Distribution Transformer Replacements

Business Case

19 January 2024

Part of Energy Queensland

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DOCUMENT VERSION

Version Number	Change Detail	Date	Updated by
Draft v0.1	Initial Draft	27/10/2023	Snr Asset Engineer
Draft v0.2	Internal Feedback update	09/11/2023	Snr Engineer Asset Strategy
V1.0	Approved	16/11/2023	Manager Asset Strategy

RELATED DOCUMENTS

Document Date	Document Name	Document Type
JAN 2024	Asset Management Plan - Distribution Transformers	PDF
NOV 2023	Risk Modelling - Weibull – Distribution Transformer v0.1	Docx & Excel
NOV 2023	RIN 2.2 Compare 2022-23 (Rosetta)	Excel
NOV 2023	Ergon 2022-23 - Category Analysis - RIN Response - Consolidated - 23 November 2023 – PUBLIC (16058117.2)	Excel
AUG 2023	Maintenance Activity Frequency (MAF) – Release 2	PDF
JUN 2023	Maintenance Acceptance Criteria (MAC) – Release 11	PDF
OCT 2023	Lines Defect Classification Manual	PDF
JUL 2023	Substation Defect Classification Manual	PDF
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

1 SUMMARY

Title	Distribution Transformer Replacements
DNSP	Ergon Energy Network
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 volume of Distribution Transformers (DT) specifically pole transformers for the 2025-30 regulatory control period. • to support the Ergon Energy forecast capital expenditure over the regulatory period via a cost benefit analysis.
Identified need	☒ Legislation ☐ Regulatory compliance ☒ Reliability ☐ CECV ☒ Safety ☒ Environment ☒ Financial ☐ Other Ergon Energy is committed to adopting an economic, customer value-based approach when it comes to ensuring the safety and reliability of the network. To demonstrate the advantages of this approach for the community and businesses, we have employed Net Present Value (NPV) modelling. This commitment is in line with our efforts to maximise the value for our customers. Ergon Energy replaces distribution transformers (REPEX expenditure) to ensure safety, reliability, environmental, and financial risks are managed in the best interest of consumers. Ergon Energy observed that the replacement volume of DT was tracking higher than expected. The improved replacement data analysis confirmed an escalating replacement rate for DT. Predominantly the step change in distribution transformer is being replaced because of the pole replacement and overhead conductor programs. These concurrent replacements are a cost-effective replacement strategy aimed at improving asset performance and operation efficiency. The increase in replacements within these programs has consequently led to an increase in the volume of DT replacements. The justification for the increase is detailed on their respective business cases. This business case covers only the defect transformer replacement volume. We have also reviewed our defect classifications to ensure prudent asset management practices are followed to maximise customer benefit. The outcome from this analysis and benefit of consequential replacement has achieved better asset performance compared to the historical performance.
Alternate options	The counterfactual is a continuation of the current replacement rate of 535 units per year. Three other options were considered as follows: • Option 1 – Repex Model Cost Scenario – Average 320/yr • Option 2 – Repex Model Live Scenario - Average 520/yr • Option 3 – Additional Targeted Replacement - Average 2,115/yr

Expenditure

The expenditure presented in this business case relates to the proposed investment undertaken to replace defective distribution transformers and associated fuses. A large number of DTs and fuses are consequentially replaced under different programs such as defective pole replacement and targeted reconductoring. However, consequential investment under other asset programs and their respective benefits are included in those respective business case.

Year $m, direct 2022-23	2025-26	2026-27	2027-28	2028-29	2029-33	Total
Defect*	**15.6**	**15.6**	**15.6**	**15.6**	**15.6**	**78.0**
Fuse Consequential **Due to defective Dist Tx replacement ***	**10.8**	**10.8**	**10.8**	**10.8**	**10.8**	**54.0**
Pole Defect Program Dist. Tx Replacement	13.2	13.2	13.2	13.2	13.2	66.0
Reconductor Program Dist. Tx Replacement	6.7	7.0	7.2	7.5	7.6	36.0
Conductor Defect Program Dist. Tx Replacement	1.0	1.0	1.0	1.0	1.0	5.0
Consequential Dist Tx Replacement	20.9	21.3	21.5	21.7	21.8	107.2
Pole Defect Program Fuse Replacement	9.1	9.1	9.1	9.1	9.1	45.5
Reconductor Program Fuse Replacement	3.5	4.6	4.8	5.0	5.1	23.0
Conductor Defect Program Fuse Replacement	0.7	0.7	0.7	0.7	0.7	3.5
Total Consequential Fuse Replacement	13.3	14.4	14.6	14.8	14.9	72.0
Business Case Total Investment	**26.4**	**26.4**	**26.4**	**26.4**	**26.4**	**132.0**

** Expenditure considered for this business case.*

Benefits

After a thorough evaluation of all available options, it has been determined that Ergon Energy will continue with **Counterfactual**. This option has been chosen over other options, as it provides the best balance of benefits, deliverability, and safety risks for our customers. Further we will continue to focus on optimizing existing processes and enhancing efficiencies where possible to deliver additional benefits.

2 PURPOSE AND SCOPE

The purpose of this document is to outline the forecast expenditure and volumes associated with distribution transformers and associated fuses for the 2025-30 regulatory control period. This business case includes the analysis of different options to demonstrate prudency through NPV modelling.

