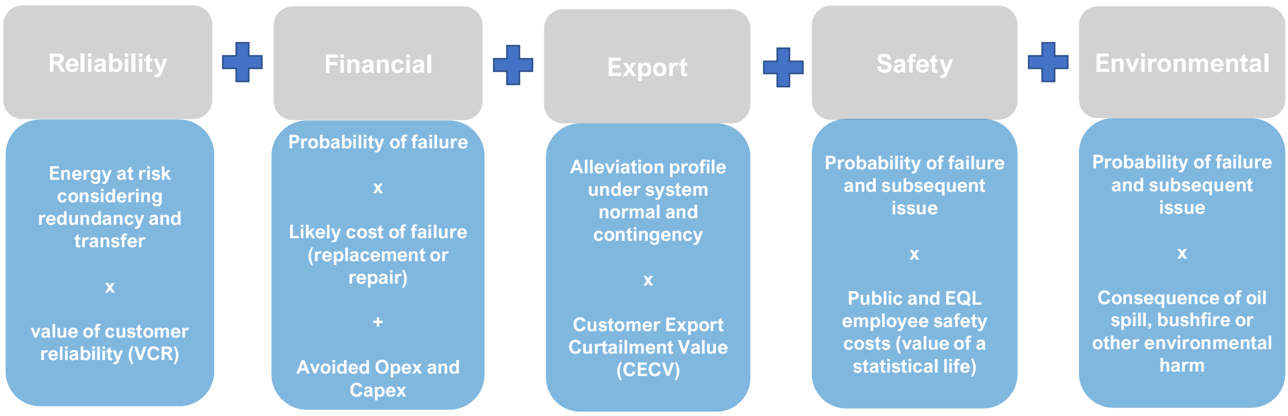

Figure 8: Risk Stream for Assets

4.1 Health Index and Probability of Failure (PoF) - Poles

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

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

Condition based risk management model combines asset information, engineering knowledge and practical experience to define the current and future condition and performance for network assets as shown in Figure 9 and Figure 10. The HI is calculated on a scale of 0 to 10 which represents the extent of condition degradation:

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

The relationship between HI and PoF is not linear, an asset can accommodate significant degradation with very little effect on the risk of failure. Conversely, once the degradation becomes significant or widespread, the risk of failure rapidly increases.

A HI of 7.5 basis typically been used as the point at which assets are identified as candidates for requiring an intervention.

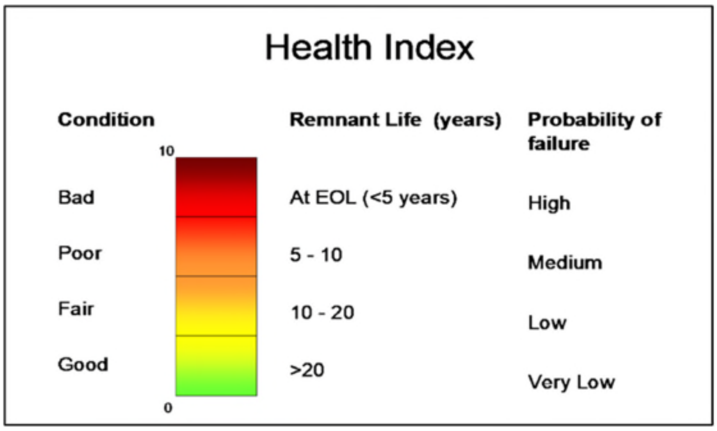

Figure 9: PoF/HI Relationship

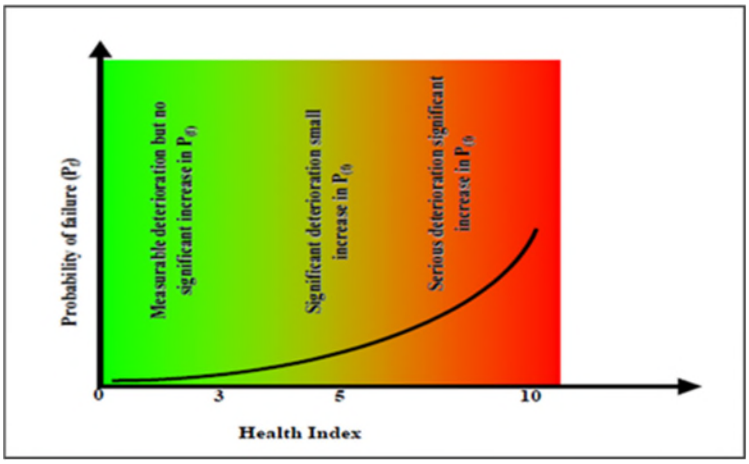

Figure 10: HI and PoF Relationship Graph

Figure 11 illustrates that approximately 64,300 poles are forecast for a HI of over 7.5 in the year 2023, requiring intervention in next three years along with P0 and P1 defective poles identified through inspections. Although the majority of defective poles are expected to be the part of the very poor condition pole population (HI ≥ 7.5), defective poles requiring nailing or replacements are also forecast from the remaining population in poor condition with a HI range between 5 and 7.5. These nailing and replacements have been factored into our forecast replacement volumes.

