# Service Lines Replacements

## Business Case

25 January 2024

energex
Part of Energy Queensland

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# DOCUMENT VERSION

| Version Number | Change Detail | Date | Updated by |
|---|---|---|---|
| Draft v0.1 | Initial Release | 07/03/2023 | Asset Strategy Engineer |
| Draft v0.2 | Draft | 13/05/2023 | Asset Strategy Engineer |
| Draft v0.3 | Finalising of draft post feedback | 31/10/2023 | Asset Strategy Engineer |
| V1.0 | Finalised | 21/11/2023 | Manager Asset Strategy |

# RELATED DOCUMENTS

| Document Date | Document Name | Document Type |
|---|---|---|
| JAN 2024 | Asset Management Plan – Services | PDF |
| NOV 2023 | Weibull Model Report – Services v0.1 | DOCX |
| NOV 2023 | Services Weibull modelling | Excel |
| NOV 2023 | Services risk modelling | Excel |
| 01/06/2023 | RIN 2.2 Compare 2021-22 (Rosetta) | Excel |
| OCT 2023 | Lines Defect Classification Manual | PDF |
| JUN 2023 | Maintenance Acceptance Criteria (MAC) – Release 11 | 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 natural Disasters.xlsx (a compendium of various sources) | Excel |
| FEB 2021 | Electrical Safety Code of Practice 2020 - Works | PDF |

# 1 SUMMARY

| Title | Service Lines Replacements |
| --- | --- |
| DNSP | Energex |
| Expenditure category | ☒ Replacement ☐ Augmentation ☐ Connections ☐ Tools and Equipment ☐ ICT ☐ Property ☐ Fleet |
| Purpose | The purpose of this business case is:<br>• to evaluate the benefits of the proposed volume of Service lines replacements for the AER regulatory period 2025-2030 investment<br>• 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<br>Energex is committed to adopting an economic, customer value-based approach when it comes to ensuring the safety and reliability of the network. To quantify 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 maximise value to our customers.<br>The purpose of this document is to outline the proposed volumes of replacement and expenditure associated with Services during the regulatory period 2025-30, in accordance with the lifecycle management strategies detailed in our Asset Management Plan. The document also includes the analysis of different options, to ascertain prudency through financial NPV modelling. Energex replaces services assets to ensure safety, reliability, environmental, and financial risks are managed in the best interest of consumers. |
| Alternate options | Three different options were considered in comparison with the counterfactual replacements (i.e. address 100% defect and Targeted volume of 750 service replacements):<br>• Option 1 – 50% of Current Targeted Program<br>• Option 2 – No Targeted Replacements<br>• Option 3 – Double the current Targeted Replacements.<br>In all options, replacment of 100% of the identified defects has been applied as a common factor in line with good industry practice. This business considers the efficient level of targeted replacements. |

<table>
<tr><td>Expenditure</td><td>In this business case, the options consider alternatives for our targeted volume of replacements, with the same defect replacement rate applied across all options. Consequential replacement of services lines with pole and conductor replacements, and their respective benefits, are included in the overhead conductor and poles business cases.

<table>
<tr><th>Year<br>$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>Targeted Replacement (this business case)</td><td>0.6</td><td>0.6</td><td>0.6</td><td>0.6</td><td>0.6</td><td>3.0</td></tr>
<tr><td colspan="7">Consequential Replacements</td></tr>
<tr><td>Consequential</td><td>5.7</td><td>5.7</td><td>5.7</td><td>5.7</td><td>5.7</td><td>28.5</td></tr>
<tr><td colspan="7">Total Service Line Replacements</td></tr>
<tr><td>Service Total Investment</td><td>6.3</td><td>6.3</td><td>6.3</td><td>6.3</td><td>6.3</td><td>31.5</td></tr>
</table>

<u>Note:</u> Defect Expenditure is OPEX, therefore not included in this Repex business case.</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 viable. This option has been chosen over other options, as it provides the best balance of benefits, deliverability and risks for the organisation</td></tr>
</table>

## 2 PURPOSE AND SCOPE

The purpose of this document is to outline the forecast expenditure and volumes associated with overhead services for the Regulatory period 2025-30. The Business case includes an analysis of different options to ascertain prudency through financial NPV modelling, considered to manage the replacement volumes to comply with regulatory obligations, maintain existing service delivery performance including customer reliability and quality standards, and especially maintain the safety of the network for the Queensland community.

This document is to be read in conjunction with the Asset Management Plan for Service Lines. All dollar values in this document are based upon real 2022-23 dollars, excluding overheads.

## 3 BACKGROUND

Energex overhead services provide a connection for electricity between the Energex overhead low voltage (LV) mains line and designated points of connection owned by individual customers. These overhead services are considered low-cost assets and are typically managed based on population, using regular inspections and systematic performance reviews to identify and address any issues or concerns.

Overhead Service unassisted failures present the following risks:

- Failure of the neutral circuit leading to elevated risk of customer shock and fatality
- Failure of the active circuit leading to loss of customer supply
- Breakage of the overhead service line, falling to the ground and remaining energized, leading to elevated public risk of public shock

Overall Service asset population performance is currently measured in terms of the number of reported public shocks directly related to Overhead Service operations. Where possible, Energex aims to reduce the number of public shocks towards zero so far as is reasonably practicable (SFAIRP).

Energex is actively working to align data collection and record systems relating to customer overhead services across all regions, employing the best and most suitable systems from both legacy organizations.

Energex continues to improve safety and the cost-effective management of these assets through the use of and continuous improvement of inspection and analysis techniques (such as Light Detection and Ranging (LiDAR), imagery and predictive analytics), optimal delivery models/techniques, and industry best practice management through active participation in Energy Networks Australia (ENA) working groups

Following a thorough examination of the asset performance, we are forecasting that the current level of defects will continue, as the consequential service replacements occurring under the defective pole replacement and targeted overhead reconductoring program are expected to be continued to achieve the current level of service. More information can be found in the business cases for Poles and Overhead Conductor.

### 3.1 Asset Population

As per 2022-23 RIN data Energex had a total of 601,749 overhead services as shown in Figure 1. The age profile of services shows 78,393 services will be over 40 years in 2029-2030. The Energex data system has not been designed to record the age of the service as historically services not being registered as an asset. Therefore, Energex uses service conductor contractual period followed by the nearest pole's pole age to infer the services age.