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

3 BACKGROUND

Following a thorough examination of our actual performance, we noted that there has been an increase in DT replacement volume while the defect rate had been reducing gradually. The higher DT transformer replacements are primarily attributed to the consequential replacements occurring under the defective pole replacement and targeted overhead reconductoring program. The higher replacement rates for both poles and conductors was the escalating failure rate of these assets, necessitating an accelerated increase in replacement volumes. This proactive approach was taken to reduce the failure rates to acceptable levels, thereby mitigating public safety and reliability risks.

Ergon Energy wished to assure itself, the regulator, and internal and external stakeholders that the distribution transformer asset management strategies proposed, provide value to the community and shareholders over time through the provision of safe and reliable overhead network and a more secure electricity supply for consumers in rural and regional Queensland.

3.1 Asset Population

An age profile of all distribution transformer assets is shown in Figure 1, there are approximately 105,500 distribution transformers in Ergon Energy distribution network. This age profile distribution reflects that 7,000 assets are over 50 years.

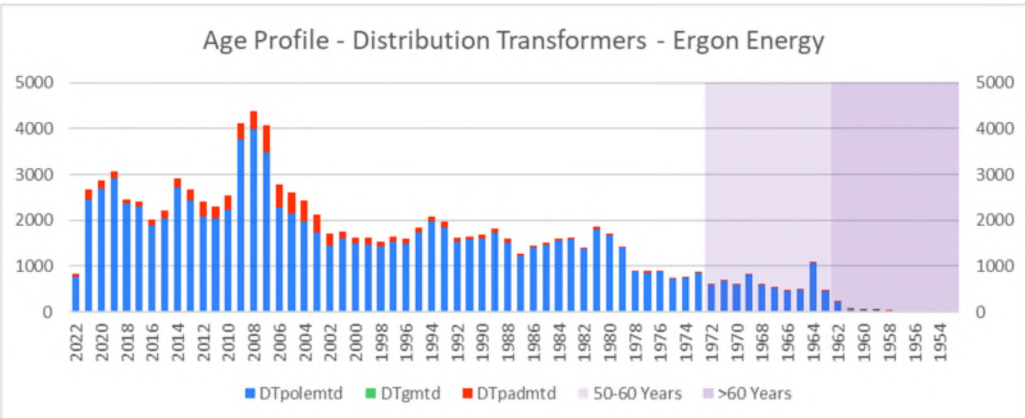

Figure 1: Distribution Transformer Asset Age Profile

3.2 Asset Management Overview

Distribution transformers are inspected periodically as per the Network Schedule of Maintenance Activity Frequency. They are reactively replaced, due to either electrical failure or poor condition (leaking oil, chipped insulators etc.) as assessed by ground-based inspection. It is generally considered uneconomical to complete refurbishment of distribution transformers, specifically small pole mounted transformers, and they are routinely scrapped once removed.

End of asset life is determined by reference to the benchmark standards defined in the Defect Classification Manuals and or the Maintenance Acceptance Criteria. Replacement work practices are optimised to achieve bulk replacement to minimise overall replacement cost and customer impact.

Distribution transformers may also be replaced based on risk, where criteria indicating assets are either at or near end of life can be identified. Consequential replacement is typically undertaken with other work such as feeder refurbishment programs or bundled into logical groups for efficiency of delivery and cost.

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 distribution transformer or associated components with transformer, excluding any associated other hardware related to pole or structure. Functional failure of this asset under normal operating conditions not caused by any external intervention such as abnormal weather or human.
Degraded (**defect**)	A distribution transformer or associated component asset deemed defective based on physical or observed serviceability criteria and if not rectified within a prescribed timescale (P0/P1/P2) could result in an unassisted 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). As a result of the defect classification analysis, all P1 defects have now been categorised as P2 to defer the replacement, unless it is assessed beyond doubt that failure is imminent, or location is too critical in terms of failure consequences.

The history of failures within the distribution transformer asset class over the last five years has been provided in Figure 2. While it is evident that there has been a significant increase in failures since 2018-19, it is worth noting that the failure trend has started reversing mainly because of consequential replacements.

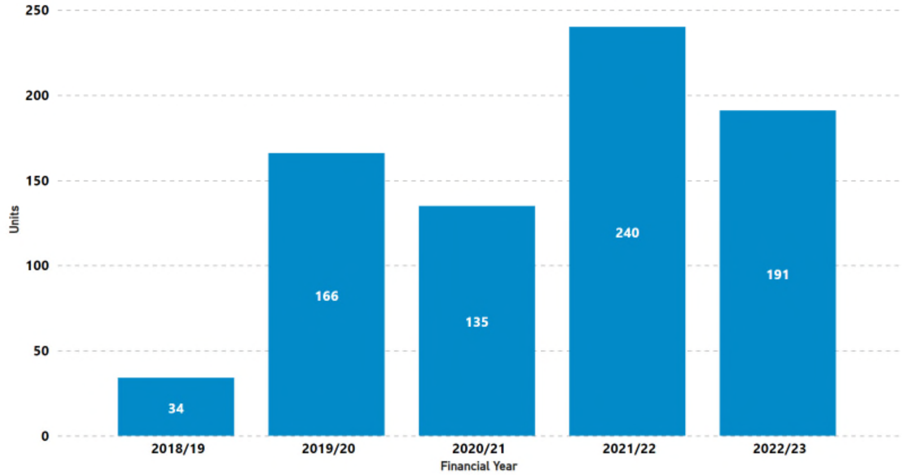

Figure 2: Unassisted Distribution Transformer Failures

In addition, the annual numbers of P1 and P2 level defects for transformers combined is shown in Figure 3. Contrary to failures trend, a decreasing trend is observed in P1 and P2 level defects of this asset class since 2019-20.

