# ATTACHMENT 6.6

# RESPONSE TO AER DRAFT DECISION OF REPLACEMENT EXPENDITURE

# CONTENTS

# 1 Purpose

The purpose of this paper is to present to the Australian Energy Regulator (AER) Essential Energy's response to the issues raised by the AER in its Draft Decision regarding Essential Energy's Replacement Expenditure (repex) submitted as part of the 2015 – 2019 regulatory proposal.

# 2 Summary

This paper details that the quantum of repex required for the 2015-2019 regulatory control period is $857M (excluding capitalised overheads). This amount is the same as proposed in the Substantive Regulatory Proposal (SRP).

Essential Energy considers that the AER's assessment of the amount of repex required ($657.7M) is insufficient due to the following findings:

> The AER's assessment relies on an inappropriate view that repex should be maintained at long term historical trends. In fact, Essential Energy's aging network will require increasing amounts of repex to deliver the current level of distribution services.

> The AER's benchmarking purports that Essential Energy's repex is higher than its peers, contains errors and inappropriately uses customer density to provide a comparative view. In fact, appropriate benchmarking shows that Essential Energy's repex is less than its peers.

> The predictive modelling undertaken by the AER contains data errors that understate the actual need. In fact, correct modelling supports Essential Energy's forecast level of repex.

> Reliance on a technical review by EMCa has mislead the AER, as many of the statements made are general in nature and are misleading or incorrect when applied to Essential Energy.

Essential Energy has responded in detail to each of the AER's findings, which are summarised in the following table.

*Table 2-1*

| AER issue | Summary of AERs reasons and findings | Essential Energy's response |
|---|---|---|
| Trending shows repex forecast is more than the average of historical trends | Long term average should provide a relevant baseline (p. 6-51). | The long term average is understated by an unknown amount due to changes in accounting practices and cannot be used to determine an average spend (refer section 4.1.1).<br><br>The aging network will require increasing amounts of repex to deliver the current level of distribution services (refer section 4.1.1) |
| Benchmarking shows repex forecast is more than required by peers | Essential Energy compares unfavourably when normalised by customer density. | Customer density is not an appropriate normalising metric for repex (refer to section 4.2.1).<br><br>Normalised by asset volume, benchmarking shows Essential Energy has the lowest repex spend in the benchmark group when viewed as spend per kilometre of line, spend per pole and spend per asset (refer to section 4.2.3). |
| Predictive modelling shows the efficient level of repex is $676M | The Repex Model indicates that a reasonable range is $590M and $682M. Selecting the lower range and adding $86M for repex not included in the model gives an efficient level of $676M. | The model is based on incomplete assessments for Overhead services, Pole staking and Switchgear replacement. It also omits un-modelled repex for step change programmes totalling $31M.<br><br>Correct modelling supports the repex forecast of $857M (refer section 4.3.3). |

| AER issue | Summary of AERs reasons and findings | Essential Energy's response |
|---|---|---|
| Information provided by others, including consultants EMCa, supports that repex is likely to be overstated | **Each issue is set out below** | |
| . | **Utilisation** - Reduced utilisation of Essential Energy's assets should result in a longer asset life and reduce the cost of an in-service asset failure allowing a deferral for the efficient timing of asset replacement (ref p.6-59) | Factually incorrect. Reduced utilisation of assets does not decrease rates of inherent deterioration as Essential Energy's assets are not heavily loaded or overloaded (refer to section 4.6.1). |
| | **Asset age** - Essential Energy is likely to be replacing assets earlier than required to meet the capex objectives (ref Overview p.50) | Factually incorrect. This implies that the average asset age for all assets should be allowed to increase, which ignores that Essential Energy already has asset lives higher than any other DNSP, and that increasing asset failure rates indicate that average asset lives should be reduced to maintain required service outcomes (refer to section 4.6.2). |
| | **Risk** - Overly conservative risk assessments are leading to higher than needed expenditures (ref. p. 6-10) | Factually incorrect. Two complementary risk assessment tools are used to reach the required granularity to make informed decisions in accordance with the Corporate Risk Policy (refer to section 4.6.3).<br><br>Consequence ratings are reflective of likely scenarios as they were informed by failure histories, insurance claims, outage data and information from like DNSPs or from case law. The staged review process increases the relativity of the risk assessments and removes overly conservative assessment (refer to section 4.6.3). |
| | **Capital governance** – framework appears to be out of date and the application of this framework to the repex forecast is inadequate (ref p.6-61). | Factually incorrect. An out of date Capital Governance process was inadvertently submitted with the regulatory proposal. EMCa's findings were based on an assessment of a legacy document.<br><br>Since the formation of NNSW in 2012, the NNSW capital governance framework and supporting processes have been used (refer to section 4.6.4). |
| | **Asset information** – ECMa assert that asset management systems, data quality and analysis do not adequately support prudent investment decision making justification (ref p.6-11) | Factually incorrect. EMCa did not ask for and was not provided with relevant information. The basis of their assertions is unknown.<br><br>Data and data analysis for key replacement actions is well established and robust. An appropriate balance between the cost of data collection and its value has been established. Essential Energy continues to improve its asset knowledge as evidenced by the 2012 initiative to link failure cause data to outages and assets (refer to section 4.6.5 and APPENDIX D – Pole Asset Strategy and Serviceability criteria). |
| | **Options analysis** – Options analysis and cost benefit analysis are not adequate (ref p.6-60) | Factually incorrect. Options analyses, including cost benefit analysis, are considered. This may not have been transparent to EMCa as the outcomes are not always clearly documented.<br><br>For instance, outcomes are documented in Serviceability Criteria and Asset Standards. As the response to a conditional failure is to do nothing or to replace, the options analysis is more about the timing of the replacement action, which is in accordance with a risk based serviceability criteria (refer to section 4.6.6). |

| AER issue | Summary of AERs reasons and findings | Essential Energy's response |
|---|---|---|
| | | |
| | **Cost estimation** - approach is not understood | The methodology utilised to derive forecast costs for each programme of work involves determining the unit of measure, the approach to costing each unit, the approach to costing the programme and determining the cost elements (labour, materials, other) (refer to section 4.6.7). |
| | **Multiple contingency allowances** – contingency allowances are not clear. Multiple contingency allowances are used (ref p. 6-11 & p.6.61). | Factually incorrect. No specific contingency amounts are included in the forecast. Unit rates are based on average historic costs (refer to section 4.6.8). |
| | **Procurement** - NNSW cost efficiencies have not been included (EMCa p.17) | Factually incorrect. The procurement efficiencies apply to Ausgrid and Endeavour rather than Essential Energy, as scale economies are already realised. For instance, less than a 1% saving is anticipated in the replacement of poles (refer to section 4.6.9). |
| | **Deliverability** – doubt that repex program can be delivered (ref p.6-61) | Factually incorrect. Deliverability of the proposed capital works is a low risk; Essential Energy's delivered capital work in the 2009-2014 regulatory period is more than the proposed capital work for the 2014-2019 regulatory period. The AER's consultant, EMCa, has incorrectly found that the nature of the work will change and a different resource capability will be required. This is not the case and the resources currently available to Essential Energy have the required skills and capability to deliver the proposed programme (refer to section 4.6.10). |

# 3 Background

Under the National Electricity Rules, Essential Energy, as a DNSP, is required to submit a regulatory proposal to the AER every five years to set appropriate network tariffs. As part of the regulatory proposal, Essential Energy has submitted a proposed repex[1] to the AER of $857M ($2013/14 excluding capitalised overheads) in respect of regulatory period 1 July 2014 to 30 June 2019.

The AER's Draft Decision has provided an alternate estimate 21 per cent[2] lower than Essential Energy's proposed repex based on:

- Forecast repex exceeding the long term average and benchmarking unfavourably[3]
- Reduced utilisation decreasing rates of deterioration[4]
- Essential Energy is likely to be replacing assets earlier than required to meet the capex objectives[5]
- Network age and condition information that is inconsistent[6]
- Predictive modelling outcomes[7]

[1] Attachment 4 2014 Reset RIN Workbook Consolidated, *Essential Energy, 2014, Template 2.2 REPEX Table 2.2.1 – Replacement Expenditure, Volume and Asset Failures by Asset Category and Table 2.2.2 – Selected Asset Characteristics (Essential Energy's REPEX)*
[2] *Draft decision Essential Energy distribution determination 2015-16 to 2018-19 Attachment 6: Capital expenditure*, AER, November 2014 , section A.3.1, p.6-49
[3] Draft decision Essential Energy distribution determination 2015-16 to 2018-19 Overview, *AER, November 2014 , section 8.6.3, p.50*
[4] Draft decision Essential Energy distribution determination 2015-16 to 2018-19 Overview, *AER, November 2014 , section 8.6.3, p.50*
[5] Draft decision Essential Energy distribution determination 2015-16 to 2018-19 Overview, AER, November 2014 , section 8.6.3, p.50
[6] Draft decision Essential Energy distribution determination 2015-16 to 2018-19 Attachment 6: Capital expenditure, AER, November 2014 , table 6-2, p.6-11

- Overly conservative risk assessments[8]
- Deliverability constraints[9]
- The use of multiple contingency allowances[10].

The AER has also stated that it accepts the findings of its consultant's review[11] which, in addition to the findings above, includes:

- Capital governance is inadequate
- Asset management approach is still maturing and asset data is poor
- Lack of compelling evidence for step changes in repex
- Options analysis and cost benefit are not adequate
- Cost estimation approach is unclear.

# 4 Discussion

Essential Energy does not accept the AER's Draft Decision. Essential Energy considers that the predictive modelling on which the decision is based contains data errors and that many of the assessments that appear to support the decision are misleading or incorrect. This paper will show that an amount of $857M is required.

The paper is structured to reflect the AER's assessment approach:

- Trend analysis
- Benchmarking
- Predictive modelling
- Unmodelled repex
- EMCa Technical Review.

A section on factual errors has also been included to provide assistance to the AER in understanding Essential Energy's proposal.

[7] Draft decision Essential Energy distribution determination 2015-16 to 2018-19 Overview, AER, November 2014 , section 8.6.3, p.50
[8] Draft decision Essential Energy distribution determination 2015-16 to 2018-19 Attachment 6: Capital expenditure, AER, November 2014 , table 6-2, p.6-10
[9] Draft decision Essential Energy distribution determination 2015-16 to 2018-19 Overview, AER, November 2014 , section 8.6.3, p.50
[10] Draft decision Essential Energy distribution determination 2015-16 to 2018-19 Attachment 6: Capital expenditure, AER, November 2014 , table 6-2, p.6-11
[11] EMCa Technical Review of Regulatory Proposals - Review of Proposed Replacement Capex in Essential Energy's Regulatory Proposal 2014 – 2019, EMCa, October 2014

## 4.1 Trend Analysis

### 4.1.1 AER's use of the long term average repex is inappropriate

*The Draft Decision states that the long term average historical repex trend should provide a relevant baseline.*[12]

Essential Energy notes that the long term average repex in figure A-7[13] of the Draft Decision is understated by an unknown amount as accounting practices have changed over this period. As such it is not possible to quantify how much the forecast repex exceeds the long term average.

The repex spend has been historically affected by legacy company policies. Capitalisation policies have varied across the historical period analysed. Some activity that was traditionally expensed in earlier years was changed to being capitalised. This has the effect of understating the historical average. Furthermore, overhead policies have varied over the 2008/09 to 2013/14 regulatory control period. These variations tend to result in a higher proportion of total corporate overheads being allocated to capital work instead of operating expenditure in prior periods. This also has the effect of understating the repex in the earlier years of the graph in figure A-7[13] of the Draft Decision.

Additionally, it is counter-intuitive that repex should remain constant at long term levels. The repex spend is expected to increase as a result of:

- Increased asset management maturity since the formation of Essential Energy in 2001 (then named Country Energy).
- Increased failure rates and deteriorating network asset health indicators as increasing numbers of assets enter the wear out phase.