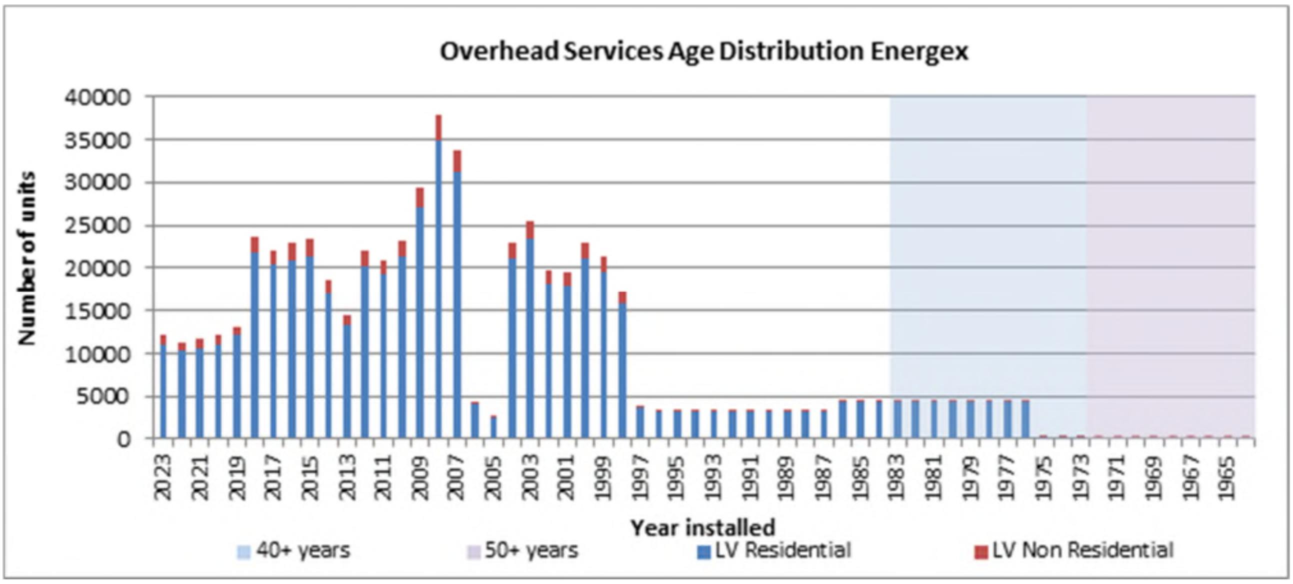


**Figure 1: LV Services Age Profile**

## 3.2 Asset Management Overview

This asset class is managed, consistent with corporate asset management policy, to achieve all legislated obligations and any specifically defined corporate key performance indicators and to support all associated key result areas as reported in the Statement of Corporate Intent (SCI).

Safety risks associated with this asset class is eliminated as per so far as is reasonably practicable (SFAIRP), and if not able to be eliminated, is mitigated to the same level. All other risks associated with this asset class are managed to be as low as reasonably practicable (ALARP).

All inspection and maintenance activities are performed consistent with manufacturers' advice, good engineering operating practice, and historical performance, with the intent to achieve the longest practical asset life overall. End of asset life is determined by reference to the benchmark standards defined in the Defect Classification Manual and or Maintenance Acceptability Criteria.

As listed in Table 1, problematic assets such as very high maintenance or high safety risk assets in the population are considered for retirement. Replacement work practices are optimised to achieve bulk replacement to minimise overall replacement cost and customer impact. Asset management strategies with continuous improvement for this class focus upon improving shock related performance in the Energex network.

| Overhead Service type | Installation Range |
|---|---|
| Bare Open Wire | < 1976 |
| Neutral Screen PVC | 1976 - 1987 |
| Parallel Web PVC | 1976 - 1997 |
| Twisted Multiphase PVC | 1976 - 1997 |
| XLPE | 1997 - Present |

**Table 1: Problematic Service Types**

In the previous regulatory period (pre 2018-19) targeted services replacement program made up the biggest component of our replacement investment due to our historical asset performance trend. The result of this proactive asset management strategy is thatEnergex has removed most of the known problematic service population and this has led to improved asset performance.

Our recent asset performance trend shows that XLPE conductor is the major portion of failure and defects due to degradation of these assets. Moreover, as service cabes are not a uniquely identified asset in our system, from 2018-19 , we have decided to continue with the reduced proactive program to target combination of unknown problematic services type population and XLPE conductor based on asset performance trend. A large number of services will also be replaced when undertaking reconductoring or defective pole replacements programs as an efficient means of work delivery. This consequential investment and benefit have been considered in the respective business cases.

## 3.3 Asset Performance

The two functional failure modes of Services defined in this model are found in Table 2.

| Functional Failure Type | Description |
|---|---|
| Catastrophic (Unassisted failure) | Loss of structural or conductivity integrity of any component associated with an overhead service, excluding any associated pole top hardware, such that the residual strength/conductivity of the component required immediate intervention.<br>Functional failure of a services asset under normal operating conditions not caused by any external intervention such as abnormal weather or human. |
| Degraded<br>(Defect) | A service asset deemed defective based on observed serviceability strength criteria and if not rectified within a prescribed timescale (P0/P1/P2) could cause to an unassisted catastrophic failure. |

**Table 2: Description of Functional Failure**

Identified defects are scheduled for repair according to a risk-based priority scheme (P0/P1/P2). 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).

As per the failure statistics, it can be concluded that the number of unassisted failures are gradually decreasing from 2018-19 to current financial year. This is mainly due to the consequential replacements from other programs.

Figure 2 displays the total number of identified P1 and P2 defects in service lines. Any low voltage service that is in poor condition, has an exposed conductor, positioned below the statutory height, or is broken or damaged will be considered a defect that requires action immediately.