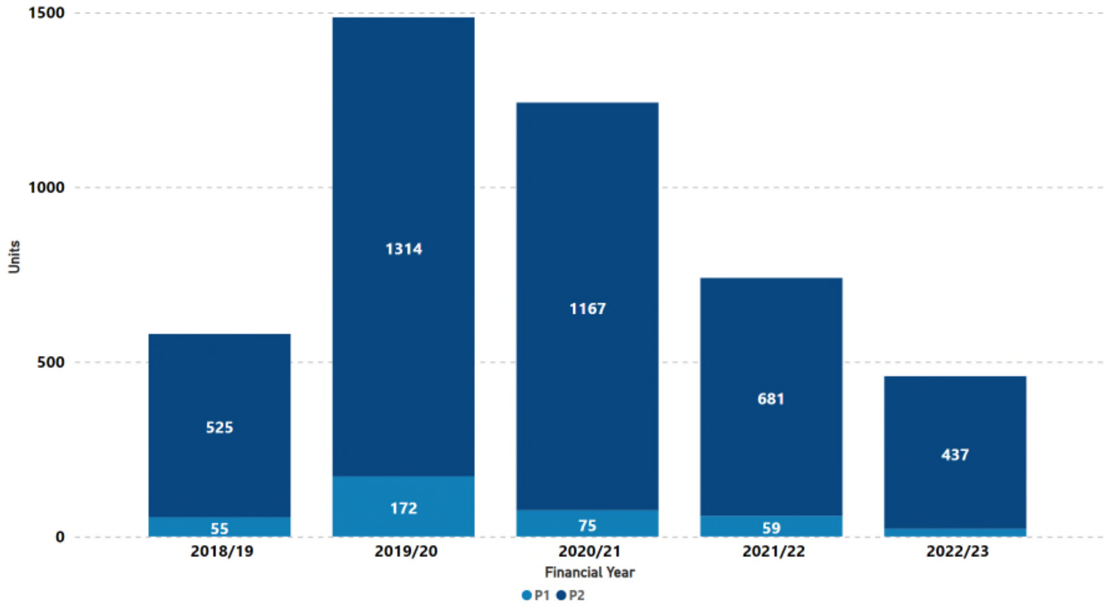

Figure 3: Distribution Transformer Defects P1 & P2

4 RISK ANAYLYSIS

Our cost-benefit analysis aims to optimize our risk calculation 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 calculated as per the equation in Figure 4.

Figure 4: Monetised Risk Calculation per Category

Each consequence category follows the same calculations in Figure 4 to obtain the total monetised risk as shown in Figure 5. Ergon Energy broadly considers five value streams for investment justifications regarding replacement of widespread assets. The ‘Export’ impact is not relevant to this study and will be excluded from the analysis.

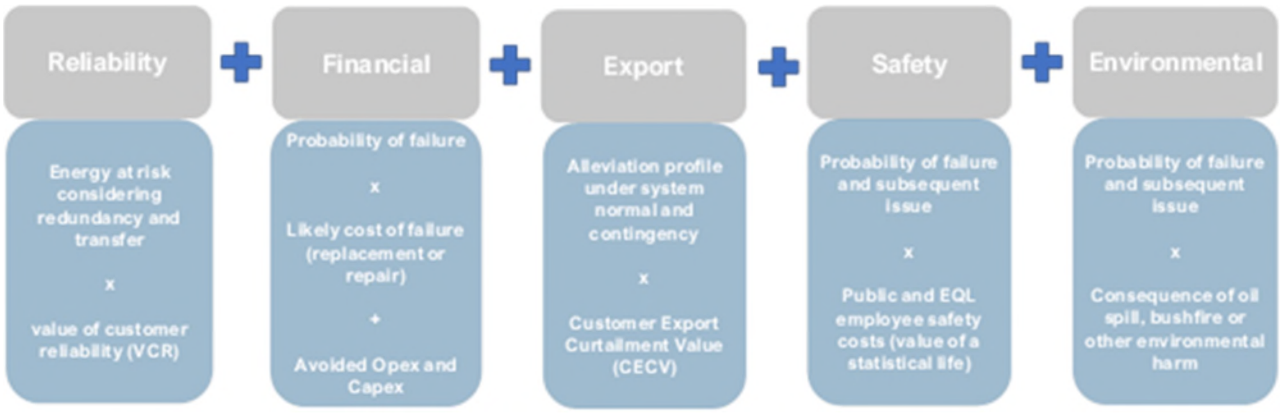

Figure 5: Total Risk Cost Calculation

4.1 Probability of Failure (PoF) – Distribution Transformers

Due to the limited condition data available for the implementation of an Asset Health Index (HI), the Weibull distribution model has been utilised instead due to its flexibility and ability to model skewed data. The statistical model Weibull Distribution has been developed for assets having only observed inspection and not having 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.

The calculated probability of failure (PoF) from the Weibull distribution allows calculation of an individual PoF for each asset, categorized by age, in the population.