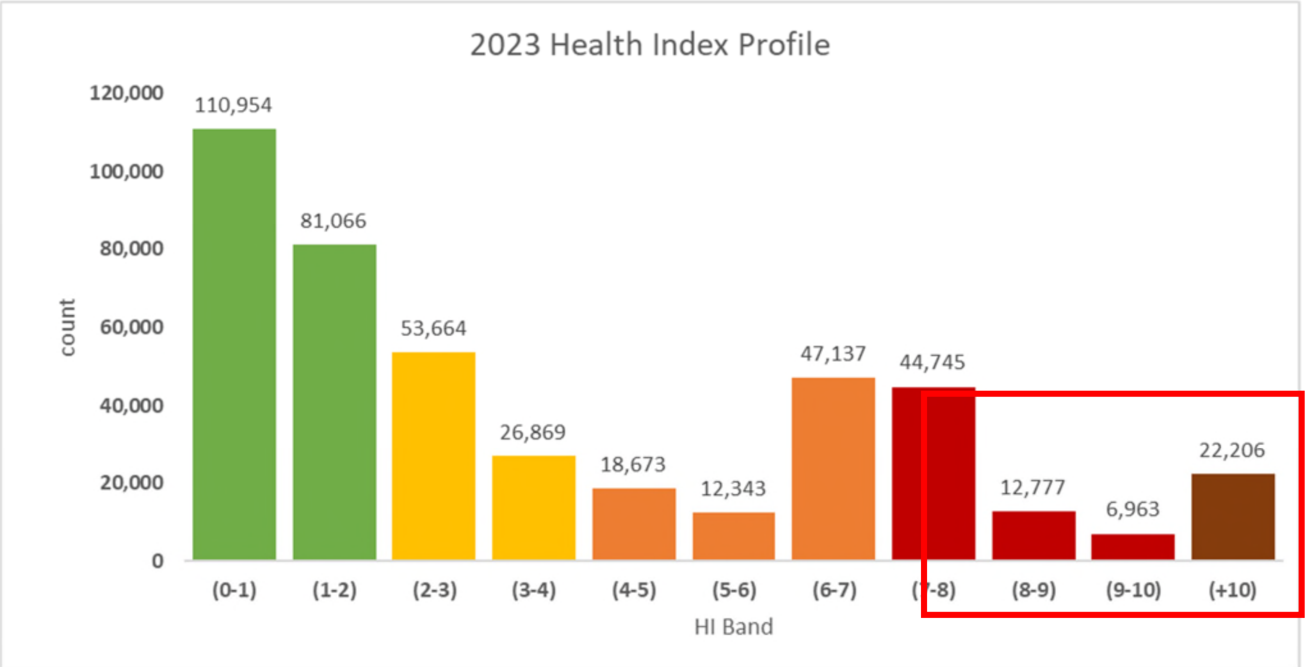

Figure 11: Current HI profile for Wood Poles

Additionally, estimated forecast HI summary of poles at the end of the modelling period (year 2043), as per CBRM, is provided in Figure 12, indicating 170,700 poles exceeding a HI of 7.5, which means an average minimum replacement rate of around 8,550 poles/year would be required in the next 20 years to keep the fleet with a HI of below 7.5.

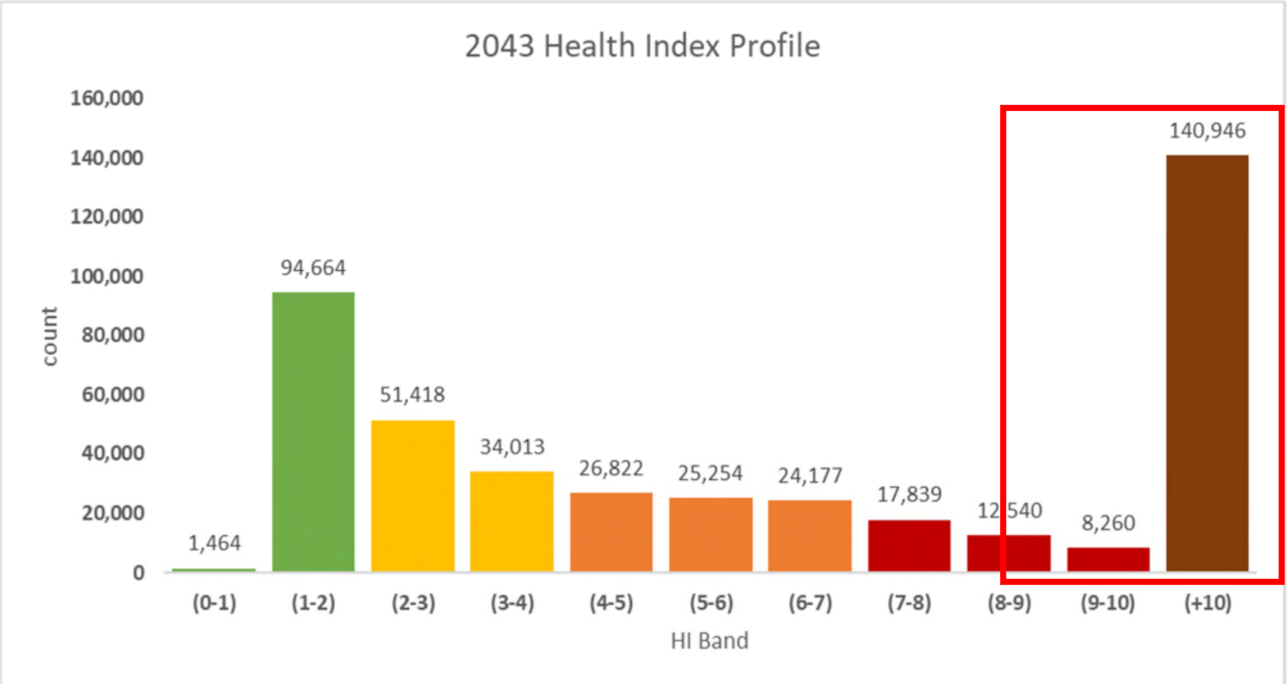

Figure 12: Future HI profile for Wood Poles

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

The key consequence of pole failures that have been modelled are reliability, financial, safety and environmental. The CoF refers to the financial or economic outcomes if an event were to occur.

The LoC refers to the probability of a particular outcome or result occurring because of a given event or action. To estimate the LoC, Energex has utilised a combination of historical performances and researched results. Energex 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, Energex also has conducted extensive research to gather relevant information and data related to the respective risk criteria such as bushfire.

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

4.2.1 Reliability

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

- **Lost load:** Each pole in our network is modelled individually, with the relationship developed between a pole and the feeder that it is connected to. The historical average load on each feeder in our network is utilised to determine the kW that would on average be lost following a pole failure. We have utilised half of the historic average load on the feeder, which represents the most likely outcome, as the data regarding the exact electrical location of the pole in a feeder is not available.
- **Load transfers and Restoration timeframe:** the average loss of supply has been estimated for a period of average three hours to six hours based on the locality, with respective staged restoration periods, based on historical data for outages/durations. This is based on the average load on our fleet of feeders, divided under five categories from 'Rural Short, rural long, urban, sub-transmission and transmission in between.
- **Value of Customer Reliability Rate:** We have used the Queensland average VCR rate.
- **Probability of Consequence:** all in-service pole failures result in an outage to customers.