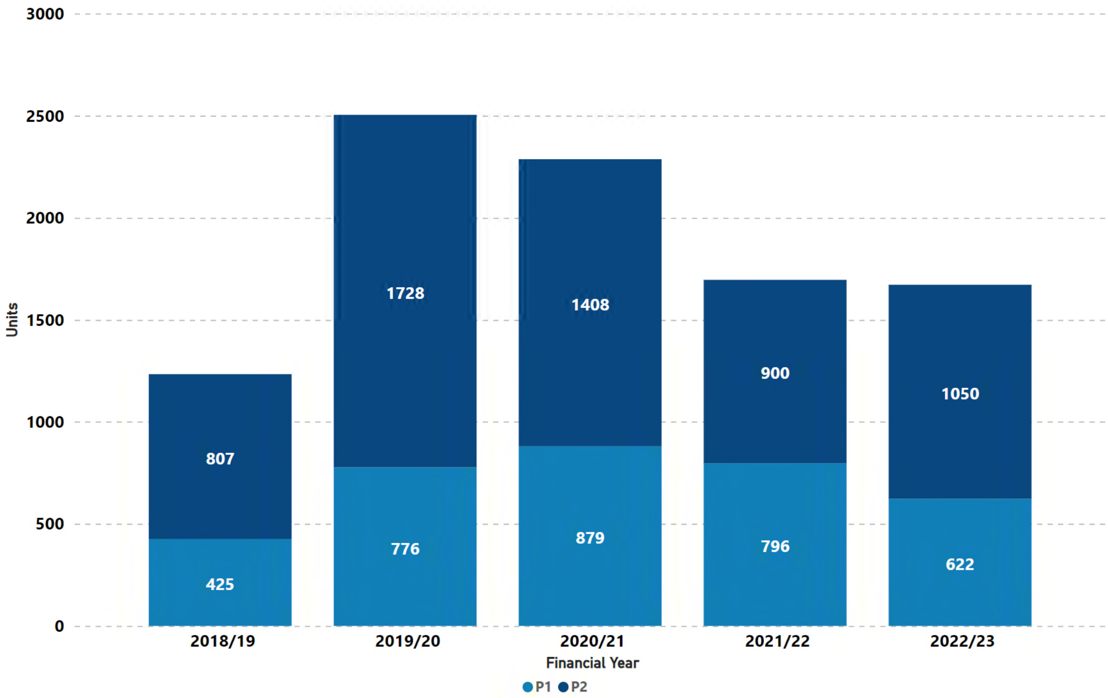


**Figure 2: Services Defects P1 & P2**

The number of defects were significant during the first two years with step up increases in next two years peaking in 2019-20, triggering an increased replacement volume program. After this increase in replacements, the defects volume with additional targeted conductor, our defect and failure rates have declined, however are still at considerably high level.

The main cause of defects are  insulation, ageing and degradations in associated components, causing loss of conductivity and strength in the services.If left unaddressed, this will eventually cause an unassisted failure of the service. Also, there are still problematic asset types in service that we are unable to identif in our current data set, but will require proactive replacement as they are identified through our inspection program.

Figure 3 shows the number of shocks and tingles reported that are directly attributable to overhead services. Energex is committed to keep the number of shocks per annum based on customer volume to as low as possible.

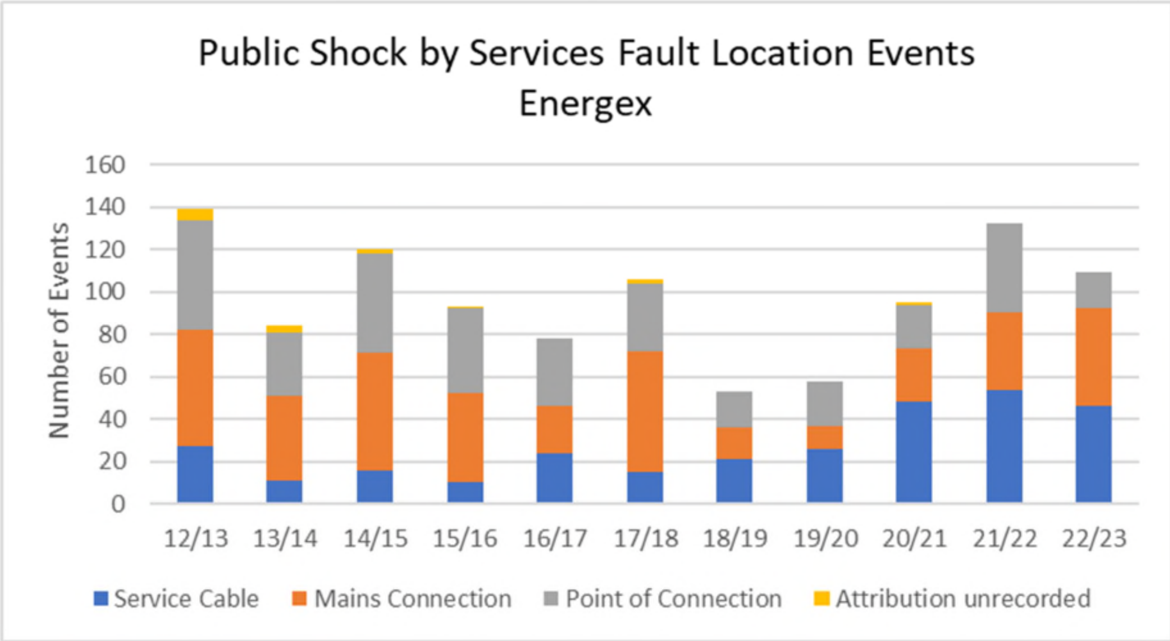


**Figure 3: Shock and Tingle Incidents**

# 4 RISK ANALYSIS

Our cost-benefit analysis aims to optimize our risk calculation and replacement volumes at the program level, so that we can maximize the benefits to our customers. After conducting a cost-benefit analysis using net present value (NPV) modeling, we have selected the proposed preferred replacement option based on the most positive NPV of the volumes considered. In this business case, the most positive NPV validates that the volume of proposed replacement over the regulatory period 2025-30 is a prudent approach.

The monetized risk is simply calculated asper the calculation in Figure 4.


**Figure 4: Monetised risk calculations**

Energex broadly considers five value streams for investment justifications regarding replacement of widespread assets. These are shown in Figure 5. The ‘Export’ impact is not relevant to this study and will be excluded from the analysis.