Using the recorded failures and inferred failure ages of distribution transformer assets that failed in the past years, a Weibull Distribution model was developed for Ergon’s distribution transformer assets as per Table 2 and Figure 6. The resultant curve produced the following characteristics:

Weibull Variables	Value
Beta β	2.2
Eta η	33

Table 2: CDF Weibull Variables – Distribution Transformers

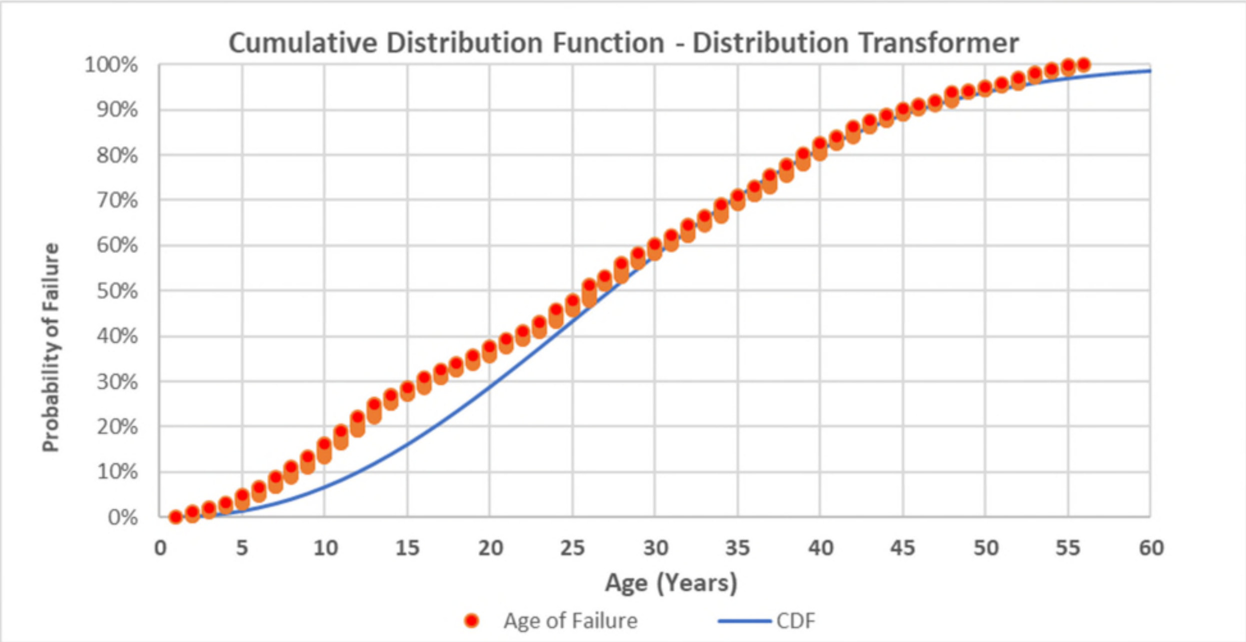

Figure 6: Weibull Cumulative Distribution Function for Distribution Transformers

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

The key consequence of distribution transformer 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, Ergon Energy has utilised a combination of historical performances and researched results. Ergon Energy has analysed past events, incidents, and data to identify patterns and trends that can provide insights into the likelihood of similar outcomes occurring in the future. Additionally, Ergon Energy also has conducted extensive research to gather relevant information and data related to the respective risk criteria such as bushfire.

To the extent possible the CoF and LoC are transformer type and size specific. This is particularly the case for the reliability and benefits stream.

4.2.1 Reliability

Reliability represents the unserved energy cost to customers of transformer outages and is based on an assessment of the amount of Load at Risk during failure Repair/replacement time. The following assumptions are used in developing the risk cost outcome for a pole failure:

- **Lost load:** Load loss for each transformer is estimated using the transformer type and kVA rating and assumed kilowatt loss is 33% of the maximum rating of the transformer type band. With the large distribution transformers (over 600kVA rating), 600kW assumption is used. The restoration time is estimated from subject matter expert based on historical evidence.
- **Value of Customer Reliability Rate:** We have used the Queensland average VCR rate.
- **Probability of Consequence:** all in-service distribution transformer 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 pole failure:

- **Transformer replacement:** different unit cost of distribution transformer replacement has been taken based on the type and size of the transformer including replacement condition (Planned or emergency). The cost varies between approximately $13,200 (Defective pole mounted distribution transformer) to $47,200 (Failure replacement – Pole mounted large distribution transformer).
- **Probability of Consequence:** all in-service transformer failures result in a need to replace the transformer under emergency.

4.2.3 Safety

The safety risk for a transformer failure is primarily that a member of the public is in the presence of a fallen transformer debris or shattered porcelain pieces in case of an explosive failure of transformer with/without fire. 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:** $1.3m
- **Disproportionality Factor:** 6 for members of the public

- **Probability of Consequence**: Following an unassisted asset failure, there is a 1 in 20 years chance of causing a fatality and 2 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. Historically, the data shows, distribution transformer has not been the cause of fatality, therefore the fatality incident due to a conductor asset unassisted failure has been considered for the modelling purpose.

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 transformer causing pole fire or bushfire. 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 $80k.
- **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:** The bushfire risk cost per crossarm is used to infer the distribution switches bush fire risk.