It is to be expected that given the average age profile of the assets the repex requirements will continue to increase over time with a peak for repex predicted around 2050. This is confirmed in Figure 4-1, using the Repex Model which shows the AER's 'reasonable' expenditure range is forecasting an accelerating replacement requirement of between 5.56 per cent and 6.16 per cent per annum. This is in contrast to the AER's implied concern that Essential Energy's proposed repex is growing at an unreasonable rate. Further, a number of new programmes of emerging issues have increased repex spend (refer to section 4.5).

[12] Draft decision Essential Energy distribution determination 2015-16 to 2018-19 Overview, *AER, November 2014 , section 8.6.3, p.50*
[13] Draft decision Essential Energy distribution determination 2015-16 to 2018-19 Attachment 6: Capital expenditure, AER, November 2014, figure A-7, p51.

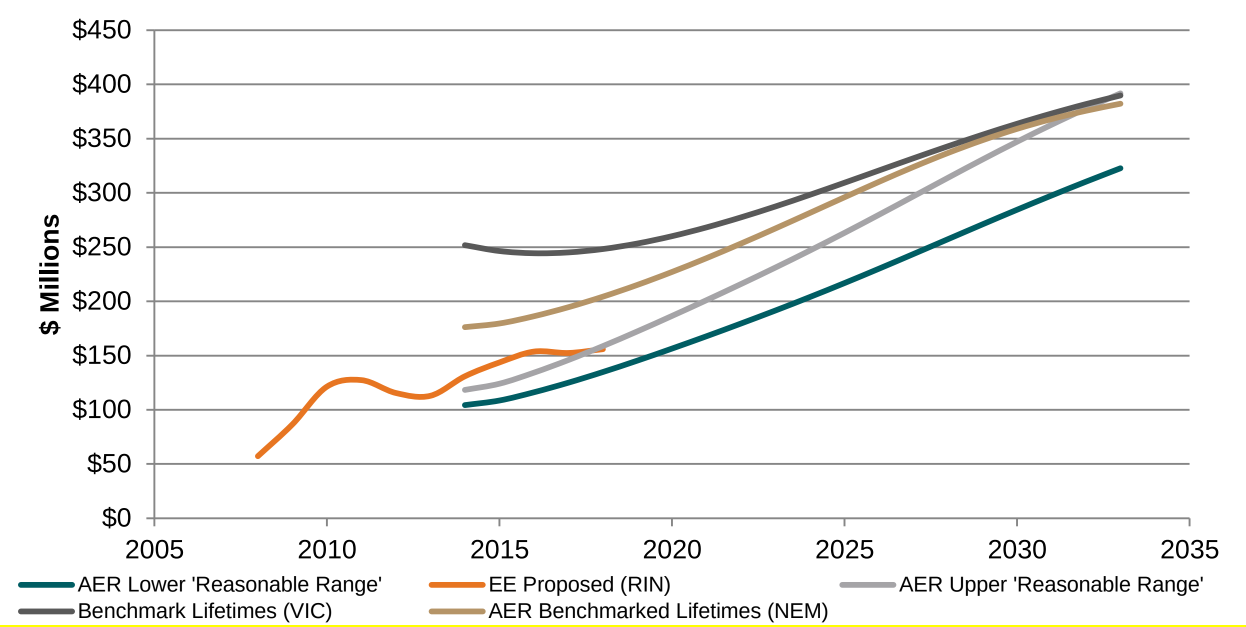


*Figure 4-1: Modelled repex spend (excluding service mains), using Essential Energy's unit costs and age profile[14,15,16]*

## 4.2 Benchmarking

The AER undertook benchmarking using information provided in the RINs. In this section we show that the benchmarking inappropriately uses customer density to provide a comparative view. The benchmarking, when adjusted to compare asset volumes, shows that Essential Energy's repex is less than its peers.

### 4.2.1 AER's use of customer density as a comparative metric is inappropriate

*The Draft Decision has made adjustments to the repex with Essential Energy's repex benchmarking unfavourably[17] when normalised by customer density.*

The AER have used three measures to benchmark DNSP repex including:

> Repex versus customer density,

> Repex versus capacity density; and

> Repex versus RAB.

While the above three metrics are informative, Essential Energy contends that they are not the most relevant metrics to use with regard to repex.

Normalised benchmarking shows Essential Energy has a comparably low repex spend when viewed as spend per kilometre of line, spend per pole and spend per asset. Through the comparison of repex quantum, the level of repex identified in the Draft Decision can be shown to be counter intuitive given the size, scale, risk, condition and average age of the Essential Energy network.

[14] The AER's reasonable upper and lower scenarios include a misinterpretation of service line unit rates and as such underestimate reasonable expenditure by approximately $39M. Therefore service line expenditure has been excluded to enable direct comparisons between scenarios.
[15] Benchmark Lifetimes (VIC) are taken at a category level from Nutall Consulting Report – Aurora Revenue Review, Nov 2011
[16] All scenarios use Essential Energy's asset base and unit costs (excluding the 'AER Upper Reasonable' which is based on benchmarked unit costs as per the draft decision).
[17] Draft decision Essential Energy distribution determination 2015-16 to 2018-19 Overview, *AER, November 2014, section 8.6.3, p.50*

The replacements that constitute Essential Energy's repex are dependent on the number of assets on the network and the assessed condition of those assets. The expenditure on existing installed assets is not demand driven and as such the replacement volumes do not correlate with the demand on the network, including the number of customers and electrical demand in MVA or kWh. It is therefore inappropriate to benchmark repex against these metrics.

### 4.2.2 Asset volumes is an appropriate comparative metric

As repex is about replacing aged assets in poor condition, it has a direct correlation to the volume of assets on the network, their condition and cost of replacement. This is already recognised by the AER in that the AER's repex model is based on the number of assets, implied condition of assets and replacement cost of assets. As this high level benchmarking cannot consider age or condition then the benchmarking should in the first case consider the number of assets in the pool to be managed. Other outputs such as customers, capacity and RAB have little to no effect.

Figure 4-2 utilises replacement cost to provide a reasonable benchmark of replacement expenditure across DNSPs; to draw specific comparisons from the data, it is also presented in line graph format in Figure 4-11.

Figure 4-2 provides a benchmark of repex spend normalised by asset replacement cost of each DNSP; this is used due to the strong correlation between asset quantities and replacement expenditure demand. Each DNSP's asset quantities are applied to the AER's provided NEM benchmarked unit costs to provide an asset base replacement cost.

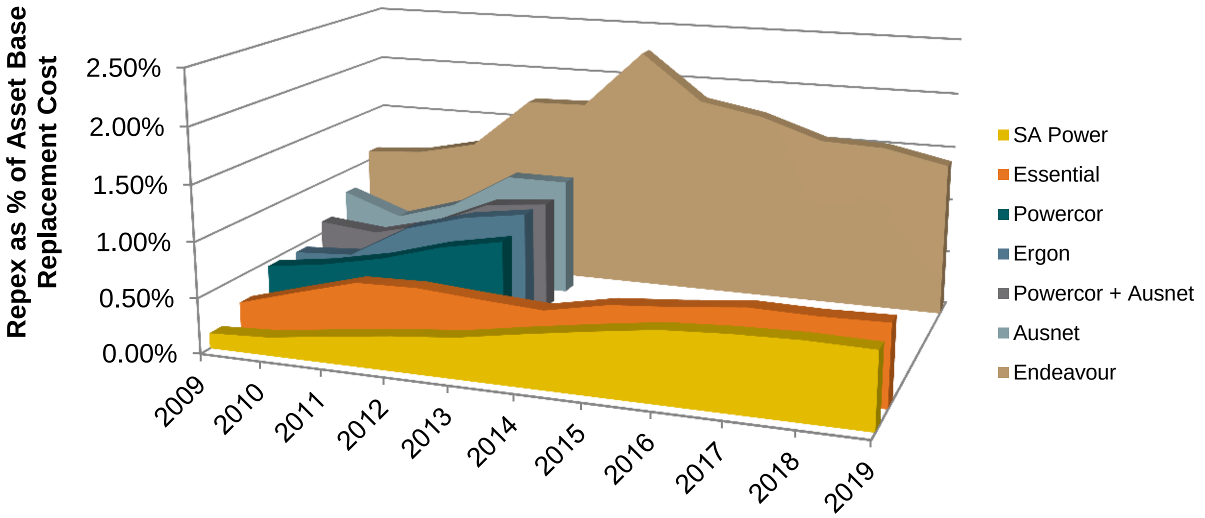


*Figure 4-2: Repex spend by asset base replacement cost*

When making comparisons, it is also useful to choose peers that have similar characteristics. Essential Energy's network length is greater than all of the Victorian DNSPs combined, and contains more poles, while being spread across a vastly greater area, as shown in Figure 4-3. Not only is customer density per line kilometre much lower than any Victorian or South Australian DNSP, the network density is also far lower in kilometres of line per square kilometre.

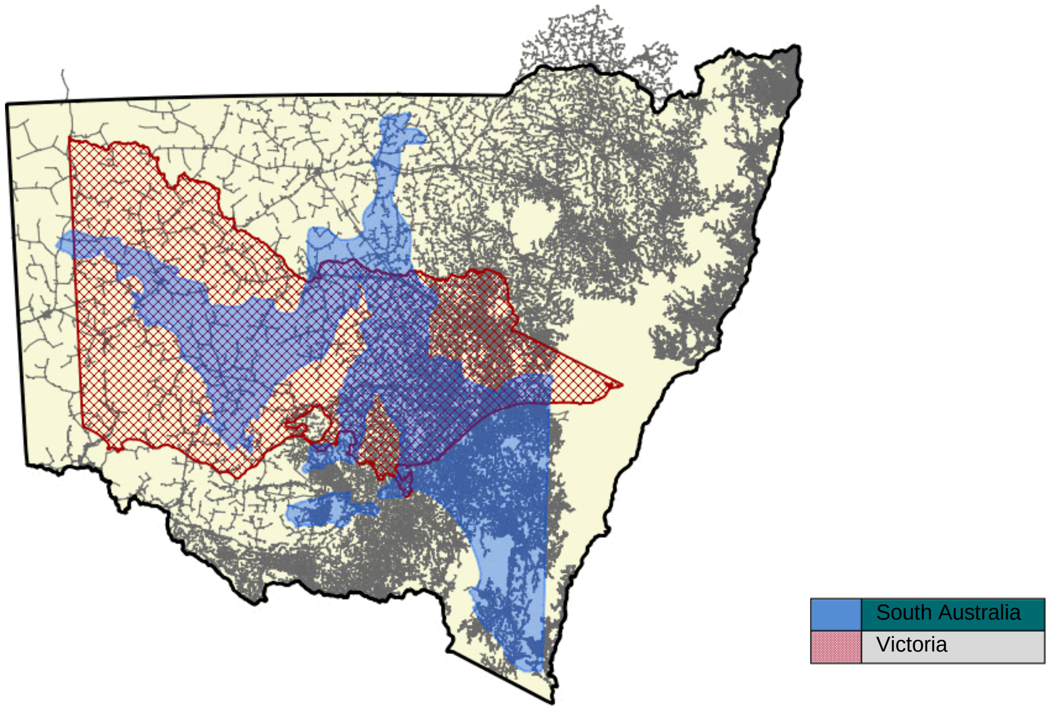


*Figure 4-3: Victoria and SA Power Networks superimposed over Essential Energy's network*

The two comparable industry peers in Victoria are AusNet and Powercor. These two distributors combined have the most similar networks to Essential Energy in the NEM, with the exception of Ergon Energy, and both were included in the AER's top quartile to determine the "efficient frontier".

AusNet and Powercor are comparable to Essential Energy because:

> They are predominantly rural distributors.

> Of the Victorian Distributors, their networks are closest to that of Essential Energy although they are noted as being twice and four times as dense on a customer per kilometre basis and much denser on a network per square kilometre basis.

> When summed as a notional single DNSP, they have a spread and span across Victoria from the east to the west of the state similar to Essential Energy. In isolation they are not a good benchmark against Essential Energy as one is more coastal and ranges while the other plains dominant.

These two distributors are shown in Figure 4-2 as having higher repex spends as a percentage of asset replacement cost. Essential Energy submitted to the AER a paper titled "Response to AER Comments on Replacement Expenditure" in October 2014, comparing the Essential Energy repex spend per asset with AusNet and Powercor. Figure 4-6 shows that Essential Energy has a lower repex spend per asset.