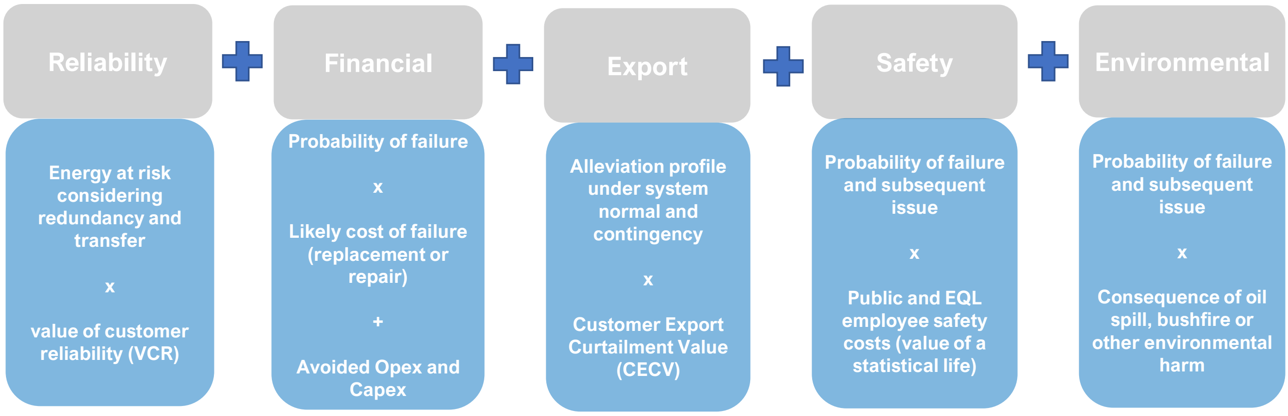


**Figure 5: Risk steams for assets**

## 4.1 Probability of Failure (Pof)

Due to the limited condition data available for the implementation of an Asset Health Index (AHI), a Weibull distribution model was utilised due to its flexibility and ability to model skewed data. This Statistical model has been developed for assets that only have inspections and no measured data to predict the PoF such as Low Voltage service cables, Pole Top Structures (Crossarm), distribution transformers and distribution switches to assist with the replacement management of ageing assets.

A Weibull distribution is one of the most widely used lifetime distributions in reliability engineering. It is a versatile distribution that can take on the characteristics of other types of distributions, based on the value of the shape parameter, beta (β) and the scale parameter, eta (η). The function used to determine the probability of failure from a particular asset's time of failure is the Cumulative Distribution Function (CDF).

Shape parameter eta defines the average period when 63.2% of the asset population is expected to fail. The beta parameter represents the failure rate behaviour, if beta is less than 1, then the failure rate decreases with time; if beta is greater than 1, then the failure rate increases with time. When beta is equal to 1, the failure rate is constant. The resultant Weibull curve shown in Figure 6 for our services population has produced aβ as 2.5 and the η as 34.

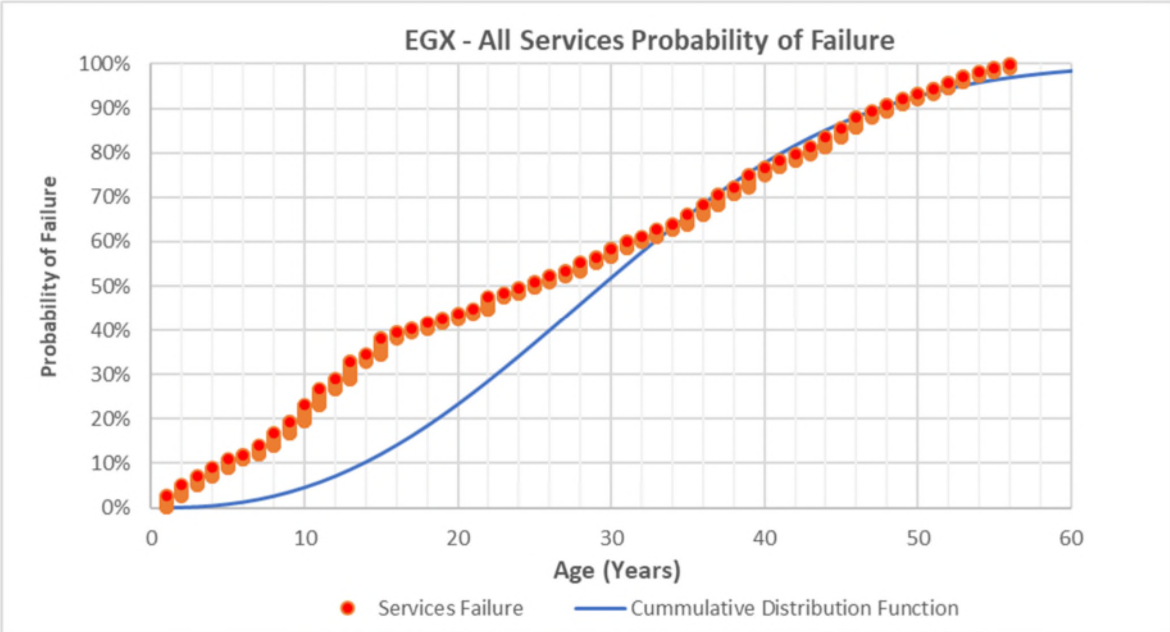


**Figure 6: Cumulative Distribution Function – All Service Cable Type**

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

The key consequence of services 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 services specific. This is particularly the case for the reliability and benefits stream, where the bushfire risk informs the benefits calculations for preventing unassisted service 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 services failure:

- **Lost load:** As per the AER Frontier Economics 2021, the average consumption for a household based on 3-person family is 1 kW. This load on each service in our network is utilised to determine the kW that would on average be lost following a service failure.
- **Restoration timeframe:** The average loss of supply has been estimated for a period of average 2 hours for service failures and 2 hours for service defect replacement.

- **Value of Customer Reliability Rate:** We have used the Queensland average VCR rate for not only different residential loads.
- **Probability of Consequence**: all in-service service 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 safety risk costs for a service:

- **Service replacement:**
    - Average failure replacement cost is $509
    - Average defect replacement cost is $508
    - Average targeted replacement cost is $482.
- **Probability of Consequence:** all in-service service failures result in a need to replace the service under emergency.

### 4.2.3 Safety

The safety risk for a service failure is primarily that a member of the public is in a premises with a failed service line. This could result in a fatality or injury. For our modelling we have used August 2022 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
- **Value of a shock or tingle:** $500
- **Disproportionality Factor:** 6 for members of the public
- **Probability of Consequence**: Following an unassisted service failure, there is a 1 in 20 years chance of causing a fatality and 1 in 10 years chance of a serious injury based on historical data evidence. In the last 10 years there has been one fatality incident associated with service line failure.

### 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 service causing a downed line 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 The 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 $80k.