5 CONSEQUENTIAL REPLACEMENT

Within the scope of the pole and overhead conductor replacement investments, we also 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 poles and overhead conductor business cases to ensure that the overall asset expenses are accounted for.

Table 3 outlines the volume of distribution transformers replaced because of the pole replacement and reconductoring proposed program during the specified reporting period.

Actual Delivery Consequential Transformer Volumes	2025-26	2026-27	2027-28	2028-29	2029-30	Total
With Pole Replacement	452	452	452	452	452	2,210
With Reconductoring	264	275	283	290	294	1,406

Table 3: Consequential Asset Volume

5.1 Fuse Replacement

Fuses are mainly an expendable protection asset operates under a fault event. Normally the fuse cartridges are replaced once it operated. Table 4 explains the RIN categorisation of Fuse. In the RIN volume, only switch fuses are counted and the expendable cartridges are excluded.

RIN Fuse Detail	Explanation
Expenditure	Consists of Expenditure from Fuse Cartridges and Switch Fuse
Volume	Volume includes only Switch Fuses (Cartridges excluded)

Table 4: RIN Fuse Expenditure and Volume

Whenever a distribution transformer is replaced, HV and LV fuses are replaced as part of the replacement process. Table 5 summarises the fuse expenditures to be undertaken with distribution transformer replacements. While there are additional costs associated with fuse replacements, there are no additional benefits. As all the options will have a similar cost impact, fuse replacement costs have been excluded from the NPV analysis.

The expendable cartridges expense will stay with switch business case without the cost benefit analysis as the expense is unavoidable and necessary to replace the burnt fuses after a fault event.

Year	2025-26	2026-27	2027-28	2028-29	2029-30	Total ($m)
Distribution Transformer Related Fuses ($m)	10.8	10.8	10.8	10.8	10.8	**54.0**

Table 5: Business case Fuse Expenditure

6 IDENTIFIED NEED

6.1 Problem statement

Ergon Energy reviewed its asset management practices with respect to distribution transformers in response to concerns that the replacement rate was tracking too high. Over recent years there has been an effort to improve the quality of the data regarding the failures and information gathered in the field about distribution transformers. The improved replacement data captured has indicated an escalating replacement rate for distribution transformers. The review has found that predominantly distribution transformers were often replaced consequentially when the defective pole and targeted reconductoring was undertaken. This business case covers only the defective distribution transformer replacement volume.

6.2 Compliance

Ergon Energy's distribution transformer assets are subject to several legislative and regulatory standards:

- National Electricity Rules (NER)
- Electricity Act 1994 (Qld)
- Electrical Safety Act 2002 (Qld)
- Electrical Safety Regulation 2013 (Qld)
- Work Health & Safety Act 2014 (Qld)
- Work Health & Safety Regulation 2011 (Qld)
- Ergon Energy Corporation Limited Distribution Authority No D01/99

6.3 Counterfactual (Base Case Scenario) Proposed Program

To provide a comparison of the potential alternatives for our cost benefit analysis, we have set the counterfactual as our current defect rate volume.

6.3.1 Costs/Volume

The estimated forecast volume and expenditure for both pole and ground mounted transformers is shown in Table 6**.**

Year	2025-26	2026-27	2027-28	2028-29	2029-30	Total
$m, direct	15.6	15.6	15.6	15.6	15.6	**78.0**
Volume	535	535	535	535	535	**2,675**

Table 6: Counterfactual Delivery Volumes

6.3.2 Risk Quantification

Figure 7 provides the results of a quantitative forecast of emerging risk associated with Ergon's distribution pole and ground mounted transformer asset population failure due to condition related failure modes. This counterfactual risk is based on existing failure and defect rates and the calculated escalation forecast.

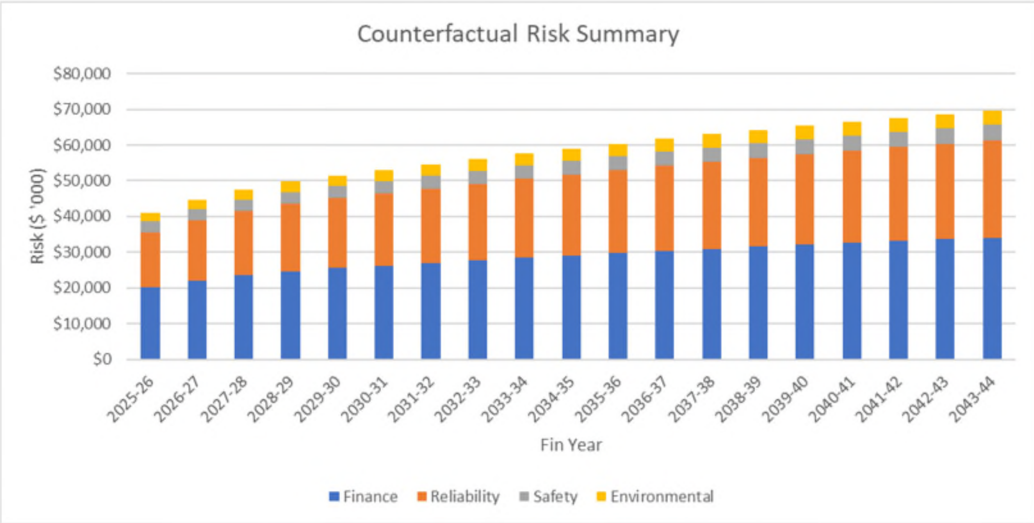

Figure 7: Counterfactual Quantitative Risk Assessment

Risk costs rise moderately in the counterfactual due to financial risks and reliability of supply associated with distribution transformer failures. The cost of these risks increases marginally over the 20-year period as shown.