Table 4-1 shows that Essential Energy has a lower repex per asset than Endeavour Energy and a blended AusNet and Powercor.

*Table 4-1: Repex per asset for comparable entities*

| | Essential Energy | Endeavour Energy | AusNet & Powercor |
|---|---|---|---|
| Repex Proposal | $856M[18] | $739.7M[19] | N/A |
| Repex Draft Decision/Spend | $675M[18] | $661M[19] | $747M[20] |
| Poles[21] | 1,377,483 | 305,822 | 919,714 |
| Circuit kilometres[21] | 193,423 | 44,305 | 119,705 |
| Distribution Substations[21] | 136,125 | 29,721 | 142,524 |
| Zone Substations[22] | 413 | 177 | N/A |
| Repex per Asset[23] | $53.0 | $192.6 | $84.1 |
| Weighted Calibrated Asset Life[24] | 70.3 | 50.4 | 65.8 |

The decision by the AER to reduce the Essential Energy replacement capital expenditure proposal is counterintuitive to the decision the AER applied to Endeavour Energy. Table 4-1 compares the key assets and replacement capital expenditure decisions of Essential Energy and Endeavour Energy.

The average pole age on the Essential Energy Network is ten years older than on the Endeavour Network and the Essential Energy network is broadly four times larger than that of Endeavour Energy with a similar customer base. Given the quantum of the draft replacement capital expenditure decision for Essential Energy is only four per cent more than Endeavour Energy, it is incongruous that both decisions can be correct and shows the risk of accepting the results of the repex model without sense checking against a sound bottom up build.

Essential Energy has a weighted average age above the NEM Benchmark and weighted calibrated asset lives well above the NEM (refer Table 4-10). Further, the Essential Energy network has a high functional failure rate compared to Victorian DNSP's (refer to section 4.6.2). This, coupled with the higher than average mean age of in service assets, high calibrated replacement lives and higher risk network operation, is a result of the historical repex for Essential Energy, which has been lower than others in the NEM.

### 4.2.3 Revised benchmarks

Essential Energy has a large asset base, with a high normalised failure rate and an age profile that is older than many of its peers. Despite this, the quantum of repex that Essential Energy is proposing is lower, by asset, than its peers resulting in comparatively higher risk network outcomes.

Figure 4-4 displays the total repex by distributor versus total kilometres of mains. It shows that Essential Energy spends less repex per kilometre than its peers.

[18] Draft decision Essential Energy distribution determination 2015-16 to 2018-19 Attachment 6: Capital expenditure, AER, November 2014, p.6-10&11
[19] Draft decision Endeavour Energy distribution determination 2015-16 to 2018-19 Attachment 6: Capital expenditure, AER, November 2014, p.6-10&11
[20] Based on historical RIN data (Table 2.2.1), 5 years 2008/09 to 2012/13.
[21] 203/14 - Essential Energy & Endeavour Energy Reset RIN Table 5.2 – Ausnet and Powercor Category Analysis RIN Table 5.2
[22] Essential Energy Investment Case ESS_89 and Endeavour Energy Regulatory Proposal 2015-19, p. 8
[23] REPEX per asset – based on 2009 to 2013 total repex spend and divide by asset count (Poles, OH Cond, UG Cable, TX's, Service Lines, Switchgear )(excluding other categories)
[24] Calibrated life weighted to Essential Energy's asset base quantities. Data from AER Draft decision Essential Energy and Endeavour Energy distribution determination Calibrated Forecast repex models and Nutall Consulting, Report - Aurora Revenue Review, Nov 2011 – Victorian data based on 2004/05 to 2008/09 period

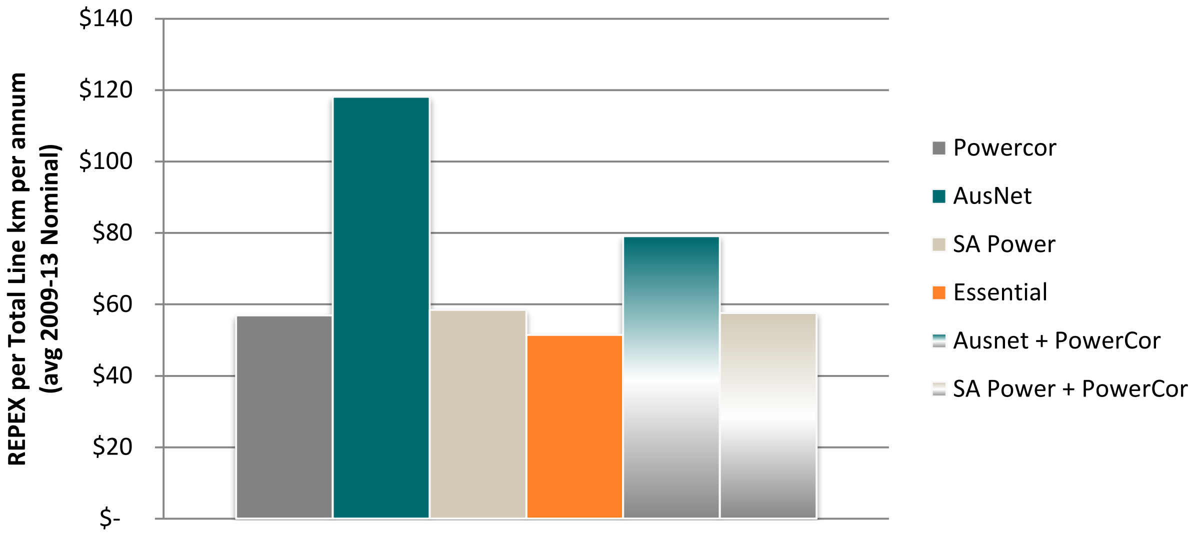


*Figure 4-4: Total repex by distributor versus total kilometres of mains*

Figure 4-5 displays the total repex by distributor versus total poles. It shows that Essential Energy spends less repex per pole than the majority of its peers. SA Power is an outlier due to their use of stobie poles (long life concrete/steel composite) and are therefore not comparable to Essential Energy in regards to poles.

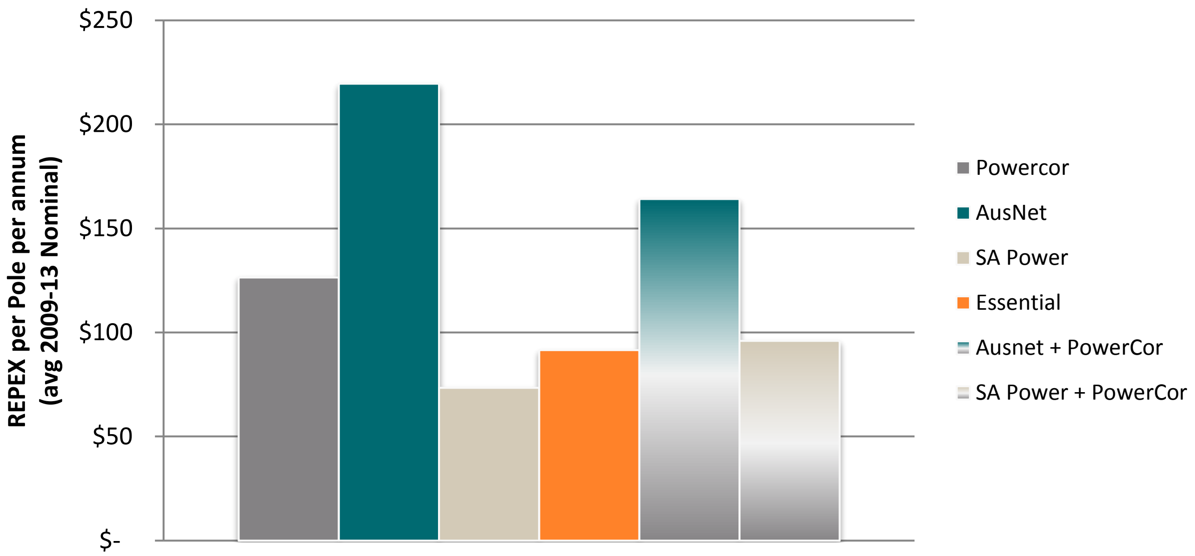


*Figure 4-5: Total repex by distributor versus total poles*

As more dense networks can have more ancillary assets it is reasonable to consider total asset counts and determine the total repex versus total assets normalised to the Essential Energy asset counts. Figure 4-6 displays total asset repex versus total asset counts. It shows that Essential Energy spends less repex per asset than its peers.

 

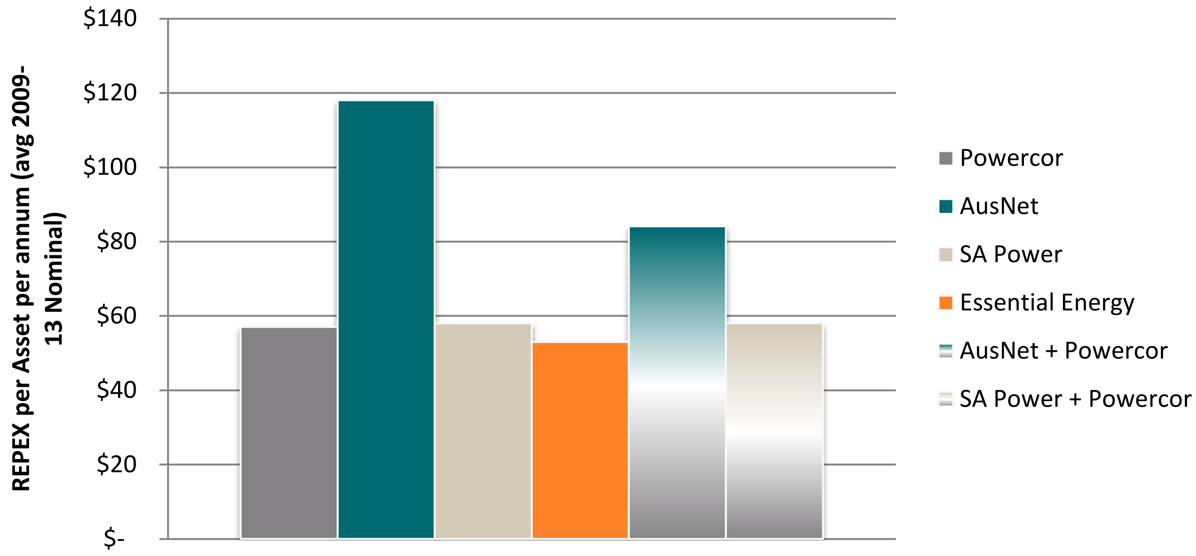


*Figure 4-6: Total repex by distributor versus total asset count*

It can be seen that Essential Energy has the lowest repex spend in the benchmark group when viewed as spend per kilometre of line, spend per pole and spend per asset. Given that repex is required to replace assets, it follows that the most relevant benchmark would be repex per asset.

These benchmarking charts demonstrate that Essential Energy's forecast repex is not higher than its peers as claimed by the AER, when compared on an asset volume basis.

## 4.3 Predictive Modelling

The AER based its forecast amount on the outcome of predictive modelling. In this section we discuss the inherent issues with the model and show that the data on which the model relies contains errors. The predictive model when based on correct data supports the Essential Energy forecast for repex.

### 4.3.1 Use of predictive modelling

*The Draft Decision has made adjustments to the repex based on predictive modelling outcomes*[25].

The use of predictive modelling outcomes in a deterministic way resulted in the Draft Decision providing Essential Energy with the lowest expenditure forecast from the AER determined 'reasonable range', without considering the reasonableness of these expenditure forecasts as applied to Essential Energy's specific asset classes and specific replacement practices. A number of limitations were not considered by the AER when using the Repex Model to provide ranges of valid reasonable expenditure.

Essential Energy agrees that predictive modelling is a reasonable high level method to identify the reasonable envelope of required repex; however, when determining the level of repex, the AER needs to consider:

> The repex requested by Essential Energy in the SRP is well within the bounds of reasonable given the accuracy of the Repex Model.