- **Probability of Consequence:** In consideration with the chances of the fire caused by services failure, EQL uses the four years average fire data to infer the frequency of different level of fire incident, fire caused by services with no material damage, spread wider, with small damage and with serious damage. EQL did not record any bushfire caused by services with serious damage in the past. Due to the location of the services is close to occupied premises, the chances of having serious damage bush fire is very low. Once in 20 years assumption is used in this model.

# 5 CONSEQUENTIAL REPLACEMENT

Within the scope of the pole and overhead conductor replacement investments, we assess the condition of the equipment attached to the assets and determine the feasibility and cost-effectiveness of replacing them. This equipment includes pole top structures, transformers, service lines, and switches. Consequently, when evaluating the benefits of this approach for our customers, we consider the investments and advantages associated with these consequential replacements in our analysis of the respective 2025-30 Poles and Overhead Conductor business cases to ensure that the overall asset expenses are accounted for. Table 3 outlines the volume of Low Voltage services we have forecast to be replaced as a result of the pole replacement and reconductoring program during the regulatory period 2025-30.

| Consequential Services Forecast Volume | 2025/26 | 2026/27 | 2027/28 | 2028/29 | 2029/30 | Total |
|---|---|---|---|---|---|---|
| With Pole Replacements | 2,768 | 2,768 | 2,768 | 2,768 | 2,768 | 13,840 |
| With Reconductoring | 4,483 | 4,483 | 4,483 | 4,483 | 4,483 | 22,415 |

**Table 3: Consequential Asset Volume – Proposed Program**

# 6 IDENTIFIED NEED

## 6.1 Problem Statement

Energex reviewed its asset management practices with respect to services. The review has found that services were frequently replaced consequentially when defective pole and targeted reconductoring was undertaken in addition to the moderate defect rate replacement. This business case covers only the defect and targeted replacement volume prudency.

Effective management of overhead service assets requires a range of factors to be considered, including public safety, physical condition, historical design standards, and environmental and operational conditions. Energex has a regulatory duty of care to manage these assets and has introduced performance targets to help monitor and manage asset-related public shocks. The asset inspection and defect management process, supplemented by targeted and consequential replacement programs, will be critical to ensuring the ongoing safety and reliability of overhead service assets in Energex.

## 6.2 Compliance

Corporate Policies relating to establishing the desired level of service are detailed in the reference documents of Appendix A – Reset RIN Data Reconciliation.

Public shocks are monitored monthly, with shocks related to neutral integrity being the most significant factor (60-70%). Public shocks are considered notifiable events, required to be reported to the Electrical Safety Office.

In line with EQL's regulatory duty of care, there is an imperative to maintain the incidence of services related shocks SFAIRP. Regulatory performance outcomes for this asset include compliance with all legislative and regulatory standards, including the Electrical Safety Act 2002 (Qld), the Electrical Safety Regulation 2013 (Qld) (ESR), and the Electrical Safety Codes of Practice.

The Electrical Safety Act 2002 (Qld) s29 imposes a specific duty of care for EQL, which is a prescribed Electrical Entity under that Act:

- An electricity entity has a duty to ensure that its works:
    - are electrically safe
    - are operated in a way that is electrically safe.
- Without limiting subsection (1), the duty includes the requirement that the electricity entity inspect, test and maintain the works

The ESR details some requirements for overhead service lines. These include various general obligations related to the safety of works of an electrical entity and a number of specific obligations, notably:

- ESR Schedule 2 - Exclusion zones for overhead electric lines
- ESR Schedule 5 - Clearance of low voltage overhead service lines
- ESR s76(4) - "The electricity entity must at periodic reasonable intervals inspect and maintain the insulation of the clamp or apparatus"
- ESR s215 - "An electricity entity must ensure the integrity of the insulation of the relevant part of the electrical entity's works is inspected and maintained … inspection and maintenance must be performed as periodic reasonable intervals"
- ESR s215 - "An electricity entity must ensure the integrity of insulation for the clamp or other apparatus at the point where consumer mains are connected to the electricity entity's overhead service line is inspected and maintained … inspection and maintenance must be performed at periodic reasonable intervals".

It is clear from the legislated requirements above that there is an intention to ensure inspection is undertaken "at periodic reasonable intervals". Its nature and interval are defined by engineering judgement, taking into account overall safety and performance obligations.

## 6.3 Counterfactual (Base Case Scenario) – Proposed Program

To provide a comparison of the potential alternatives to our preferred program for our cost benefit analysis, we have set the counterfactual volumes as our proposed program.

### 6.3.1 Cost and Volumes

Energex programmed 750 targeted services replacement per year on top of the 100% defect and failure replacement during the maintenance programs. It is noted that the defect and failure replacement is covered under the OPEX program. The resultant replacement cost and volume for the forecast period is shown in Table 4.

The Queensland Energy and Job Plan (QEJP) includes targets for the installation of smart meters by 2030 and there is a possibility to transition towards 'replacement on defect' approach for this asset class as neutral break shall be detected by the smart meters to eliminate the shock risks from the broken neutrals, the biggest risk associated with this asset class. To transition towards this strategy, initially we have reduced our targeted replacement volume from historical 2,000 per annum to 750 per annum. However, as the asset performance trend is continuously monitored, the outcome of the trend will determine the future intervention as necessary for the community. More information can be found in our Smart Meter Data Acquisition business case.

| Counterfactual Volume and Costs ($m) | 2025/26 | 2026/27 | 2027/28 | 2028/29 | 2029/30 | Total |
|---|---|---|---|---|---|---|
| Services Cost $m | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | **3.0** |
| Targeted Replacement Quantity | 750 | 750 | 750 | 750 | 750 | **3,750** |

**Table 4: Counterfactual Delivery Volumes**

### 6.3.2 Risk Quantification

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 program interventions.

Figure 7 provides the results of a quantitative forecast of emerging risk associated with Energex's services asset population failure due to condition related failure modes. Risk costs rise moderately in the counterfactual due to Safety risks associated with Services asset failures. The cost of these risks increases marginally over the 20-year period shown, driven mainly if Energex maintained the same counterfactual rate going forward.