4.2.2 Financial

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

- **Pole replacement:** different unit cost of pole replacement has been taken based on voltage level and type of pole varying approximately between $6,000 (LV Pole) to $27,000 (sub-transmission) with an average of $6,986 per pole.
- **Pole Reinforcement:** Unit cost of pole reinforcement (nailing) has been taken as $1,031 per pole.
- **Pole Nailing:** has been assumed as 30% of total pole remediation program (Replacement + Reinforcement) for modelling purposes.
- **Probability of Consequence:** all in-service pole failures result in a need to replace the pole under emergency.

4.2.3 Safety

The safety risk for a pole failure is primarily that a member of the public is in the presence of a fallen conductor which was caused by pole failure. This could result in a fatality or injury. For our modelling we have used October 2023 published document from Australian Government, Department of the Prime Minister and Cabinet (Office of Best Practice Regulation) – Best Practice Regulation Guidance Note - Value of a Statistical Life:

- **Value of a Statistical Life:** $5.4m
- **Value of an Injury:** $1.35m
- **Disproportionality Factor:** 6 for members of the public

- **Probability of Consequence**: Following an unassisted pole failure, there is a 1 in 20 years chance of causing a fatality and 3 in 20 years chance of a serious injury based on historical data evidence. The average number of safety incidents has been derived by analysing 20 years of Significant Electrical Incident data comprising 4 incidents where unassisted pole failure has driven a safety incident of the appropriate severity.

4.2.4 Environmental - Bushfire

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

- **Value of Bushfire:** $22.3m – which includes average damage to housing and fatalities following a bushfire being started. In Queensland *as per* Australian major natural Disasters.xlsx (a compendium of various sources), there were 122 homes lost and 309 buildings lost during bushfires between 1990 and present (2021) across 12 significant fire records. Homes were estimated an average cost of $400,000 while the buildings were estimated at an average cost of $80,000. The weighted average cost of bushfire consequence per pole has been estimated as $6,763.
- **Safety Consequence of bushfire:** Safety consequences are evaluated on same assumptions as safety incident consequence in 4.2.3 with a frequency of 0.5 per incident as there has been 6 fatalities recorded across those 12 bushfire incidents in Queensland.
- **Probability of Consequence:** Following the failure of a pole, we have estimated that there is a 0.0260 chance of causing a fire. This is based on a historical full two years data when there were 18 fires recorded due to electrical asset failures in Energex. In those two years there were 12 pole failures, 285 cross-arm failures and 402 conductor failures that had potential to cause fire ignition, giving a probability of 0.026 (18/699). 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.

5 CONSEQUENTIAL REPLACEMENT

Following the identification of a defective pole, we also conduct an evaluation of the condition of the equipment affixed to the pole and determine whether it is feasible and cost-effective to replace them. This equipment includes crossarms, transformers, service lines, and switches. Refer to Table 4 in Section 5.1 for further details on the benefit assumptions.

When evaluating the advantages of this approach for our customers, our cost-benefit analysis considers the replacement of this equipment as an integral part of a pole replacement. In other words, we have factored in the investments and benefits associated with these consequential replacements into the analysis to ensure that the overall replacements are factored into the analysis. Table 2 provides the estimated consequential asset volume, based on last year actual delivery, to be replaced under forecast pole replacement program.

Consequential Replacement Volume	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Pole Top	5,490	5,490	5,490	5,490	5,490	**27,450**
Services	2,768	2,768	2,768	2,768	2,768	**13,840**
Pole Transformer	66	66	66	66	66	**330**
Switch	705	705	705	705	705	**3,525**

Table 2: Consequential Replacement – Counterfactual Option

In undertaking a comparison between the alternative options to our actual delivery, we have utilised the same ratios of replacement of the items listed in Table 2. Accordingly, a ratio table has been used as summarised in Table 3 to determine the volumes for other options.

Consequential Replacement Ratio	Defect Program Ratio	Targeted Program Ratio
Pole Top Structure	2.09	2.09
Services	1.09	1.04
Pole Transformer	0.04	0.01
Switches	0.6	0.1

Table 3: Consequential Replacement Ratio per pole

5.1 Benefit Assumptions

In accounting for the costs and benefits from the consequential of replacement of switchgear, pole top structures, transformers and services with the replacement of a defective pole, we have utilised our cost benefit modelling outlined in the business case for each of these four asset categories.

We acknowledge that the consequential replacement of the four asset categories is an "advancement" or bring forward of the replacement of the assets than would otherwise be required. An estimate of the already used service life of these assets at the time the replacement is provided in Table 4.

Consequential Replacement Asset Description	Average Failure age in Years as per Weibull Analysis	Estimated Average Age at the time of pole replacement (at 58 years)	% Life already used at pole replacement time
Pole Top Structure	41.5	16.5	40%
Services	37	21	57%
Pole Transformer	33	25	76%
Switches	21	16	76%

Table 4: Expected Used Life of Consequential Replacement

Consequential replacements of pole top structures are estimated to be replaced with only 40% of their life used; the asset providing least benefit from replacement as 60% life is still unused. Similarly, services are replaced with 57% of their life used while transformers and switches provide maximum benefits being replaced with 76% of their life used. However, our conservative approach is to assume that all the consequential assets are replaced at 75% of remaining life. On that basis, we allocate 25% of the benefits as identified in the business case for these consequential assets. This ensures that we factor the minimum level of benefits that our customers will see from these consequential replacements, with the likelihood that the benefits will be higher than this value in most cases.

The following are assumptions used in the analysis of NPV of consequential replacements:

- Estimated average age of pole at the time of replacement is 58 years.
- Allocate 25% of the average benefit of replacement of these assets as the benefits. attributable to replacing these assets with our defective poles.

Consequential benefits only applicable to pole replacement and not for pole reinforcements.