> Essential Energy's low historical repex spend results in the understating of a prudent repex level when modelled by the Repex Model.

[25] Draft decision Essential Energy distribution determination 2015-16 to 2018-19 Overview, *AER, November 2014, section 8.6.3, p.50*

- The reasonableness of repex forecasts produced; when applied to Essential Energy's specific asset classes, which appears intuitively unreasonable when compared to Endeavour Energy's Draft Decision.
- The inability of the Repex Model to respond to changes in assessed levels of risk or small periods of conditional replacement of specific equipment (e.g. type failures).
- The sensitivity of modelled outputs to a valid range of inputs.
- Calibrated lives are directly determined from the 2008/09 to 2013/14 regulatory control period's replacement volumes, directly related to a DNSP risk profile over that period.
- Calibrated lives are reflective of historic inspection practices; introduction of a sophisticated AP&A inspection program is therefore not considered within the forecast.
- Deterministic use of high level tools may lead to erroneous outcomes.

Essential Energy has specific issues with the use of the Repex Model in a deterministic way as:

- It does not account for changes in risk for the forthcoming regulatory control period and therefore needs to be used in conjunction with a detailed technical review.
- Without a detailed technical review it is not possible to demonstrate that the Repex Model provides a reasonable substitute forecast; where its results differ from a DNSP's proposal.

Due to the process of calibrating the Repex Model to a DNSP's historic expenditure it is implied that asset condition and business risks over the 2008/09 to 2013/14 regulatory control period will not be materially different from the 2014/15 to 2018/19 regulatory control period. Therefore the Repex Model is not capable of assessing the prudency of any programmes that are not part of a DNSP's historic asset replacement quantities. This has resulted in an unreasonable assessment of a number of programmes that are not part of Essential Energy's historic asset replacement quantities and therefore not appropriately considered by the Repex Model and as such require specific review; these programmes are outlined in section 4.5 and should be technically reviewed by the AER and considered on merit.

### 4.3.2 Specific Issues with Modelled Repex

Essential Energy has identified specific issues with the modelled repex as presented by the Draft Decision:

- In the Reset RIN, Essential Energy completed table 5.2.1 for service lines on the basis of route length (kilometres). An inapplicable forecast replacement cost has been applied to the Repex Models forecast replacement quantity which has resulted in an understatement of service lines repex in the Repex Model.
- The AER has applied the low voltage timber pole staking rate of Ausgrid to the timber pole population of Essential Energy with no regard to the differences in the serviceability criteria between the two DNSPs which are vastly different. This has resulted in a significant understatement of the required repex in the Repex Model.
- The switchgear repex has been understated due to a data error that has been identified in the historical replacements fields of the RIN. As indicated in the Basis of Preparation (BoP), the historical replacement data for fuses has been based on a count of completed WASP work tasks "*Fuse – Replace Fuse"* and "*Fuse – EDO Fuse Programmed Replacement*".

Together these issues understate the required repex by $99M as shown in Table 4-2.

*Table 4-2: Critical issues impacting the repex allocated in the Draft Decision*

| Issue | Description | Reasoning | Adjustment | Section |
|---|---|---|---|---|
| Services | Incorrect replacement cost implemented in Repex Model | Route length (km) for service line asset volume applied to unit rate per service | Net $39M | 4.3.2.1 |
| Pole Staking | Revert to substantive regulatory proposal ratio of timber pole replacement and staking | Substituting part of a pole strategy of one DNSP into another's strategy where they have vastly different serviceability criteria is poor engineering practice and fundamentally flawed | Net $49M | 4.3.2.2 |
| Switchgear | Switchgear data error in RIN made by Essential Energy | The omitted data affects the calibration of the Repex Model and the forecast repex allowance | Net $11M | 4.3.2.3 |

#### 4.3.2.1 Overhead Service Mains

The service mains repex has been understated because the forecast service replacement cost by number of service connections has been applied to the route length, rather than the population of services.

The AER has used their Repex Model to estimate the forecast repex for service lines. The repex allocated for service lines is grossly understated due to a misinterpretation of the data provided by Essential Energy in the Reset RIN. Essential Energy seeks to clarify the misinterpretation and requests the AER reconsider the allocated repex for service lines.

When modelling the service lines category, the AER has modelled the total line kilometres of service mains in the Reset RIN as if it were the total number of services. Essential Energy seeks to clarify the data provided in the Reset RIN.

> As shown in in Table 2.2.1 of the Reset RIN (repex tab), the asset replacement and asset failure data for service lines has been entered in unit quantities. For example, Essential Energy has proposed a total forecast replacement of 42,000 services over the 2014-19 regulatory control period.

> In Table 5.2.1 of the Reset RIN (Asset Age Profile tab), the historical age data has been entered in kilometres. For example, the total length of service lines installed in the network is 16,418 kilometres.

When calculating the forecast repex, the Repex Model applies a per service unit cost to the population recorded in kilometres. In order to correctly determine the forecast repex, a unit cost calculated per kilometre is required.

Considering this information, if the AER models the service lines category using an appropriate unit cost per kilometre, the total repex allowance for the 2014/15 to 2018/19 regulatory control period would be $40.253M rather than the current allocation of $0.848M.

Essential Energy has an estimated 16,418 kilometres of service lines and 779,701 service line connections. The average service length can therefore be calculated as 21.06m. Using this average service length, an appropriate forecast unit cost per kilometre can be calculated as shown in Table 4-3: Forecast Unit Costs (2013/14)Table 4-3.

*Table 4-3: Forecast Unit Costs (2013/14)*

| | Unit Cost (per service) | Unit Cost (per kilometre[26]) |
|---|---|---|
| < = 11 KV ; RESIDENTIAL ; SIMPLE TYPE | $772 | $36,657 |
| < = 11 KV ; COMMERCIAL & INDUSTRIAL ; SIMPLE TYPE | $926 | $43,970 |
| < = 11 KV ; RESIDENTIAL ; COMPLEX TYPE | $772 | $36,657 |

Essential Energy also seeks to clarify a concern raised by the AER on page 58 of Attachment 6: Capital Expenditure document. This concern relates to the asset age profile for service lines (Figure A-16). The graph illustrates the age profile weighted by replacement cost and includes the average forecast repex for the service lines category. The AER conclude that:

> *For service lines … the value of Essential Energy's assets in commission for any given year is, for the most part, below the average annual forecast of repex for the 2014-19 period. (ref p 6-58, Attachment 6: Capital Expenditure).*

As previously identified, the AER has misunderstood the Reset RIN data provided by Essential Energy and has used an inappropriate unit cost to determine the forecast repex. Figure 4-7 illustrates the asset age profile weighted by the correct unit costs proposed in Table 4-3

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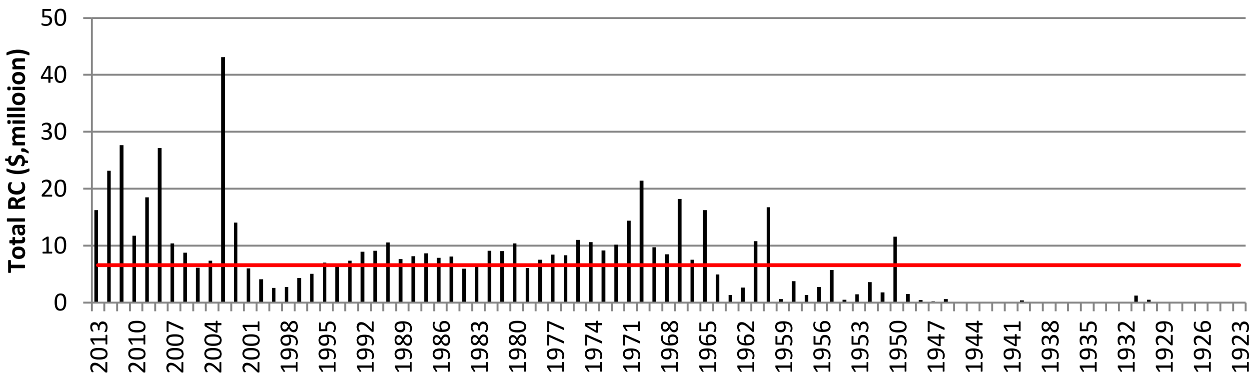


*Figure 4-7: Asset age profile - Service line (weighted by correct unit cost)*

As shown in the graph, the value of Essential Energy's assets in commission for any given year is typically above the average annual forecast repex for the 2014-19 period. Essential Energy requests the AER address the error in the modelling and provide an updated allowance for service line repex.

#### 4.3.2.2 Pole Staking

The pole replacement and staking repex has been understated because the low voltage timber pole staking rate of Ausgrid has been applied by the AER to the timber pole population of Essential Energy with no regard to the differences in the serviceability criteria of the two DNSPs, which are vastly different.

In determining the level of forecast expenditure required for Essential Energy to maintain its pole assets the AER made a substitution within Essential Energy's pole serviceability criteria. Ausgrid's LV pole staking rate of 47 per cent was substituted for Essential Energy's already revised and increased forecast pole staking rate of 18 per cent. Section 8.2 in APPENDIX D – Pole Asset Strategy and Serviceability criteria covers in detail the lack of engineering basis for such a substitution without adoption of the associated serviceability

[26] Calculated from data provided in the Essential Energy Reset RIN

criteria. As a result Essential Energy contends that the Repex Models unit rates should be 'blended'[27] to include Essential Energy's proposed staking rate of 18 per cent; resulting in an increase in the base 'reasonable' expenditure range of $49.228M.

At a high level the timber pole serviceability criteria for Ausgrid and Essential Energy are compared in Table 4-4. The circumstance used is for the most common Essential Energy pole being an unsupported in line "pin" pole.

*Table 4-4: Comparison of pole serviceability criteria[28]*

| Ausgrid[29] | | Essential Energy | |
|---|---|---|---|
| Average wall thickness | <70mm | Minimum wall thickness | <25mm |
| or Standard Safety Factor | <2 | or Detailed Safety Factor | <2 |
| Treatment | Assess for staking or replacement | Treatment | Assess for staking or replacement |
| Annualised replacement rate | 53% | Annualised replacement rate | 82% |
| Annualised staking rate | 47% | Annualised staking rate | 18% |

Ausgrid use a "standard safety factor" calculation which is determined by reduction in circumference and/or internal defect based on the nominal dimensions of the pole (this assumes that the pole is fully loaded which it very rarely is) whereas Essential Energy use a "detailed safety factor" calculation which uses the same dimensions but assesses the actual pole tip load which results in a far less conservative outcome, effectively working the pole harder and longer.

Essential Energy has reviewed in some detail the differences in the Serviceability Criteria and pole management strategy between the two DNSPs as detailed in APPENDIX D – Pole Asset Strategy and Serviceability criteria. This investigation shows that adopting the Ausgrid strategy on the Essential Energy pole population would approximately double replacement costs (refer to Table 8-4, Ausgrid's strategy applied to Essential Energy would cost $607.79M). Essential Energy does not consider adopting the Ausgrid pole management strategy efficient or prudent for Essential Energy's pole population and environmental circumstances.