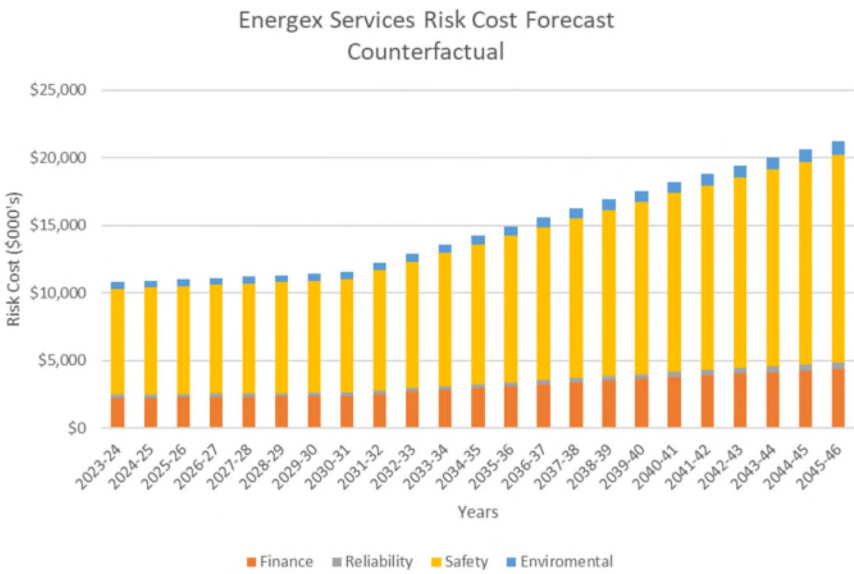


**Figure 7: Counterfactual Quantitative Risk Assessment**

Figure 8 shows the failure forecast for services over the next 20 years shows similar feature as the risk evaluation. The current forecast shows the failure is increasing but in conjunction with consequential replacement from pole and conductor programs the failures are expected to be maintained within current service levels. However, additional targeted replacements may be required in future regulatory periods.

Additionally, the Queensland Energy and Job Plan (QEJP) include installation of smart meters by 2030 and there is a possibility to transition towards 'replacement on defect' approach for this asset class as neutral break shall be detected by the smart meters to eliminate the shock risks from the broken neutrals, the biggest risk associated with this asset class.

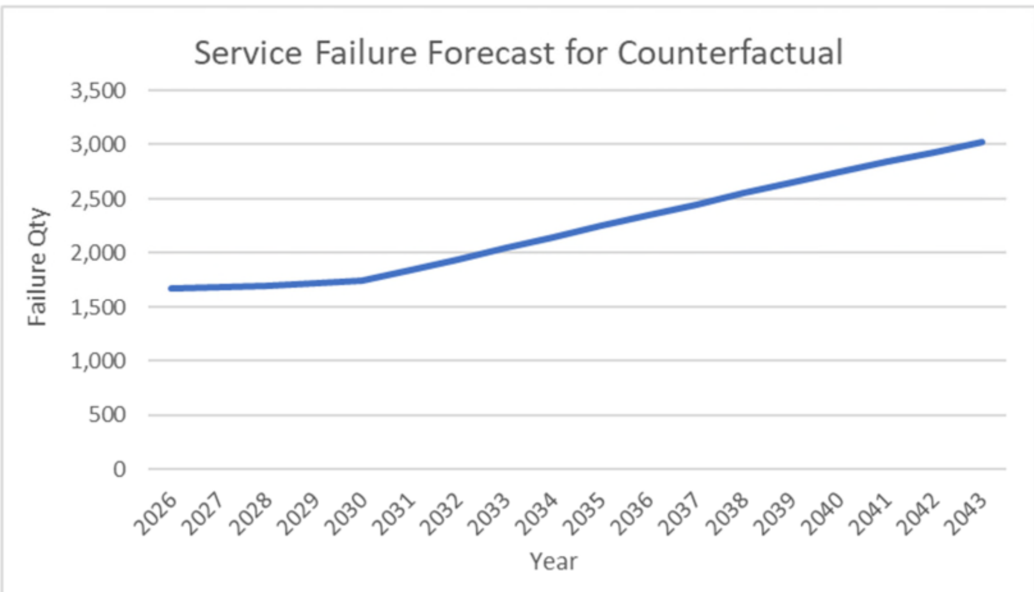


**Figure 8: Counterfactual Failure Forecast**

# 7 OPTIONS ANALYSIS

In the process of maximizing the value to customers to address the identified need, Energex has sought to identify a practicable range of technically feasible, alternative options that will satisfy the network requirements in a timely and efficient manner.

## 7.1 Option 1 – 50% of Current Targeted Program

This option considers 375 targeted services replacement per year on top of the 100% defect and failure replacement during this maintenance programs, a reduction on our counterfactual of 50% of proactive replacements. The resultant replacement cost and volume for the forecast period is shown in Table 7:

### 7.1.1 Intervention Volumes

The intervention volume that have been modelled as part of Option 1 are outlined in Table 5.

| Replacement Volumes and Costs | 2025/26 | 2026/27 | 2027/28 | 2028/29 | 2029/30 | Total |
|---|---|---|---|---|---|---|
| Defect % | 100% | 100% | 100% | 100% | 100% | **100%** |
| Targeted Replacement Quantity | 375 | 375 | 375 | 375 | 375 | **1,875** |

**Table 5: Replacement Cost/Volume**

### 7.1.2 Risks/Benefits

In this option, our modelling shows that the unassisted service failures are projected to increase considerably in comparison to those in the counterfactual option. Furthermore, opting for this approach will result in a growing need for substantial investment in the near term due to the escalating rate of asset failures. This is primarily because leaving a significant number of defective and old/obsolete services in active services resulting in increased investment requirements and poor asset performance.

## 7.2 Option 2 – No Targeted Program

This option includes only defect and failure replacements and no targeted services replacement. This option provides the worst NPV performance.

### 7.2.1 Intervention Volumes

The intervention volumes that have been modelled as part of Option 3 are outlined in Table 6.

| Replacement Volumes and Costs | 2025/26 | 2026/27 | 2027/28 | 2028/29 | 2029/30 | Total |
|---|---|---|---|---|---|---|
| Targeted Volume | - | - | - | - | - | - |
| Volumes based on % defect Replacement | 100% | 100% | 100% | 100% | 100% | **100%** |

**Table 6: Replacement Cost/Volume**

### 7.2.2 Risks/Benefits

Under this option, our modelling indicates that unassisted service failures are expected to be more compared to the counterfactual option. Choosing this approach will necessitate a significant increase in near-term and long -term investments due to the rising rate of asset failures and will be detrimental to Energex commitments of reduce the number of shocks.

## 7.3 Option 3 – Double the Targeted Program

This option includes 100% of defect and failure replacement with 1,500 targeted services replacement – double the volume of the counterfactual targeted delivery. This option provides the best NPV performance, but the feasibility will be limited by current resources and there is also a significant cost impact on customers.