6 IDENTIFIED NEED

6.1 Problem Statement

Energex reviewed its asset management practices with respect to poles. The review found that defect pole replacements identified from routine inspection and targeted volume replacements are at the expected level to manage the current levels of service. Additionally, poles are also frequently replaced consequentially under targeted reconductoring based on 'Repex Guideline' where aged poles are targeted with other relevant assets for the cost-effective delivery. This counterfactual strategy has evidently aided in maintaining the asset performance. This business case covers only the defect and targeted replacement volume prudency.

This business case evaluates the proposed level of replacement/reinforcement and evaluates the benefits to customers from these replacements/reinforcements. Other options that are practically feasible have also been identified and benefits evaluated and compared to demonstrate the prudency of our approach.

The purpose of this business case is to ensure that we deliver the maximum benefits to customers through ensuring the right level of forecast investment to efficiently limit the reliability, safety, environmental and financial risks from pole failures.

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

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

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

6.2 Compliance

Pole assets are subject to several legislative and regulatory standards. The Asset Management Plan provides the full list; some of the key regulations are:

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
- are operated in a way that is electrically safe.

The duty includes the requirement that the electricity entity inspects, tests, and maintains the works.

The Electrical Safety Regulation 2013 (ESR) details requirements for electric lines, specifically about safety clearances, of which poles are classed as associated equipment. These include various general obligations related to the safety of works of an electrical entity.

The Queensland Electrical Safety Codes of Practice (ESCOP) 2020 – 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.

Some key relevant clauses used to guide the programs are:

- ESCOP s5.1 – must achieve a minimum three-year moving average reliability of 1:10,000pole failure per annum.
- 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.
- ESCOP s5.3.4 – A suspect pole must be assessed within three months; An unserviceable pole must be replaced or reinstated within 6 months.

Reinforcing the importance of our Electrical Safety Act obligations, on 3rd January we received a Notice to Give Information and Produce Documents to the Regulator in line with Section 122C(3) of the Act.

While the reliability performance for poles has a regulatory standard set via the Queensland Electrical Safety Codes of Practice (ESCOP) 2020 – Works, occurrence of in-service pole failure in urban areas has much higher associated risk, due to the higher likelihood of public presence. The desired level of service for poles in the Energy Queensland network is to achieve in-service pole failure numbers which deliver a safety risk outcome which is considered SFAIRP, and as a minimum, maintains current performance standards.

6.3 Counterfactual (Base Case Scenario) – Historical Volumes – Preferred Proposed Option

To provide a comparison of the potential alternatives to our actual delivery for our cost benefit analysis, we have set the counterfactual to historical defect and targeted volumes for pole replacement/reinforcement program based on average delivered volumes for last three years.

6.3.1 Costs/Volumes

The estimated volume and expenditure in this option are shown in the Table 5 and Table 6.

Counterfactual Volume Pole and Consequential Replacement	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Pole Replacement & Reinforcement	**4,026**	**4,026**	**4,026**	**4,026**	**4,026**	**20,130**
Pole Replacement	2,624	2,624	2,624	2,624	2,624	**13,120**
Pole Reinforcement	1,402	1,402	1,402	1,402	1,402	**7,010**
Pole Top (Consequential)	5,490	5,490	5,490	5,490	5,490	**27,450**

Services (Consequential)	2,768	2,768	2,768	2,768	2,768	**13,840**
Pole Transformer (Consequential)	66	66	66	66	66	**330**
Switch (Consequential)	705	705	705	705	705	**3,525**

Table 5: Counterfactual Option – Volumes

Counterfactual Expenditure **Pole and Consequential Direct Expenditure**	**2025-26 $m**	**2026-27 $m**	**2027-28 $m**	**2028-29 $m**	**2029-30 $m**	**Total $m**
Pole Replacement	**18.3**	**18.3**	**18.3**	**18.3**	**18.3**	**91.6**
Pole Reinforcement	**1.4**	**1.4**	**1.4**	**1.4**	**1.4**	**7.0**
Pole Top (Consequential)	11.9	11.9	11.9	11.9	11.9	59.5
Services (Consequential)	2.2	2.2	2.2	2.2	2.2	11.0
Pole Transformer (Consequential)	1.9	1.9	1.9	1.9	1.9	9.5
Switch (Consequential)	6.1	6.1	6.1	6.1	6.1	30.5
Consequential Total	**22.0**	**22.0**	**22.0**	**22.0**	**22.0**	**110.0**

Table 6: Counterfactual Option – Costs

6.3.2 Risk Quantification

Utilising the modelling approach outlined in Section 4.2, Energex has determined the risk values for a twenty-year time horizon as a period representative of the expected period of realisable benefits from any interventions. The forecast for pole failures under this scenario shown in Figure 13.

In this option, our modelling shows that unassisted pole failures are projected to remain compared to the current levels during the regulatory period 2025-30. This option is the most effective choice for moving towards maintaining the failure rate at current levels and maximizing customer benefits.

Considering current performance, it's essential to maintain the same level of investment in the future as a minimum to continue improving customer benefits and avoid the need for a significant increase in near-term investments.