As the consequential replacement are forecasted to be increased in the next 5 years with the increment in reconductor volume, based on the "REPEX guideline" the older transformers will be targeted consequentially as part of the efficiency bundling. That will result in reduction in transformer defect. Therefore, the expected defect rate will be 75% of the historical defect and has been consider in our investment forecast. The current forecast shows the failure is increasing but in conjunction with consequential replacement from pole and conductor programs the failures will be maintained within current service levels.

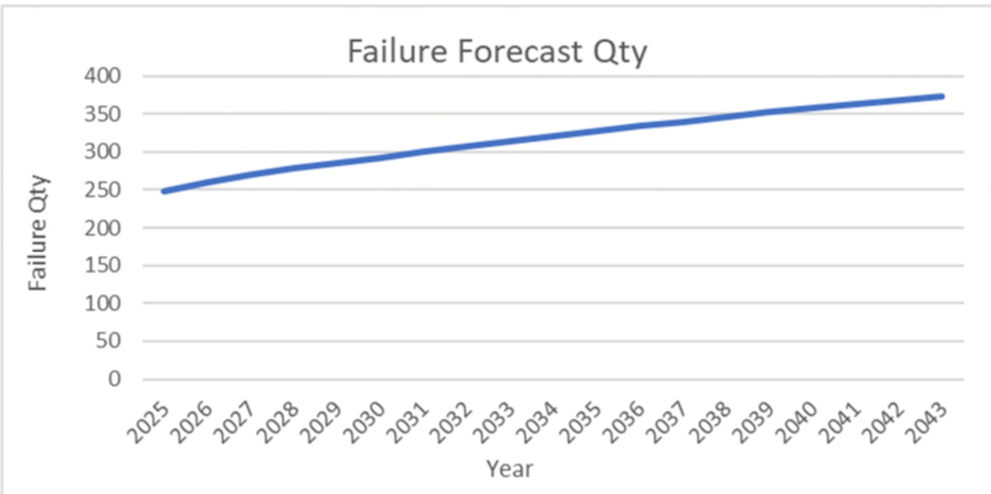

Figure 8: Counterfactual Failure Forecast

7 OPTIONS ANALYSIS

In assessing the prudency of our proposed volumes, we have compared a range of interventions against the counterfactual to assess the options that could have maximised value to our customers. We have sought to identify a practicable range of technically feasible, alternative options that can satisfy the network requirements in a timely and efficient manner.

It is notable that fuse replacements are required during distribution transformer replacements. While there are additional costs associated with fuse replacements, there are no additional benefits. As all the options will have a similar cost impact, fuse replacement costs have been excluded from the NPV analysis.

7.1 Option1 – REPEX Model Cost Scenario

This option includes the replacement of transformers based on REPEX model cost scenario with volumes estimated using distribution transformers expenditure allowance between 2025-30 regulatory control period divided by average actual unit cost. The estimated volume is around 60% of counterfactual.

7.1.1 Intervention Volume

The volume summary under this option has been provided in Table 7.

Year	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Volume	319	319	319	319	319	**1,596**

Table 7: Intervention Volume - Option 1

7.1.2 Risks/Benefits

In this option, our modelling shows that the unassisted failures are projected to increase substantially as it is leaving around 40% of defect unattended which may result in unassisted failure. 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 low defective transformer replacement volume result in keeping increasingly more defective transformers in active service, causing a flow on effect of investment requirements and poor asset performance.

7.2 Option 2 – Repex Model – Lives Scenario

This option includes the replacement of transformers based on REPEX model Lives scenario with volumes estimated using distribution transformers expenditure allowance between 2025-30 divided by average actual unit cost. This estimated volume is similar to counterfactual.

7.2.1 Intervention Volume

The volume summary under this option has been provided in Table 8.

Year	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Volume	521	521	521	521	521	**2,605**

Table 8: Intervention Volume - Option 2

7.2.2 Risks/Benefits

While this option is similar to the counterfactual replacement rate, our modelling also shows the assets performing consistent with counterfactual. Like our counterfactual option, this option is a well-balanced optimum solution for our customer.

7.3 Option 3 – Additional Targeted Replacement

This option includes additional proactive replacement of 1,580 transformers (>45 years old) in addition to corrective replacement of all identified defective assets (counterfactual).

7.3.1 Intervention Volume

The volume summary under this option has been provided in Table 9.

Year	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Volume	2115	2115	2115	2115	2115	**10,575**

Table 9: Intervention Volume - Option 3

7.3.2 Risks/Benefits

Under this approach, our modelling predicts that the occurrence of unassisted distribution transformer failures will be reduced in comparison to the counterfactual option and all other. However, this option requires more resources and investment compared to all the other options with significant cost impact on customers outweighs the advantages.

8 OUTCOMES OF OPTIONS ANALYSIS

8.1 Distribution Transformer Failure Forecast

The distribution transformer failure forecast for all main options is shown in Figure 9. As stated, in Option 1 where a portion of the defects left unattended leads to elevated failure. Option 3 being the best asset performance model requires additional investment offsetting the risk reduction and community benefits up to some extent. Option 2 and counterfactual maintains the current performance and delivers the balanced outcome.