### 7.3.1 Intervention Volumes

The intervention volume that have been modelled as part of Option 2 are outlined in Table 7.

| Replacement Volumes and Costs | 2025/26 | 2026/27 | 2027/28 | 2028/29 | 2029/30 | Total |
|---|---|---|---|---|---|---|
| Defect % | 100% | 100% | 100% | 100% | 100% | **100%** |
| Targeted Replacement Quantity | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 | **7,500** |

**Table 7: Replacement Cost/Volume**

### 7.3.2 Risks/Benefits

Under this approach, our modelling predicts that the occurrence of unassisted services failures will be notably reduced in comparison to the counterfactual option. Accordingly, this transition aims to bring the failure rate down SFAIRP ensuring a satisfactory level of public safety risks. While this option provides significant advantages to customers it is not without substantial cost impacts.

# 8 OUTCOMES OF OPTIONS ANALYSIS

## 8.1 Service Failure Forecast

The service failure rate forecast for all the main options have been provided in the Figure 9. The projected failure forecast shows a significant improvement in asset performance for the options which involve increased targeted replacement strategy.

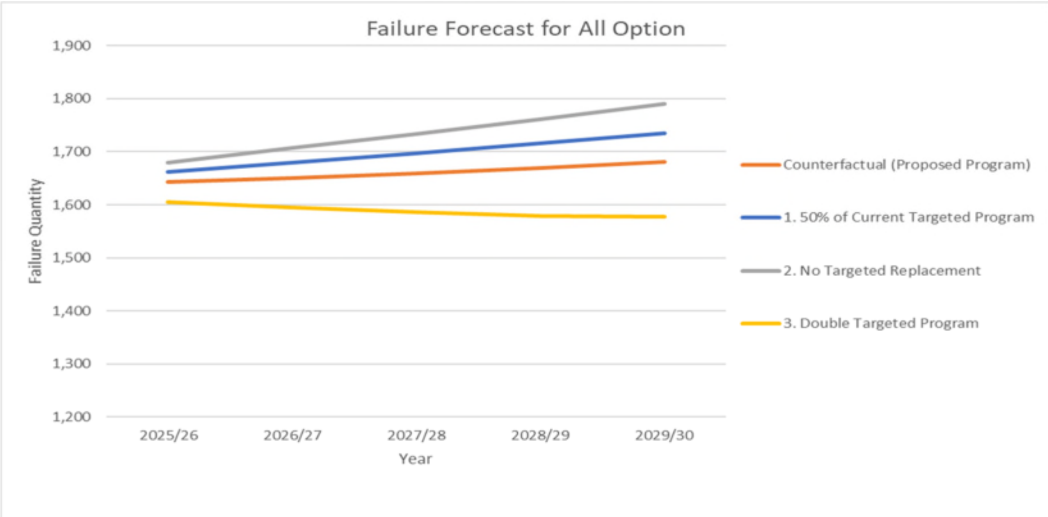


**Figure 9: Failure Forecast - Intervention options**

## 8.2 Economic Analysis

The NPV of cost benefit analysis of the options is summarized in Table 8 and the associated volume in Table 9.

- The proposed program (counterfactual) is taken as the baseline for the analysis. This includes 750 targeted replacements and 100% defects
- Option 1 includes 375 targeted replacements and 100% defects. This option will save $806k investment compared to preferred option. However, due to increasing failures there will be negative benefits to the customer which provide a negative net NPV
- Option 2 includes no targeted replacements and 100% defects. This option will save $1.6m of investment. However, due to increasing failures this option leads to loss of $2.8m benefit compare to counterfactual
- Option 3 includes 1,500 targeted replacements and 100% defects. This option will require additional $1.6m investment. As a result of the reduction of asset failure, this option will provide $2.8m benefit to the customer.

| Options | Rank | Net NPV | Intervention CAPEX NPV | Intervention Benefits NPV |
|---|---|---|---|---|
| Counterfactual (Proposed Program) | 2 | $0 | $0 | $0 |
| 1. 50% of Current Targeted Program | 3 | -$558,073 | $806,795 | -$1,364,868 |
| 2. No Targeted Replacement | 4 | -$1,117,428 | $1,613,533 | -$2,730,960 |
| 3. Double Targeted Program | 1 | $1,111,991 | -$1,613,772 | $2,725,763 |

**Table 8: NPV Modelling and Consequential Benefits**

| Options | Targeted | Defect |
|---|---|---|
| Counterfactual (Proposed Program) | 750 | 100% |
| 1. 50% of Current Targeted Program | 375 | 100% |
| 2. Double Targeted Program | 0 | 100% |
| 3. No Targeted Replacement | 1,500 | 100% |

**Table 9: Option volumes**

Figure 10 compares the net NPV progression and gains over the modelling period compared to counterfactual option. This indicates significant benefits associated with option 3 with rising NPV rate due to the additional investment. However, this option requires additional resource and investment compare to counterfactual, and depending on the level of roll-out of smart metering this capability will allow us to reduce risk in other ways.

Our preferred option counterfactual is the most optimum solution in terms of investment, net NPV gains and practicality of delivery. Considering that Counterfactual is the option which is highly likely to achieve network standard compliances with improvement in the public safety risk, it is prudent to choose this option.