Essential Energy engaged the services of Nathan Spencer of URI Engineering[30] to review the AER Draft Decision that suggests adoption of Ausgrid's staking rate of 47 per cent for Low Voltage Timber poles for all Essential Energy's timber poles . Mr Spencer is a recognised industry expert of some standing, and highly respected researcher with regard to timber poles. Essential Energy has attached at APPENDIX E – Review of AER's Draft Decision on EE's 2015 – 2019 Pole REPEX: URI Engineering, Jan 2015, Mr Spencer's report. The conclusions of his report can be summarised in the following statement:

> *The application of Ausgrid's pole reinforcement percentage to Essential Energy's network is the only material method used to reduce the Repex allowance. In our opinion this is grossly reckless from a risk and long term financial perspective and lacks appropriate understanding of the different asset management conditions – and in particular the differences in the pole serviceability criteria – between the two companies.*[31]

[27] 'blending' as define in attachment 6, section F.6.2 – Essential Energy Draft Decision 2015/16 to 2018/19.
[28] Essential Energy is not criticising Ausgrid or any other utilities serviceability criteria. The selection of serviceability criteria is a complex activity intrinsically linked to risk and consequence. Essential Energy operates a geographically disperse network with low customer density. The risk / consequence for pole failure in Essential Energy is thus different to a CBD utility with high customer density and proximity to assets.
[29] NS145 Pole Inspection and Treatment Procedures: Ausgrid ,June 2011
[30] Nathan Spencer, BE(Civil), CPEng, NPER, RPEQ
[31] Review of AER's Draft Decision on EE's 2015 – 2019 Pole Repex: URI Engineering, Jan 2015

 

Essential Energy has determined that the calculation basis for the Draft Decision in regard to poles applied by the AER has assumptions that materially affect the outcomes. In regards to poles there are two issues of concern:

- The AER has applied the Ausgrid LV pole staking rate of 47 per cent to Essential Energy's pole replacement population. It is not possible to mix and match reinforcement rates across DNSPs without using the associated serviceability criteria. As demonstrated in Table 8-4 application of the Ausgrid serviceability criteria in Essential Energy carries significant cost implications (approximately $607M over the regulatory period).

- There has been a misinterpretation of the data supplied in the Reset RIN by the AER and subsequently applied by the AER in the Repex Model. In the Reset RIN Asset category the line item "STAKING OF A WOODEN POLE" was filled out by Essential Energy with the number of poles it intends to reinforce in the regulatory period. Essential Energy has determined that the AER has interpreted this line item as the number of reinforced poles Essential Energy intends to replace.

Essential Energy has adjusted for what Essential Energy believes is an unreasonable substitution of serviceability criteria. As such, the pole replacement expenditure has been reforecast with unit costs based on a staking rate consistent with the rest of Essential Energy's serviceability criteria, 18 per cent.

#### 4.3.2.3 Switchgear Replacement Programmes

The switchgear repex has been understated due to a data error that has been identified in the historical replacements fields of the RIN. As indicated in the Basis of Preparation (BoP), the historical replacement data for fuses has been based on a count of completed WASP work tasks "*Fuse – Replace Fuse"* and "*Fuse – EDO Fuse Programmed Replacement*".

Essential Energy has identified that it had erroneously overlooked including the *"Substation – Programmed Refurbishment"* work task which involves replacing fuses as part of the substation refurbishment programme. As this programme accounts for a large volume of historical fuse replacements (over 8,300 units), Essential Energy seeks to be transparent with the AER and outline this error.

An amended RIN table 2.2.1[32] has been included which has been updated with the correct historical replacement data for fuses. This data affects how the AER have calibrated the replacement lives for fuses in their Repex Model. Accounting for this change in data, the calibrated lives have been recalculated in Table 4-5 as per the method Essential Energy believes is used by the AER. [33]

***Table 4-5: Calibrated lives of switchgear assets***

| | Draft Decision Calibrated Lives | Amended Calibrated Lives |
|---|---|---|
| < = 11 KV ;  FUSE | 68.2 | 63.7 |
| OTHER - > 11 KV & < = 22 KV  ; FUSE | 61.6 | 56.9 |
| OTHER - > 22 KV & < = 33 KV ; FUSE | 51.9 | 48.6 |
| OTHER - > 33 KV & < = 66 KV ; FUSE | 57.7 | 56.0 |

The alteration in calibrated replacement lives affects the Repex Model forecast expenditure. The end result is that the calibrated/forecast Repex Model used to forecast the bottom of Essential Energy's 'reasonable

[32] Amended Repex RIN information as submitted to the AER on 8th January 2015
[33] The amended calibrated lives have been calculated as per the method Essential Energy believes is used by the AER. Using the average replacement quantity from the 2008/09 to 2013/14 regulatory control period to calibrate the lives initially and then increasing these average replacement quantities for three years of growth based on the forecast first year percentage growth. The model is then recalibrated using these revised replacement quantities to produce amended calibrated lives.

range', forecasts a total of $114.97M for switchgear. This is a net increase of $11.01M above the current allocated expenditure.

### 4.3.3 Revised model outcomes

#### 4.3.3.1 Reasonable Expenditure Range

Essential Energy has recalculated the AER's reasonable range for repex, adjusting for the issues of Overhead Services, Pole Staking and Switchgear Replacement as set out in section 4.3.2.

Essential Energy's proposed 'modelled' repex falls within the revised reasonable range, as shown in Figure 4-8.

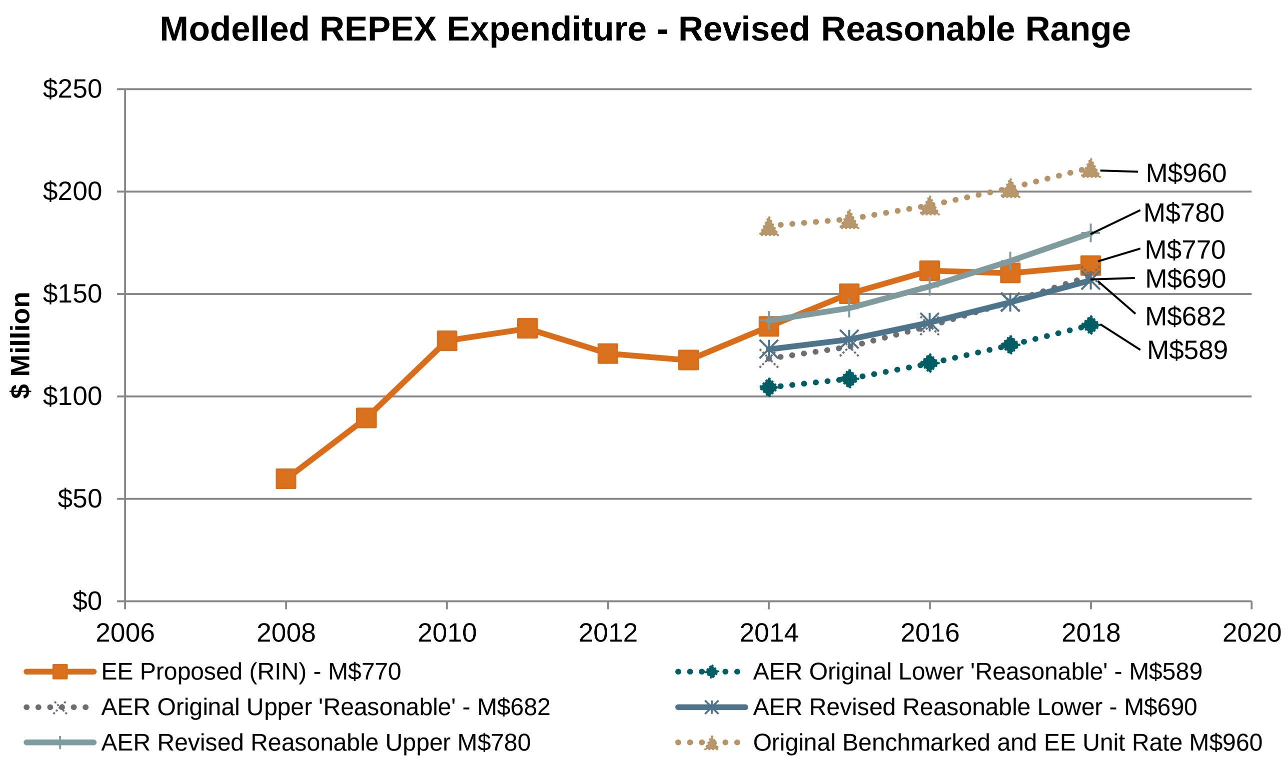


*Figure 4-8: Revised reasonable range*[34]

Figure 4-8 shows the revised 'reasonable range' proposed by Essential Energy. This range considers the AER's 'reasonable range' as the base build, adjusting for misinterpretations in data and rectifying unsupported assumptions about Essential Energy's replacement practices. It is clear that Essential Energy's forecast modelled repex ($770M) fits within the revised 'reasonable range'.

The dotted lines represent the Draft Decision forecast expenditure, while the solid lines represent the same expenditure calculation methodology corrected for identified material errors. The highest expenditure scenario at $960M represents the benchmarked NEM calibrated asset lifetimes and Essential Energy unit rates; this scenario is deemed outside the 'reasonable' range by the AER and highlights the variability of the model to a reasonable range of inputs.

[34] Calibrated ages taken from AER published Repex Models. Any adjustments are as per section 3.3.7

#### 4.3.3.2 Repex Model outcomes compared to other DNSPs

Essential Energy's proposed repex benchmarks favourably against the repex required for other NEM DNSPs to manage Essential Energy's asset base.

Essential Energy's calibrated mean life[35] provides the second lowest forecast expenditure in the NEM for the management of Essential Energy's asset base, as shown in Figure 4-9. Using the AER's Repex Model for the age profile of Essential Energy's assets the level of repex over the calibration period and forecast period has been below and will continue to be below the level of investment that the majority of NEM DNSPs (excluding CitiPower) would require to manage Essentials Energy's network within their currently accepted risk profile.

Figure 4-9 compares only Essential Energy with networks that are operating at what the AER would define as the most efficient performers or 'frontier' DNSPs. The city based NSW DNSPs[36] are excluded from Figure 4-9 as outliers and are shown in Figure 4-10 for completeness.

Step-changes in expenditure for some expenditure trends in Figure 4-10 indicate that when using another DNSP's calibrated asset life, a significant portion of the assets have survived to an older age than that DNSP would expect, based on the past replacement by that DNSP. This highlights the high average age of a number of Essential Energy's asset categories relative to other DNSPs.

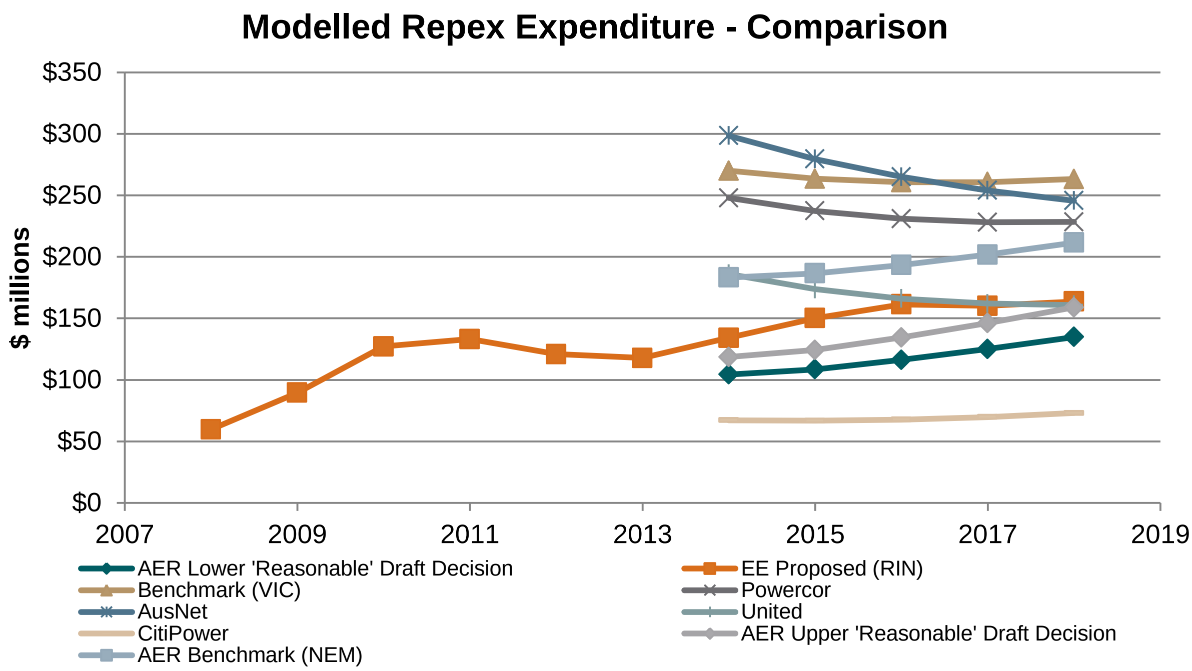


*Figure 4-9: Modelled repex using Essential Energy's forecast unit costs[37]*

[35] These lives provided are based on historic replacement volumes
[36] Note that these outliers are included as indicators only as network topology plays a role in determining replacement expenditure requirements and as such does not allow for direct comparison. It is preferable to compare between networks of a similar topology that cover a similar geographical area.
[37] Service lines have been excluded to allow uncorrected comparison. Where detailed calibrated mean lives were not available, published category calibrated lives were used (from p.120 Aurora Electricity Distribution Revenue Review – Nuttell Consulting)