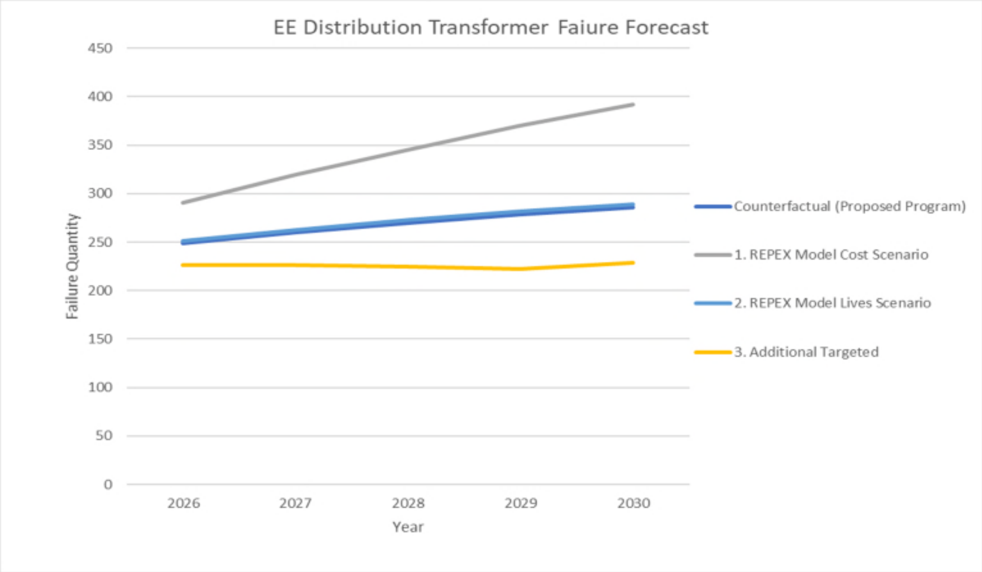

Figure 9: Failure Forecast - Intervention options

8.2 Economic Analysis

The NPV of the cost benefit analysis of the options is summarised in Table 10 which demonstrates the following:

- Option Counterfactual – has been set for zero NPV but indicating the best balance of benefits to customers and failure reductions with no additional cost impact.
- Option 3 provides a risk reduction but the substantial investment requirement outweighs the benefit, resulting in a negative NPV.
- Option 1 against counterfactual leads to poor asset performance as portion of defects left unattended leads to unassisted failure.

Options	Rank	Net NPV	Intervention CAPEX NPV	Intervention Benefits NPV
Counterfactual (Proposed Program)	**1**	**$0**	$0	$0
1. REPEX Model Cost Scenario	**4**	**-$69,851,476**	$29,963,613	-$99,815,089
2. REPEX Model Lives Scenario	**2**	**-$3,232,982**	$741,917	-$3,974,898
3. Additional Targeted	**3**	**-$23,167,327**	-$141,538,712	$118,371,385

Table 10: NPV modelling outcomes for all options

Table 11 summarises the volume replacements for all options.

Distribution Transformer	2025/26	2026/27	2027/28	2028/29	2029/30
Counterfactual (Proposed Program)	535	535	535	535	535
1. REPEX Model Cost Scenario	319	319	319	319	319
2. REPEX Model Lives Scenario	521	521	521	521	521
3. Additional Targeted	2116	2116	2116	2116	2116

Table 11: Option volumes

Figure 10 illustrates the advantages and disadvantages of all options over the counterfactual.

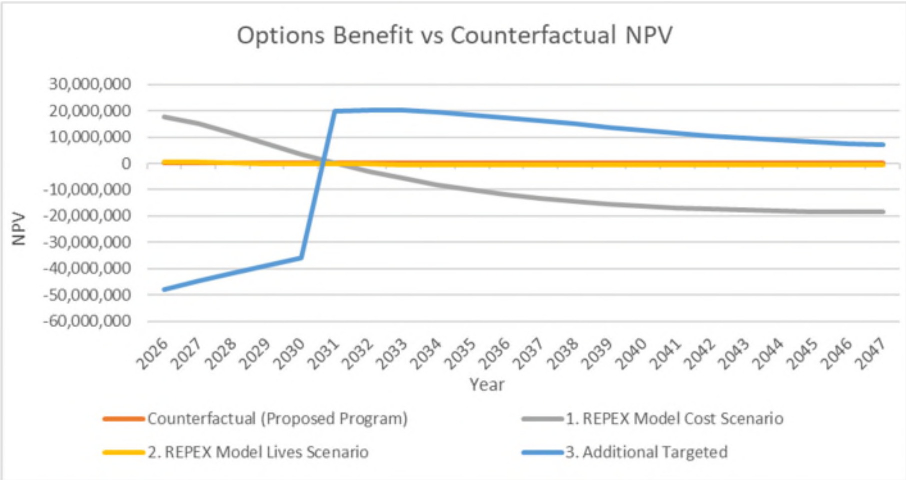

Figure 10: Benefits for all options

Any volume lower than the counterfactual option has resulted in a negative NPV. Therefore, the Counterfactual is the option which will achieve compliance with our network standards and provides significant customer benefits. As such, it is prudent to continue with business as usual. Even though Option 3 (additional targeted volume) provides additional customer benefits, the substantial investment outweighs the benefit and delivers a negative NPV.