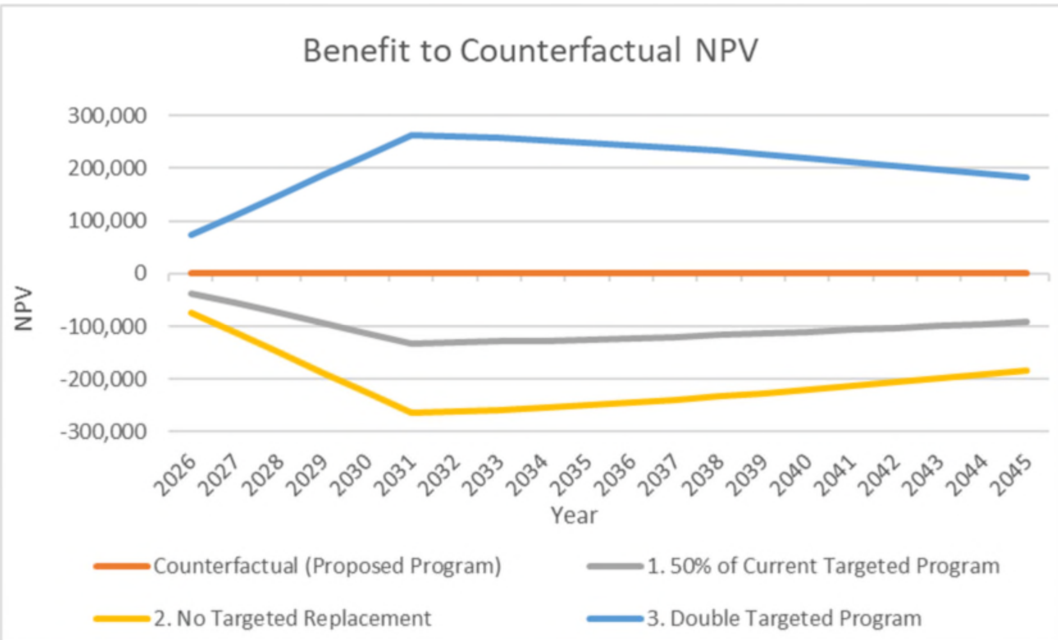


**Figure 10: Benefit to Counterfactual NPV**

The analysis presented here in Table 10 compares the options to their respective counterfactual (**Preferred**) alternatives.

| Criteria | Option 1 – 50% of Current Targeted Program | Option 2 – No Targeted Program | Option 3 – Double Targeted Program |
|---|---|---|---|
| **Net NPV** | -$0.6m | -$1.1m | $1.1m |
| **Investment Risk** | Low | Low | High |
| **Benefits** | Low | Very Low | High |
| **Delivery Constraint** | Low | Low | High |
| **Detailed analysis –** Advantage | • -50% of the targeted replacement will result in $0.8m investment benefit.<br>• Remove all defective assets.<br>• Low impact on delivery requirement | • Do minimal option will result in $1.6m investment benefit. | • Additional $2.7m Customer Benefit compares to counterfactual.<br>• Positive NPV<br>• Remove all defctive assets.<br>• Best option to transition towards improving asset performance. |
| **Detailed analysis –** Disadvantage | • Doesn’t reduce failure rate as desirable or in SFAIRP approach<br>• Negative NPV | • Public shock and failure rate may rise.<br>• Leads to poor asset performance<br>• Negative NPV | • High investment risk option with cost impact on customers<br>• High delivery impact with additional budget of $1.6m<br>• Double the resource requirement. |

**Table 10: Options Analysis Scorecard**

# 9 SUMMARY

It is clear, even if Energex double the targeted replacement as per Option 3, the outcome is NPV positive. However, due to the emerging use of smart meter data, Energex's proposed plan is to move forward with the **Counterfactual (Preferred)** volume from the regulatory period of 2025-2030. This proposed plan has been deemed prudent based on the risk monetisation outcome.

## 9.1 Sensitivity

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
- 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

After a thorough evaluation of all available options, it has been determined that the **counterfactual option** is the most viable. This option has been chosen over other options, as it provides the best balance of benefits and risks for the organization. As such, the decision has been made to continue operations as usual, with a focus on optimizing existing processes and enhancing efficiencies where possible.

Our counterfactual option also 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 – RESET RIN DATA RECONCILIATION

| | 2025/26 | 2026/27 | 2027/28 | 2028/29 | 2029/30 |
|---|---|---|---|---|---|
| | Expenditure | Expenditure | Expenditure | Expenditure | Expenditure |
| RIN (Services) | 6,335,108 | 6,335,108 | 6,335,108 | 6,335,108 | 6,335,108 |
| Service Replacement | | | | | |
| Service Defect | 0 | 0 | 0 | 0 | 0 |
| Targeted Replacement | 593,814 | 593,814 | 593,814 | 593,814 | 593,814 |
| Consequential Services Replacement | | | | | |
| Pole Consequential Replacement | 2,191,828 | 2,191,828 | 2,191,828 | 2,191,828 | 2,191,828 |
| Conductor Consequential Replacement | 3,549,466 | 3,549,466 | 3,549,466 | 3,549,466 | 3,549,466 |
| **Consequential Replacement** | **5,741,294** | **5,741,294** | **5,741,294** | **5,741,294** | **5,741,294** |
| | | | | | |
| **BC Total** | **593,814** | **593,814** | **593,814** | **593,814** | **593,814** |

**Table 11: Reset RIN reconciliation table – Expenditure $ in 2022-23**

| $, direct 2024-25 | 2025/26 | 2026/27 | 2027/28 | 2028/29 | 2029/30 |
|---|---|---|---|---|---|
| | Expenditure | Expenditure | Expenditure | Expenditure | Expenditure |
| RIN (Services) | 7,203,132 | 7,227,377 | 7,247,467 | 7,260,990 | 7,309,148 |
| Service Replacement | | | | | |
| Service Defect | 0 | 0 | 0 | 0 | 0 |
| Targeted Replacement | 675,177 | 677,449 | 679,332 | 680,600 | 685,114 |
| Consequential Services Replacement | | | | | |
| Pole Consequential Replacement | 2,492,148 | 2,500,537 | 2,507,488 | 2,512,166 | 2,528,828 |
| Conductor Consequential Replacement | 4,035,807 | 4,049,391 | 4,060,647 | 4,068,224 | 4,095,206 |
| **Consequential Replacement** | **6,527,955** | **6,549,927** | **6,568,135** | **6,580,390** | **6,624,034** |
| | | | | | |
| **BC Total** | **675,177** | **677,449** | **679,332** | **680,600** | **685,114** |

**Table 122: Reset RIN reconciliation table – 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 (Services) | 8,001 | 8,001 | 8,001 | 8,001 | 8,001 |
| Service Replacement | | | | | |
| Service Defect | 0 | 0 | 0 | 0 | 0 |
| Targeted Replacement | 750 | 750 | 750 | 750 | 750 |
| Consequential Services Replacement | | | | | |
| Pole Consequential Replacement | 2,768 | 2,768 | 2,768 | 2,768 | 2,768 |
| Conductor Consequential Replacement | 4,483 | 4,483 | 4,483 | 4,483 | 4,483 |
| **Consequential Replacement** | **7,251** | **7,251** | **7,251** | **7,251** | **7,251** |
| | | | | | |
| **BC Total** | **750** | **750** | **750** | **750** | **750** |

**Table 13: Reset RIN reconciliation table – Volume**