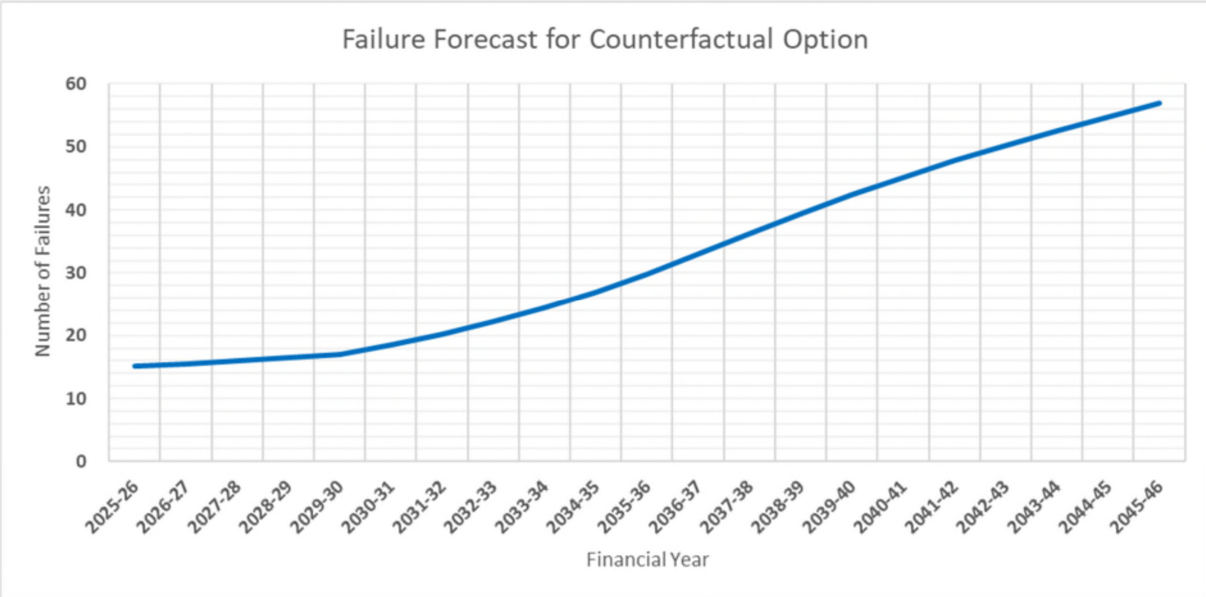

Figure 13: Projected Pole Failures Energex

Figure 14 provides the results of a quantitative forecast of emerging risk associated with Energex pole asset population failure due to condition related failure modes. The forecast summary indicates that the emerging risk remain constants or increases marginally during the regulatory period 2025-30 compared to the current level. Although, the modelling suggests that the future, beyond 2030, replacement volumes could require further increase to control the growing risk.

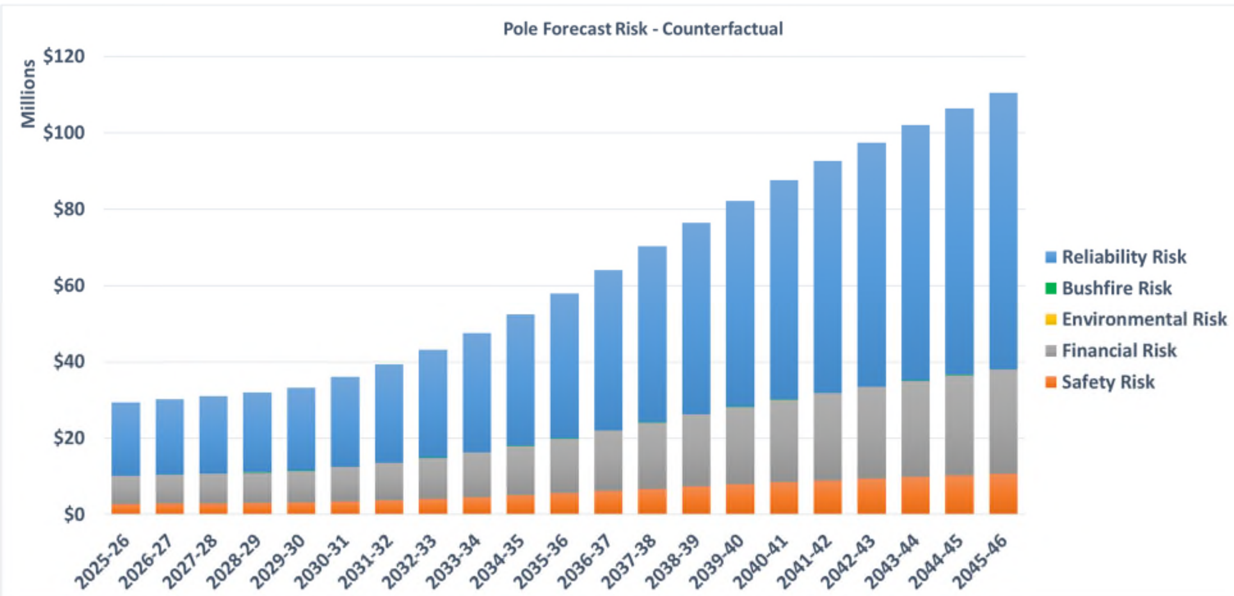

Figure 14: Counterfactual quantitative risk assessment

7 OPTIONS ANALYSIS

In assessing the prudency and efficiency of our actual delivery, we have compared a range of interventions against the counterfactual (current defect and targeted rate) to assess the options that would have maximised value to our customers. We have sought to identify a practicable range of technically feasible, alternative options that would have satisfied the network requirements in a timely and efficient manner.

7.1 Option 1 – REPEX Model Cost Scenario

This option includes the replacement/reinforcement for poles based on REPEX model cost scenario with volumes estimated using pole allowance expenditure between 2025-30 divided by our three-year average actual unit cost.

7.1.1 Intervention Volume

The volumes that have been modelled in Option 1 are outlined in Table 7.

Historical Volume **Pole and Consequential Replacement**	**2025-26**	**2026-27**	**2027-28**	**2028-29**	**2029-30**	**Total**
Pole Replacement & Reinforcement	**4,671**	**4,671**	**4,671**	**4,671**	**4,671**	**23,335**
Pole Replacement	3,044	3,044	3,044	3,044	3,044	**15,220**
Pole Reinforcement	1,627	1,627	1,627	1,627	1,627	**8,135**
Pole Top (Consequential)	6,369	6,369	6,369	6,369	6,369	**31,845**
Services (Consequential)	3,212	3,212	3,212	3,212	3,212	**16,060**
Pole Transformer (Consequential)	76	76	76	76	76	**380**
Switch (Consequential)	818	818	818	818	818	**4,090**

Table 7: Replacement Volume

7.1.2 Risks/Benefits

In this option, our modelling shows that the unassisted pole failures are projected to improve marginally comparable to those in the counterfactual option. Energex projected to consider this option in future regulatory period to align with the ageing population profile.