 

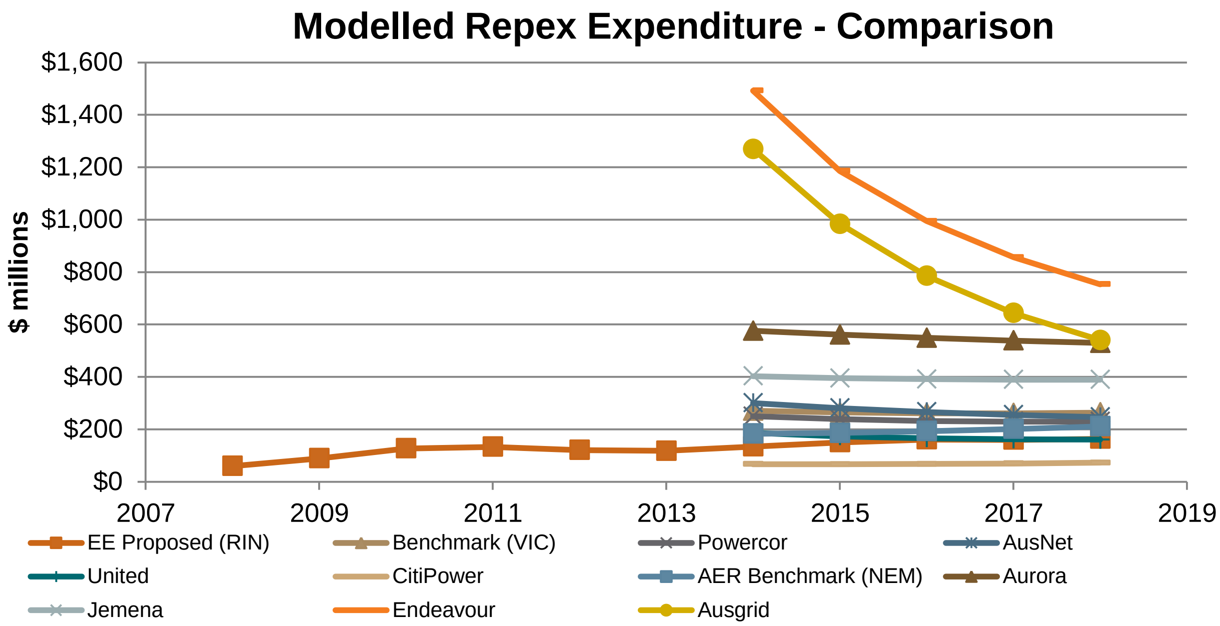


*Figure 4-10: All modelled repex using Essential Energy's forecast unit costs[38]*

## 4.4 Further discussion on use of Repex Model

### 4.4.1 Historic and Forecast Repex Benchmark

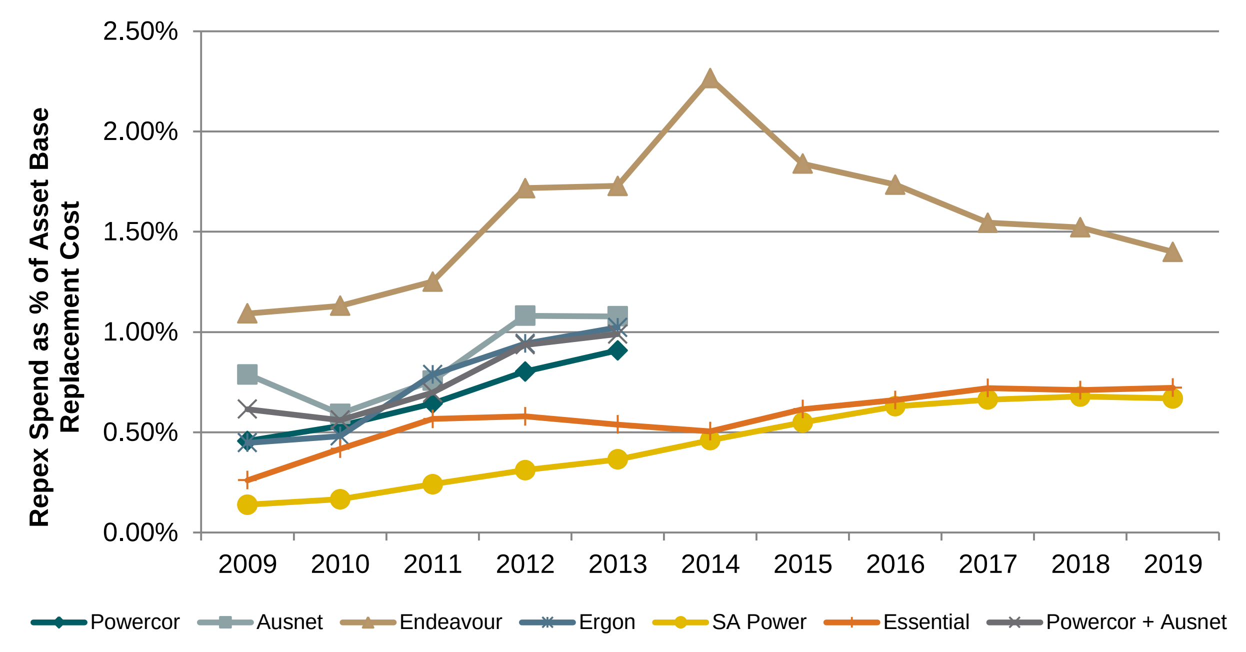


*Figure 4-11: Repex spend by asset base replacement cost[39,40]*

[38] Service lines have been excluded to allow uncorrected comparison. Where detailed calibrated mean lives were not available, published category calibrated lives were used (from p.120 Aurora Electricity Distribution Revenue Review – Nuttell Consulting)

[39] Replacement costs determined using; RIN asset quantities and the AER's NEM Benchmarked unit costs - categories included Poles, OH Conductor, UG Cable, Services, Transformers, Switchgear (including categories added by DNSP's under these headings) – where a benchmarked unit cost does not apply to DNSP listed category the DNSP's calculated (historic) unit cost is used

[40] Annual Repex spend determined using: RIN table 2.2.1 - Poles, OH Conductors, UG Cables, Service Lines, Transformers, Switchgear and Other (DNSP listed Other – this category is mostly used by Ausgrid and Endeavour)

Figure 4-11 provides a benchmark of repex spend normalised by asset replacement cost of each DNSP; this is used due to the strong correlation between asset quantities and replacement expenditure demand. Each DNSP's asset quantities are applied to the AER's provided NEM benchmarked unit costs to provide an asset base replacement cost.

Additionally Figure 4-11 highlights that Essential Energy's historic and proposed replacement expenditure benchmarks favourably across the NEM. It also shows that Essential Energy's proposed repex expenditure appears to be forecast at a reasonable level to address the emerging replacement expenditure demand; driven by an asset base with an already high and increasing average age. This is further apparent when compared to SA Power Networks, which has been used as an example of efficient levels of expenditure by the AER, proposed expenditure in Figure 4-11. It is evident SA Power Network has been at the bottom of an investment cycle and is proposing to lift expenditure from a period of under investment.[41] In their most recent regulatory proposal they indicate the need for a substantial increase in asset replacement works. This circumstance is not unlike the need for Essential Energy:

> *As approved by the AER, SA Power Networks has significantly increased asset inspection activities during the current RCP. These inspections have confirmed that a substantial increase in asset replacement works must be undertaken over the next 5–15 years if we are to appropriately manage the increasing level of network risk. To quantify the asset replacement work for the next RCP, we have used a range of methods including condition based risk management (CBRM) modelling*[42]

The AER should consider Essential Energy's low historic level of repex when determining whether or not the forecasts provided by the Repex Model represent a valid 'reasonable range' for prudently managing an aging asset base.

### 4.4.2 Comparison of Repex Proposals

Essential Energy's repex forecast as proposed in the Draft Decision is intuitively unreasonable when compared to Endeavour Energy. Essential Energy's proposed normalised repex expenditure is significantly lower compared to the remaining NSW DNSPs, as shown in Figure 4-12. Each NSW DNSP has a different network topology, risk appetite and operating circumstances. However, given that the level of repex proposed by Essential Energy is lower than its NSW peers, it is unreasonable to use the lowest 'reasonable' amount forecast by the Repex Model, as used by the AER in forming their Draft Decision.

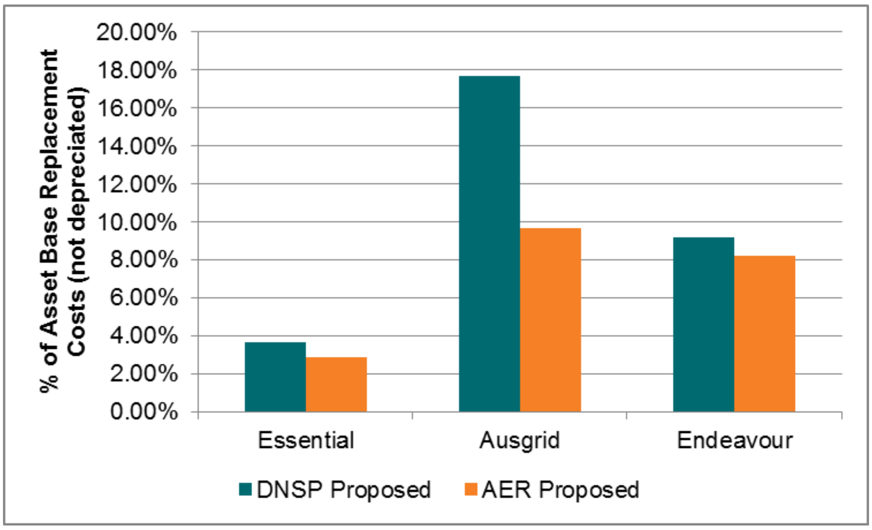


*Figure 4-12: Proposed and Draft decision five year repex as per cent of modelled repex replacement cost*[43]

[41] SA Power Networks Regulatory Proposal 2015–2020 - Page 187
[42] SA Power Networks – Regulatory Proposal 2015-2020 – Page 21
[43] Replacement Costs taken from AER published REPEX models – using each DNSP's forecast unit rates

There are inconsistencies resulting from using the Repex Model output directly to determine the repex allowance. Endeavour Energy has not been provided with a 'reasonable range' of repex, rather they have been provided with one specific value deemed to be reasonable, as shown in Table 4-6. It appears that this has resulted from the fact that the lowest outcome of the 'reasonable range' for Endeavour's modelled repex being above that proposed by Endeavour. This compares very differently with the other two DNSPs and further suggests that rather than utilising the outputs of the Repex Model as an indicator of prudent expenditure it has been used directly to determine the level of expenditure without a due diligence review of inputs that set the level of expenditure forecast. These discrepancies highlight the importance of reviewing the reasonableness of the Repex Model inputs, specifically the level of historic repex relative to the level expected of a prudent operator, when determining the reasonableness of Repex Model's output.

When considering the Draft Decision's expenditure for both Endeavour Energy and Essential Energy it appears counter intuitive that similar expenditures are reasonable; when the age and scale of both networks are considered, refer toTable 4-1. If for no other reason, this should cast material doubt over the mechanistic use by the AER of the Repex Model in their Draft Decision for Essential Energy.