The analysis presented in Table 12 compares the options to their respective counterfactual alternatives for distribution transformers.

Criteria	Option 1 – Repex Model Cost Scenario	Option 2 – Repex Model Lives Scenario	Option 3 – Additional Targeted Volume
Net NPV	-$70m	-$3m	-$23m
Investment Risk	Low	Very Low	Low
Benefits	Low	Low	High
Delivery Constraint	Low	Low	Low
Detailed analysis – Advantage	• Do Minimum Scenario • Investment saving of $30m.	• Aligns closer to counterfactual option • Maintains current level of service • Asset performance similar to counterfactual.	• Transition towards improvement of asset performance • Additional benefit of $118m.
Detailed analysis – Disadvantage	• Leaving 40% of defects unattended • Negative NPV • Poor asset performance • Elevated safety and finance risk • Loss of $100m benefit for the customers.	• Not improving the asset performance, only maintains.	• Additional investment of $141m • High resource impact • Negative NPV • Investment outweigh customer benefit.

Table 12: Options Analysis Scorecard

9 SUMMARY

Ergon Energy Network's proposed plan is to move forward with the **Counterfactual** volume for the 2025-2030 regulatory control period. This proposed plan aligns with the current defect replacement volume and has been deemed prudent based on the cost benefit analysis.

We have assessed and modelled three feasible options compared to the proposed counterfactual delivery forecast for the 2025-30 regulatory control period. A reduction in replacement volumes delivers negative NPV benefit with increased risks for our community.

Our analysis shows that distribution transformer failure rate are likely to be maintained at the current level under the Counterfactual. Hence, we forecast that the current level of remediation programs as proposed option.

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

In most of the sensitivity analysis outcomes, Option 4 remains as the most prudent option.

10 RECOMMENDATION

The proposed counterfactual option 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.

APPENDICES

10.1 Reset RIN

Expenditure $, direct 2022-23	2025/26	2026/27	2027/28	2028/29	2029/30
RIN	36,591,431	36,921,151	37,140,964	37,360,778	37,470,684
Transformer Defect	**15,645,907**	**15,645,907**	**15,645,907**	**15,645,907**	**15,645,907**
Consequential Transformer Replacement					
Pole Defect Program	13,222,494	13,222,494	13,222,494	13,222,494	13,222,494
Reconductor Program	6,695,178	7,024,898	7,244,712	7,464,525	7,574,432
Conductor Defect Program	1,027,851	1,027,851	1,027,851	1,027,851	1,027,851
Consequential Replacement	**20,945,524**	**21,275,244**	**21,495,057**	**21,714,871**	**21,824,777**
Consequential Fuse Replacement					
Transformer Defect Program	10,800,498	10,800,498	10,800,498	10,800,498	10,800,498
Pole Defect Program	9,127,596	9,127,596	9,127,596	9,127,596	9,127,596
Reconductor Program	3,509,932	4,601,549	4,829,157	4,980,896	5,132,635
Conductor Defect Program	709,534	709,534	709,534	709,534	709,534
Consequential Replacement	**24,147,559**	**25,239,176**	**25,466,785**	**25,618,524**	**25,770,263**

Table 13 RIN reconciliation table – Expenditure $ in 2022-23

Expenditure $, direct 2024-25	2025/26	2026/27	2027/28	2028/29	2029/30
RIN	41,636,167	42,222,521	42,685,659	42,989,487	43,432,860
Transformer Defect	**17,802,955**	**17,892,445**	**17,981,651**	**18,003,092**	**18,135,417**
Consequential Transformer Replacement					
Pole Defect Program	15,045,435	15,121,063	15,196,452	15,214,572	15,326,401
Reconductor Program	7,618,220	8,033,577	8,326,259	8,589,117	8,779,643
Conductor Defect Program	1,169,558	1,175,437	1,181,297	1,182,705	1,191,398
Consequential Replacement	**23,833,212**	**24,330,077**	**24,704,008**	**24,986,395**	**25,297,443**
Consequential Fuse Replacement					
Transformer Defect Program	12,289,526	12,351,301	12,412,881	12,427,682	12,519,027
Pole Defect Program	10,385,987	10,438,194	10,490,235	10,502,744	10,579,940
Reconductor Program	3,993,834	5,262,268	5,550,092	5,731,309	5,949,318
Conductor Defect Program	807,355	811,413	815,459	816,431	822,432
Consequential Replacement	**27,476,702**	**28,863,176**	**29,268,667**	**29,478,166**	**29,870,717**

Table 14 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	1,251	1,263	1,270	1,278	1,281
Transformer Defect	**535**	**535**	**535**	**535**	**535**
Consequential Transformer Replacement					
Pole Defect Program	452	452	452	452	452
Reconductor Program	229	240	248	255	259
Conductor Defect Program	35	35	35	35	35
Consequential Replacement	**716**	**728**	**735**	**743**	**746**
Consequential Fuse Replacement					
Transformer Defect Program	1,070	1,070	1,070	1,070	1,070
Pole Defect Program	904	904	904	904	904
Reconductor Program	348	456	478	493	508
Conductor Defect Program	70	70	70	70	70
Consequential Replacement	**2,392**	**2,500**	**2,523**	**2,538**	**2,553**

Table 15 RIN reconciliation table – Replacement Volumes