7.2 Option 2 – REPEX Model Lives Scenario

This option includes the replacement/reinforcement for poles based on REPEX model Lives scenario with volumes estimated using pole allowance expenditure between 2025-30 divided by our three-year average actual unit cost achieving a replacement life of 76 years.

7.2.1 Intervention Volume

The volumes that have been modelled in Option 2 are outlined in Table 8.

REPEX Model Lives Scenario **Pole and Consequential Replacement**	**2025-26**	**2026-27**	**2027-28**	**2028-29**	**2029-30**	**Total**
Pole Replacement & Reinforcement	**1,057**	**1,057**	**1,057**	**1,057**	**1,057**	**5,285**
Pole Replacement	689	689	689	689	689	**3,445**
Pole Reinforcement	368	368	368	368	368	**1,840**
Pole Top (Consequential)	1,442	1,442	1,442	1,442	1,442	**7,210**
Services (Consequential)	727	727	727	727	727	**3,635**
Pole Transformer (Consequential)	17	17	17	17	17	**85**
Switch (Consequential)	185	185	185	185	185	**925**

Table 8: Replacement Volume

7.2.2 Risks/Benefits

Under this option, our modelling indicates that unassisted pole failures are expected to be significantly higher compared to the counterfactual option. This level of performance is worst among all options and would lead to significantly higher investment in future due to stacking up of defective poles in service.

Additionally, our recent failure and defect analysis shows that treated poles are not achieving the same level of lifespan as untreated poles. Treated poles are the majority of our population and are failing mainly due to timber integrity issues from faster growing timber. Moving to an age-based replacement option may result in a significant rise in unassisted pole failures given our pole failures are not directly related to the age of the poles. Recent failure and defect analyses have also confirmed this issue. Therefore, choosing this approach will necessitate a significant increase in near-term investments due to the rising rate of asset failures and Energex will consider every possible step to discount this option.

7.3 Option 3 – Health Index ≥ 7.5

This option volume is based on CBRM/CNAIM health index model aiming to replace asset on or beyond 7.5HI.

7.3.1 Intervention Volume

The volumes that have been modelled in Option 3 are outlined in Table 9.

Repex Model Live Scenario Volume Pole and Consequential Replacement	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Pole Replacement & Reinforcement	**8,550**	**8,550**	**8,550**	**8,550**	**8,550**	**42,750**
Pole Replacement	5,572	5,572	5,572	5,572	5,572	**27,860**
Pole Reinforcement	2,978	2,978	2,978	2,978	2,978	**14,890**
Pole Top (Consequential)	11,660	11,660	11,660	11,660	11,660	**58,300**
Services (Consequential)	5,885	5,885	5,885	5,885	5,885	**29,425**
Pole Transformer (Consequential)	140	140	140	140	140	**700**
Switch (Consequential)	1,498	1,498	1,498	1,498	1,498	**7,490**

Table 9: Intervention Volumes – Option 3

7.3.2 Risks/Benefits

Under this approach, our modelling predicts that the occurrence of unassisted pole failures will reduce significantly or would minimise the failure rate by removing all the prospective defective poles from the network. However, this option would require step up changes in investment and resources requirements leading to significant cost impact on customers outweighing the benefits.

8 OUTCOMES OF OPTIONS ANALYSIS

8.1 Pole Failure Forecast

The pole failure rate forecast for all the main options have been provided in the Figure 15.

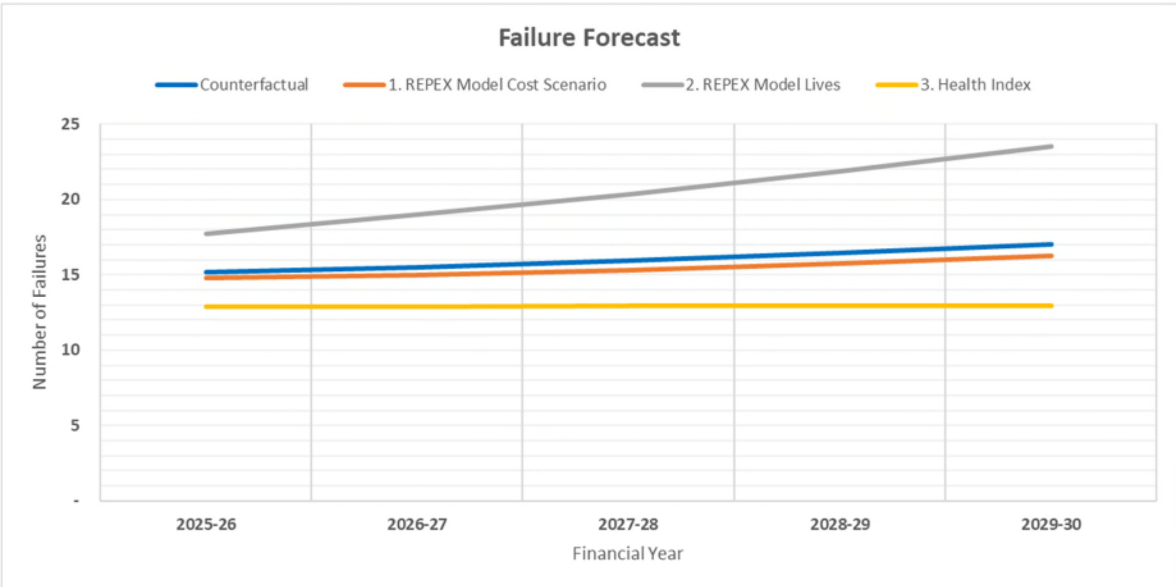

Figure 15: Failure Forecast - Intervention options

The proposed counterfactual option along with other options provide an acceptable level failure rate in line with our ESCOP requirements by maintaining the current levels or marginal increase. Option 3 is the only option which forecasts a reduction in failure rate and hold it at moderate lower level. However, option 3 requires additional investment offsetting the risk reduction and community benefits up to some extent.

Counterfactual approach delivers the maximum community benefits by maintaining the failure rate and public safety with reasonable investment and therefore has been proposed for regulatory period 2025-30.