*Table 4-6: NSW determination repex*[44]

| All expenditure – ($ millions) | Essential Energy | Ausgrid | Endeavour Energy |
|---|---|---|---|
| Replacement Costs[45] (modelled repex Replacement Costs not depreciated) | 23,392.10 | 18,245.40 | 8,027.30 |
| DNSP Proposed (all repex) (ex overheads) | 856 | 3,226 | 738.7 |
| DNSP Proposed % Replacement Cost (all repex) (ex overheads) | 3.66% | 17.68% | 9.20% |
| DNSP Proposed (un-modelled repex) (ex overheads) | 86 | 459[46] | 223.7 |
| DNSP Proposed (modelled repex) (ex overheads) | 770 | 2,600[46] | 515 |
| % Reduction (modelled repex) | 23.51% | 45.04% | -0.78% |
| AER Proposed (un-modelled repex) (ex overheads) | 86 | 339 | 142 |
| AER Proposed (all repex) (ex overheads) | 675 | 1,769 | 661 |
| AER Proposed % Replacement Cost (all repex) | 2.89% | 9.70% | 8.23% |
| AER Proposed (modelled repex only) (ex overheads) | 589 | 1,429 | 519 |
| AER 'Reasonable Range' (modelled repex) (ex overheads) Upper | 682 | 1430 | 519 |
| AER 'Reasonable Range' (modelled repex) (ex overheads) Lower | 590 | 1360 | 519 |

### 4.4.3 Sensitivity Analysis of the Repex Model

As outlined above, the AER has used the Repex Model to provide a valid range of replacement expenditure. This equates to 90 per cent of proposed replacement expenditure. This modelling is undertaken through several scenarios, each of which is developed from varying one of the two key input variables:

> Asset life

> Replacement unit costs.

By varying the asset lives and unit costs, the AER has produced scenarios that range from 1,146 per cent above, to 51.4 per cent below the allocated repex in the Draft Decision. As such it is clear that the outputs of the Repex Model are highly sensitive to the input data, and can often produce outputs that are unreasonable for a given reasonable range of inputs. Essential Energy contends that this makes it inappropriate for the

[44] Data taken from AER provided REPEX models and draft decision without adjustment for any identified errors
[45] Replacement Costs taken from AER published REPEX models – using each DNSP's forecast unit rates
[46] Note – appears to be $167M missing from Ausgrid's complete proposal and what was assessed as part of the REPEX model and what was assessed as un-modelled replacement expenditure.

Repex Model to be used directly as a replacement forecast for a DNSP's expenditure. Its use therefore should be limited to providing a guide as to where the reasonable range of expenditure may lie.

Figure 4-13 and Figure 4-14 highlight the variability of the model to changes in model inputs and calibration. Figure 4-13 shows the effect small changes in the calibrated lives has on the replacement expenditure forecast. The chart is centred on the weighted calibrated life of 70.3 years and demonstrates that for a change as small as 5 per cent in calibrated life has an impact of $279.7M or 47.43 per cent on forecast expenditure. The AER should consider the accuracy of the applied calibrated ages when using the Repex Model deterministically as a substitute forecast. As it is clear that small and reasonable variations within the margin of error for the data used in calculating the calibrated lives, have a significant impact on the expenditure forecast using the Repex Model.

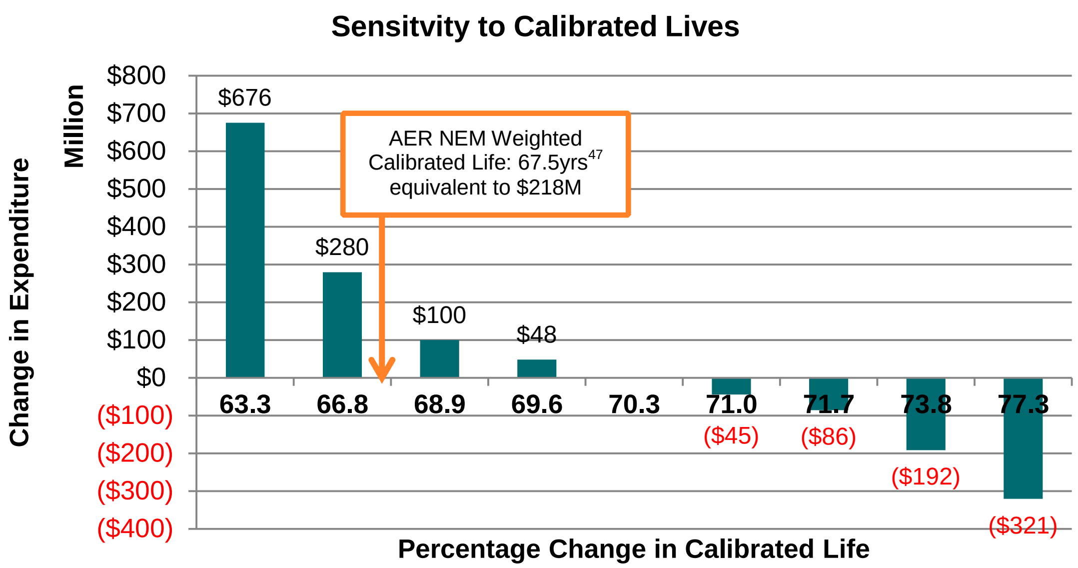


*Figure 4-13 - Repex Model sensitivity to calibrated lives*[47]

Figure 4-14 presents the forecast expenditure results for the application of a number of DNSP's calibrated lives to Essential Energy's asset base; this provides further evidence of the significant variation in expenditure forecasts that result from the application of reasonable inputs. Although Essential Energy recognises the application of one DNSP's calibrated life is not directly applicable to another DNSP calibrated lives; it is relevant to inform of the estimated scale of investment required between varying asset management practices and network environments. The AER should consider that Essential Energy's SRP appears reasonable within context of the calibrated lives used to produce the forecasts in Figure 4-14.

[47] See Table 4-9: Weighted average asset age and calibrated life

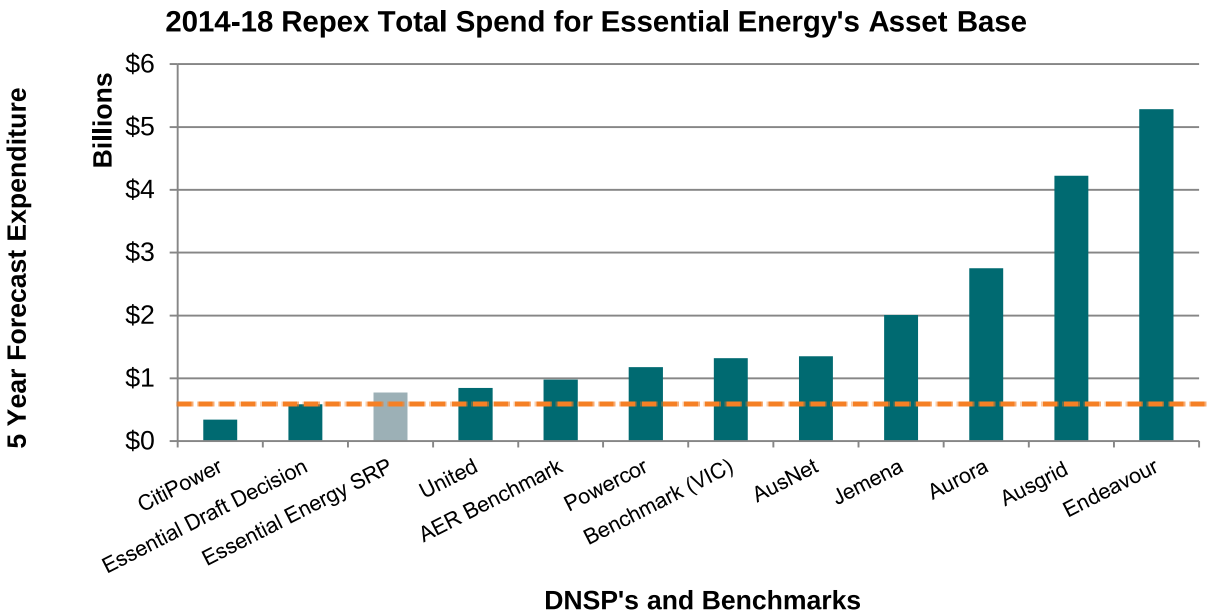


*Figure 4-14 - Repex forecasts based on NEM DNSP calibrated lives*

The AER should consider the key points raised above along with specifically identified variations; as these significant differences in observed outputs produced by the Repex Model indicate that in isolation it is not a reliable forecasting tool. Therefore should not be directly used as the method of setting capital expenditure consistent with clause 6.5.7 of the NER as it does not accurately reflect the efficient costs of achieving or provide a realistic expectation of the costs of inputs required to achieve the capex objectives.

In summary:

> It is clear from the AER's produced scenarios that range from 1,146 per cent above, to 51.4 per cent below the allocated repex in the Draft Decision that the Repex Model is highly sensitive to the input data.

> The Repex Model is highly dependent on calibrated life; with the 2.8 years older calibrated lives of Essential Energy compared to the NEM weighted average resulting in $218M less replacement expenditure for Essential Energy.

> The AER should consider Essential Energy's low historic level of repex when determining whether or not the forecasts provided by the Repex Model represent a valid 'reasonable range' for prudently managing an aging asset base.

> Essential Energy found material misinterpretation in the use of data in the Repex Model, specifically in the way the service line expenditure was forecast. This raises concerns with the reasonableness of the expenditure forecast provided, when such a large underinvestment in a safety critical asset category is not identified in a sense check of the model outputs.

#### 4.4.3.1 Deterministic use of Predictive Modelling

The AER has used predictive modelling as the primary tool in assessing repex expenditure. It is not clear to what extent, if at all, the AER has considered additional information sources of assessment. This does not align with the Expenditure Forecast Assessment Guide, and results in an unreasonable repex allowance.

Essential Energy accepts that the use of a top down model as part of the assessment of the proposed level of DNSP expenditure is reasonable; however the method in which The Repex Model has been applied by the AER in this determination is unreasonable and is not in line with the comments made as part of the Expenditure Forecast Assessment Guide. As was made clear prior to the determination in response to the draft expenditure forecast assessment guidelines, *"We consider that the deterministic use of high level tools may lead to erroneous outcomes, with a DNSP not being provided sufficient allowances to maintain the safety, security of the network and to meet its regulatory obligations."*[48] It is clear from the revised level of repex that the predictive modelling has been used as the foremost tool in determining the level of repex.

Of even greater concern is the lack of scope of the Technical Review of the SRP, which included only three general areas, whether Essential Energy's:

> forecast is reasonable and unbiased;

> costs and work practices are prudent and efficient; and

> risk management is prudent and efficient.

This process of reviews is not consistent with a number of previous statements by the AER and supportive submissions to the AER. The AER stated *"we will use The Repex Model as a first pass model in future determinations, in combination with other assessment techniques. Initially we will likely review proposed repex forecasts for all asset categories in detail."*[49] Further the AER quoted a supporter of top down modelling the MEU (Major Energy Users Group) *"Major energy users are strongly supportive of the use of predictive models …… (however) recognising the inherent risks of using such models as definitive tools for setting allowances."*[50] As such Essential Energy believes its SRP has not been appropriately considered, nor has it been demonstrated that in keeping with the proposed assessment techniques that the AER has used the Repex Model as simply a tool to inform of the asset categories that require in depth review. Contrary, it appears to have been unreasonably used as the primary tool in assessing and setting repex expenditure.

### 4.5 Unmodelled repex

The step change programmes included in the Substantive Regulatory Proposal have not been considered in the AER's reforecast repex.  It is Essential Energy's view that the step change programmes have not been granted the due technical review by the AER as required.

Essential Energy has proposed several risk based replacement programmes that have either had a step change in expenditure or have previously not existed. These repex programmes have either had no history of replacements or have had historically low levels of replacement. It is Essential Energy's view that the step change programmes have not been granted due to lack of technical review by the AER as required. On that basis Essential Energy restates the case for these programmes and refers the AER to other utilities that have programmes of a similar or identical nature which have been granted funding commensurate with the programme by the AER.

The primary drivers for the change in repex are either a change in risk associated with the asset or an increase in failure experience. Essential Energy has determined that the Repex Model assessment approach and calibration does not accommodate for programmes that incur a step change in expenditure. These programmes should be considered on technical review given the fact that the Repex Model will understate the required expenditure for step change programmes.

The replacement programmes with step changes are detailed in Table 4-7.