8.2 Economic Analysis

The NPV of cost benefit analysis of the options is summarised in Table 10 with volume summary provided in Table 11, which demonstrates the following:

- Options 1 and 3 provide positive NPV.
- The option 2 which indicates worst performance in terms of failures and customer benefits deliver negative NPV.
- Option 1 is the best option to consider if Energex prefers to moderately improve the asset performance.

The increased volume of replacements in Option 3, as per Volume Summary Table 11, would deliver even higher customer benefits and associated higher NPV, however this would have an impact on the resource and service cost to our customers.

Base Case including CCPEX							
NPV Analysis to Counterfactual							
		Rank	**Net NPV incl CCPEX**	**CAPEX (NPV)**	**Benefit (NPV)**	**CCPEX NPV**	**CCPEX Benefits NPV**
	Counterfactual	3	0	0	0	$0	$0
Option 1	REPEX Model Cost Scenario	2	$12,747,701	-$21,320,765	$39,349,818	-$13,757,536	$8,476,183
Option 2	REPEX Model Lives	4	-$79,636,708	$95,741,191	-$199,516,004	$63,259,446	-$39,121,341
Option 3	Health Index	1	$54,851,034	-$149,145,296	$240,991,424	-$96,589,690	$59,594,595

Table 10: NPV Modelling Outcomes for all Options

Replacement Volumes						
		2025-26	**2026-27**	**2027-28**	**2028-29**	**2029-30**
	Counterfactual	4,025	4,025	4,025	4,025	4,025
Option 1	REPEX Model Cost Scenario	4,670	4,670	4,670	4,670	4,670
Option 2	REPEX Model Lives	1,057	1,057	1,057	1,057	1,057
Option 3	Health Index	8,550	8,550	8,550	8,550	8,550

Table 11 **Volume Summary – All Options**

Table 12 shows the additional consequential NPV benefits for the various intervention options due to cross arm, services, switches and distribution transformers replacements in conjunction with pole replacements program. We concurrently replace these assets when we replace a pole to ensure efficient delivery and avoid further replacements at the same locating in the future.

NPV Analysis to Counterfactual				Pole		Consequential (25% Benefit Factor)		
Options		Rank	Net NPV incl CCPEX	CAPEX (NPV)	Benefit (NPV)	Pole Attached Assets	CCPEX NPV	CCPEX Benefits NPV
Counterfactual		3	$0	$0	$0		$0	$0
						Pole Top	$0	$0
						Services	$0	$0
						Pole Top Transformer	$0	$0
						Switches	$0	$0
Option 1	REPEX Model Cost Scenario	2	$12,747,701	-$21,320,765	$39,349,818		-$13,757,536	$8,476,183
						Pole Top	-$3,707,423	$5,182,589
						Services	-$1,010,353	$285,559
						Pole Top Transformer	-$3,629,320	$76,327
						Switches	-$5,410,440	$2,931,708
Option 2	REPEX Model Lives	4	-$79,636,708	$95,741,191	-$199,516,004		$63,259,446	-$39,121,341
						Pole Top	$17,011,826	-$23,903,234
						Services	$4,649,181	-$1,316,611
						Pole Top Transformer	$16,701,318	-$351,873
						Switches	$24,897,120	-$13,549,622
Option 3	Health Index	1	$54,851,034	-$149,145,296	$240,991,424		-$96,589,690	$59,594,595
						Pole Top	-$26,096,467	$36,248,818
						Services	-$7,087,134	$1,997,707
						Pole Top Transformer	-$25,456,269	$534,215
						Switches	-$37,949,820	$20,813,856

Table 12: NPV Modelling Outcome for all Options including Consequential Benefits

Any volume lower than the counterfactual option, like option 2, had a negative NPV, demonstrating that the counterfactual option would be preferred over a lower replacement volume. Therefore, counterfactual is the option which is highly likely to achieve network standard compliances and customer benefits, this is prudent to continue business as usual. Option 1 and 3 both have additional targeted replacement and deliver an overall higher positive NPV, but these options impact on resources and our overall program deliverability.

Figure 16 illustrates the advantages and disadvantages of all options over their counterfactual.

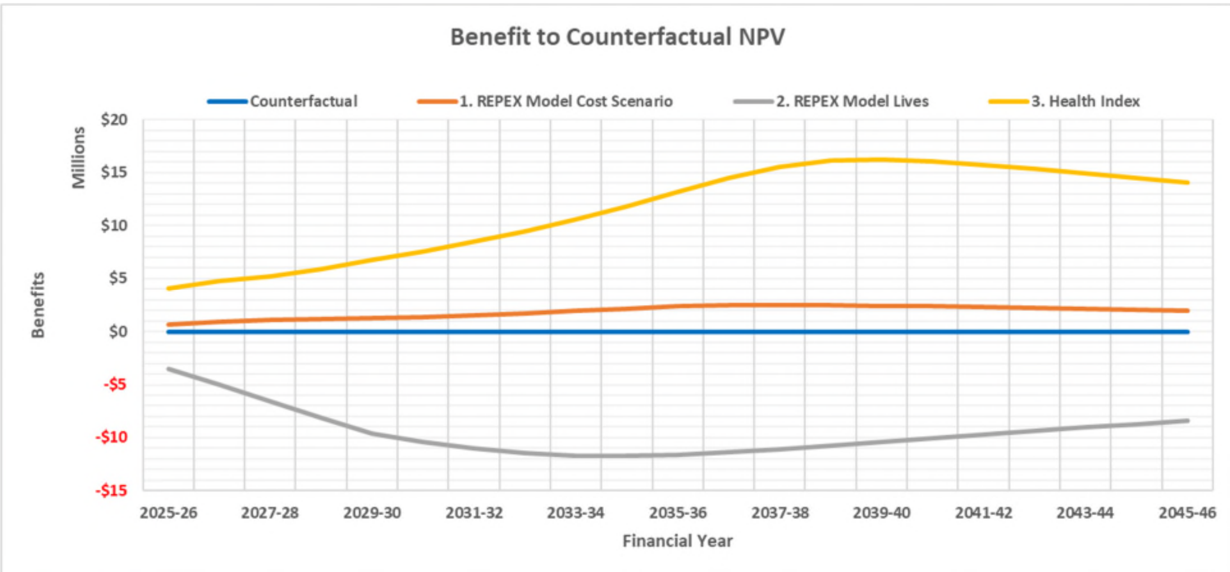

Figure 16: Benefits for All Options

The analysis presented here in Table 13 compares the options to their respective counterfactual **(Preferred Option)** alternatives.

Criteria	Option 1 –Repex Model Cost Scenario	Option 2 – Repex Model Lives Scenario	Option 3 – Health Index ≥ 7.5
Net NPV	$13m	-$80m	$55m
Investment Risk	Low	Very Low	High
Benefits	Medium	Very Low	High
Delivery Constraint	Low	Very Low	High
Detailed analysis – Advantage	• Similar to counterfactual • Additional customer benefit of $48m • Positive NPV • Sustainable option for future strategy to align with ageing asset population profile.	• Saving of $159m • Do minimum scenario.	• Removing condition-based asset • Best Improvement in improving asset performance • Additional $301m Customer Benefit • Removes all defective assets from the network. • Problematic assets can be removed proactively.
Detailed analysis – Disadvantage	• Additional investment of $35M.	• Increased risk for community • Benefit loss of $239m • Negative NPV • Elevated risk and failure.	• Additional investment of $246m • High impact on delivery requirement • Cost impact on customers.

Table 13: Option Analysis Score Card

9 SUMMARY

Energex Network's proposed plan is to move forward with the counterfactual (Preferred) volume for the regulatory period of 2025-2030. This proposed plan aligns with the actual delivery of historical volumes to maintain the in-service failures.

We have assessed and modelled three feasible options compared to proposed counterfactual delivery forecast for the Reset RIN period from 2025-26 to 2029-30. To ensure that the analysis is robust and comprehensive, we have included the consequential replacements of assets to be undertaken at the time of pole replacements:

- A reduction from our counterfactual volume in Option 2 delivers negative NPV benefit with increased risks for our community.
- Any additional volume to the counterfactual will yield benefit to the customers with NPV positive outcome as well.

It is noted that the modelled result for counterfactual shows that pole failure rates are likely to maintained in short terms with gradual increase in long terms. Hence, we forecast that the current level of remediation programs as proposed, with possible escalations in future beyond 2030.

9.1 Sensitivity Analysis

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

- Annual Risk cost
- Weighted Average Capital Cost (WACC)
- Probability of Failure (PoF).

In most of the sensitivity analysis outcomes the 'Preferred Option' has claimed its prudency and effectiveness over other options and therefore is recommended to be approved.

10 RECOMMENDATION

The proposed counterfactual delivery is reflective of the commitment to provide maximum customer benefit at optimised customer price impacts. It 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.

11 APPENDIX A – REPEX FORECAST – RESET RIN

	2025/26	2026/27	2027/28	2028/29	2029/30
	Expenditure	Expenditure	Expenditure	Expenditure	Expenditure
RIN (Pole + Nail)	26,614,495	26,614,495	26,614,495	26,614,495	26,614,495
RIN (Pole Nail Only)	1,445,808	1,445,808	1,445,808	1,445,808	1,445,808
Pole Replacement					
Nail (RIN)	1,445,808	1,445,808	1,445,808	1,445,808	1,445,808
Pole Defect (US Pole)	6,196,144	6,196,144	6,196,144	6,196,144	6,196,144
Proactive Pole	12,130,517	12,130,517	12,130,517	12,130,517	12,130,517
Pole Replacement Total (Pole + Nail)	**19,772,469**	**19,772,469**	**19,772,469**	**19,772,469**	**19,772,469**
Consequential Pole Replacement					
Reconductor Consequential Replacement	6,842,026	6,842,026	6,842,026	6,842,026	6,842,026
Consequential Replacement	**6,842,026**	**6,842,026**	**6,842,026**	**6,842,026**	**6,842,026**

Table 14: Reset RIN – Pole Replacement Expenditure $ in 2022-23

$, direct 2024-25	2025/26	2026/27	2027/28	2028/29	2029/30
	Expenditure	Expenditure	Expenditure	Expenditure	Expenditure
RIN (Pole + Nail)	30,261,160	30,363,016	30,447,419	30,504,229	30,706,545
RIN (Pole Only)	1,643,910	1,649,443	1,654,028	1,657,114	1,668,105
Pole Replacement					
Nail (RIN)	1,643,910	1,649,443	1,654,028	1,657,114	1,668,105
Pole Defect (US Pole)	7,045,127	7,068,840	7,088,490	7,101,716	7,148,817
Proactive Pole	13,792,617	13,839,041	13,877,511	13,903,404	13,995,617
Pole Replacement Total (Pole + Nail)	**22,481,654**	**22,557,324**	**22,620,029**	**22,662,234**	**22,812,539**
Consequential Pole Replacement					
Reconductor Consequential Replacement	7,779,507	7,805,692	7,827,390	7,841,995	7,894,006
Consequential Replacement	**7,779,507**	**7,805,692**	**7,827,390**	**7,841,995**	**7,894,006**

Table 15: Reset RIN – Pole Replacement Expenditure $ in 2024-25

	2025/26	2026/27	2027/28	2028/29	2029/30
	Replacement Qty	Replacement Qty	Replacement Qty	Replacement Qty	Replacement Qty
RIN (Pole + Nail)	5,005	5,005	5,005	5,005	5,005
RIN (Pole Nail Only)	1,402	1,402	1,402	1,402	1,402
Pole Replacement					
Nail (RIN)	1,402	1,402	1,402	1,402	1,402
Pole Defect (US Pole)	887	887	887	887	887
Proactive Pole	1,737	1,737	1,737	1,737	1,737
Pole Replacement Total (Pole + Nail)	**4,026**	**4,026**	**4,026**	**4,026**	**4,026**
Consequential Pole Replacement					
Reconductor Consequential Replacement	979	979	979	979	979
Consequential Replacement	**979**	**979**	**979**	**979**	**979**

Table 16**: Reset RIN – Pole Replacement Volumes**