[48] NSW DNSP's joint submission on AER draft expenditure forecast assessment guidelines - 20 September 2013
[49] Better Regulation Explanatory Statement Expenditure Forecast Assessment Guideline, AER, November 2013, p. 189
[50] Major Energy Users, AER better regulation program – proposed guidelines for expenditure assessment – MEU comments on draft guidelines, 20 September 2013, p. 17.

*Table 4-7: Step change programmes*

| Project | Description | Repex ($M 2013/14) |
|---|---|---|
| ESS_43_S – LV UG Cable Replacement (CONSAC) | The low voltage CONSAC cable replacement programme is required due to the electrical safety risks associated with premature failure of this underground cable installation. Faults are occurring at joint locations, terminations and on the neutral screen conductor. The programme is not inconsistent with that applied in other DNSPs and subsequently approved by the AER. | $18.89M |
| ESS_2009 – Utility Blackspot Programme | This programme has been developed to address the frequency of vehicles colliding with power poles on sides of roadways. It is a collaborative effort with the NSW Centre for Road Safety and the NSW State Government to curb the road toll and trauma associated with pole crashes. | $7.75M |
| ESS_4009 – Subtransmission Polymer Termination Replacement | This programme is to carry out planned replacement of specific sub-transmission polymer underground cable terminations with known and unacceptable failure history. | $0.82M |
| ESS_33_S – LV Protection Programme Forecast Far West | This programme is designed to address the operational risk posed by a legacy LV protection practice that saw the installation of a number of distribution substation sites without LV fusing. | $2.04M |
| ESS_65_S – Broken Hill Asset Refurbishment | This programme involves refurbishing the standby generators at Broken Hill. The Broken Hill region is supplied by a radial 220kV overhead line. These generators provide N-1 redundancy for this network. The generators are the only alternate source of supply in the event of an outage on the 220kV X2 line between Broken Hill and Buronga which has a history of failures and extended restoration times of up to 5 days. | $1.40M |
| | Total | $30.90M |

## 4.6 Factual inaccuracies

In support of its decision to reduce repex, the AER has relied on a technical review by EMCa and other information. Many of the statements made are general in nature and are misleading or incorrect when applied to Essential Energy. In this section, the inaccuracies are discussed so as to provide assistance to the AER in understanding our proposal.

### 4.6.1 Utilisation affects asset deterioration

*The Draft Decision states that reduced asset utilisation should result in a longer asset life and reduce the cost of an in-service failure allowing a deferral for the efficient timing of asset replacement.*[51]

Poles, pole top structures, overhead conductors, underground cables, service lines, switchgear and SCADA which account for 89 per cent of the repex are not impacted by utilisation. The utilisation level of other assets including transformers is low, and as such any further decrease in utilisation will have a minimal impact on the deterioration rates.

[51] Draft decision Essential Energy distribution determination 2015-16 to 2018-19 Attachment 6: Capital expenditure, AER, November 2014, p 6-59

In a practical sense the cause of conditional failure modes that drive the need for the largest component of refurbishment are moisture ingress, corrosion, timber rot, termite activity and mechanical wear and failure. The utilisation of assets from an electrical capacity perspective is not related in any way to these inherent asset degradation mechanisms.

The split between assets not affected or immeasurably affected by utilisation and that affected marginally by utilisation is shown in Table 4-8.

*Table 4-8: Repex per asset category ($000 2013/14)*

| Asset Category | 2014/15 | 2015/16 | 2016/17 | 2017/18 | 2018/19 | Total | |
|---|---|---|---|---|---|---|---|
| Poles | 55,209 | 56,698 | 61,009 | 65,779 | 72,925 | 311,619 | 36% |
| Pole top Structures | 12,430 | 9,337 | 12,660 | 12,635 | 11,911 | 58,973 | 7% |
| Overhead Conductors | 16,895 | 17,785 | 18,370 | 19,880 | 18,765 | 91,695 | 11% |
| Underground Cables | 5,664 | 8,137 | 10,012 | 11,364 | 7,481 | 42,658 | 5% |
| Service Lines | 3,190 | 6,472 | 7,662 | 7,768 | 7,866 | 32,957 | 4% |
| Switchgear | 36,238 | 43,296 | 44,196 | 36,183 | 35,275 | 195,188 | 23% |
| SCADA | 7,040 | 5,604 | 6,339 | 4,667 | 4,726 | 28,375 | 3% |
| **Subtotal – items not impacted by utilisation** | **136,665** | **147,329** | **160,248** | **158,275** | **158,948** | **761,465** | **89%** |
| Transformers | 16,914 | 17,731 | 20,092 | 19,203 | 21,448 | 95,388 | 11% |
| **Subtotal – items with marginal utilisation impact** | **16,914** | **17,731** | **20,092** | **19,203** | **21,448** | **95,388** | **11%** |
| **Total** | **153,579** | **165,060** | **180,340** | **177,479** | **180,396** | **856,854** | |

The utilisation levels of marginally affected assets are low:

> The Essential Energy network, due to its remote nature and with some 134,000 distribution substations to supply just 812,000 customers, has always had and will always have low utilisation.

> As the network is so lightly loaded and in the main voltage constrained, not thermally constrained, all the switchgear on the network is rated substantially more than the required load carrying capacity or fault interrupting capacity because the minimum available ratings are typically far more than adequate.

Any decrease in utilisation will have no discernible impact on repex. While it is agreed that transformers age more quickly when operated near their maximum capacity or when overloaded, given the already low utilisation of transformers on Essential Energy's network, any change in the utilisation of equipment will not be large by comparison to the rating of the equipment. Further the candidates for any repex are not the new transformers with the lower utilisation, rather the transformers with existing condition based issues and those smaller distribution units conditionally failed due to tank corrosion, leaks and impact damage.

### 4.6.2 Average asset age should be allowed to increase

*The Draft Decision states that Essential Energy is likely to be replacing assets earlier than required to meet the capex objectives [of the NER].*[52]

This statement is counter intuitive because:

> The average asset age of Essential Energy's assets is already 13 per cent higher than the average of the NEM DNSPs indicating later replacement rather than early replacement, when compared to peers.

[52] Draft decision Essential Energy distribution determination 2015-16 to 2018-19 Overview, AER, November 2014, p. 50

> The average weighted life of Essential Energy's assets is four per cent greater than the NEM DNSPs and nine per cent higher than the average of the Victorian DNSPs (who have similar service conditions), indicating a different (less conservative) approach is adopted to deciding when an asset is deemed to have reached the end of life.

> The volume of asset defects and conditional failures in Essential Energy's network is rising, indicating more assets each year are entering the wear out phase and requiring attention. The volume of failures per 100 kilometres is four times higher than for the Victorian DNSPs, indicating that Essential Energy allows more assets to run to failure rather than to be replaced early.

#### 4.6.2.1 Residual asset lives

A key finding identified by the AER was that Essential Energy forecast higher residual service lives for some asset classes at the end of the 2015-19 period. Essential Energy has identified an error in the calculation used to populated Reset RIN table 3.3.4.2 that resulted in overestimation of the residual lives. For an updated residual service life chart refer to Figure 11-1 in Appendix G These updated residual service lives highlight that Essential Energy does not plan to increase its residual service lives over the RCP, rather to maintain or in some cases reduce further the residual life of some assets.

Essential Energy wishes to also highlight the inappropriate use of economic lives in determining residual service lives; as these lives were found by the AER to produce *"outcomes (that) are not credible or reliable"*[53] in relation to AER's base case repex model. As such Essential Energy does not accept that it *"may be seeking more repex than is necessary for some asset classes to maintain their function compared to the past"*[54].

#### 4.6.2.2 Asset lives

Essential Energy has a high weighted average age and a high calibrated life. Given that calibrated lives are directly determined from the 2008/09 to 2013/14 regulatory control periods replacement volumes, any increase in these calibrated lives is directly related to a DNSP taking on a higher level of risk, via a reduction in asset replacements.

Essential Energy has traditionally had a low repex spend due to a risk strategy based on a lower impact of failure and hence an increased failure rate to achieve the appropriate risk/cost balance. This is reflected for instance, in its serviceability criteria for poles, which is less conservative than others in the NEM (SA Power Networks aside who have long life stobie poles), and is evidenced by Essential Energy's high average weighted age of assets and high weighted calibrated service lives compared to the NEM Benchmark, as shown in Table 4-9.

***Table 4-9: Weighted average asset age and calibrated life***

| | Essential Energy (years) | NEM Benchmark (years) |
|---|---|---|
| Weighted Average Age[55] | 32.9 | 28.7[56] |
| Weighted Calibrated Life[57] | 70.3 | 67.5[58] |

Essential Energy does not incur repex based on age, but considers age as a proxy to determine the likely condition of populations of assets. Essential Energy has an average weighted calibrated asset life of 70.3 years, as shown in Table 4-10. This is the equal second highest for the DNSPs listed, exceeded only by

53 Draft decision Essential Energy distribution determination 2015-16 to 2018-19 Attachment 6, AER, November 2014, section A3.3 p64
54 Draft decision Essential Energy distribution determination 2015-16 to 2018-19 Attachment 6, AER, November 2014, section A3.1 p56
55 CA RIN data – table 5.2 based on the following categories; Pole, OH Conductor, UG Cable, Transformers and Switchgear
56 Average made up of Ausgrid, Ergon, Endeavour, Powercor, AusNet, Essential – SA Power removed as outlier due to use of 'stobie' poles
57 Calibrated life weighted to Essential Energy's asset base quantities. Data from AER Draft decision Essential Energy distribution determination Calibrated Forecast repex models
58 Note. AER data – outliers greater than 1 standard deviation removed

CitiPower. Consequently when compared to peers Essential Energy pushes assets to greater average replacement lives.

*Table 4-10: Weighted asset calibrated life*[59]

| DNSP | Average Weighted Life (years) | Variance |
|---|---|---|
| Essential Energy | 70.3 | 0% |
| Ausgrid | 59.6 | -15% |
| Endeavour | 50.4 | -28% |
| VIC Benchmark | 64.2 | -9% |
| Aurora | 57.9 | -18% |
| United | 70.3 | 0% |
| Jemena | 61.1 | -13% |
| AusNet | 66.8 | -5% |
| Powercor | 64.7 | -8% |
| CitiPower | 78.9 | 12% |
| AER Benchmark | 67.5[60] | -4% |

Essential Energy's higher calibrated replacement life is evident in the historical spend profile, displayed in Figure 4-11 which shows that Essential Energy has historically low replacement rates that are on the frontier of industry performance.

#### 4.6.2.3 Asset Failures

Further evidence that Essential Energy operates a prudent risk strategy is Essential Energy's higher failure rates compared to other DNSPs, and modelling predictions that the rate of pole failures will continue to rise until 2050.

**Current Asset Failures**

Essential Energy has the highest unassisted pole failure rate in the NEM at approximately 1:9550 per annum. Given the high failure rate it is not surprising that Essential Energy has the oldest average pole age in the NEM and the oldest calibrated pole life, with the exception of SA Power Networks who have long life stobie poles.

Essential Energy is experiencing high overhead asset failure rates at 5.9 failures per 100 kilometres of line as shown in Table 4-11. The majority of these failures are related to pole top assets failing in service.

*Table 4-11: Total Asset Failures 2013*

| Category | Essential Energy[61] | All Victorian DNSP's[62] |
|---|---|---|
| Total Asset Failures | 10,809 | 2,269 |
| Normalised Asset Failures (/100km) | 5.9 | 1.4 |
| Normalised Asset Failures (/1000 poles) | 7.9 | 1.8 |

Figure 4-15 shows an emerging issue of increasing average outage duration against wind speed. It is evident that asset and component failures are causing outages and faults at wind speeds well below the

[59]Source: Nutall Consulting, Report - Aurora Revenue Review, Nov 2011 and AER NSW draft decision 2014-19 calibrated Repex Models. Victorian and Tasmanian data based on 2004/05 to 2008/09 period. SA Power, Ergon and Energex are not included due to lack of AER published calibrated ages.
[60] AER data – outliers greater than 1 standard deviation removed
[61] Essential Energy ENI Report - Excludes fuse operations
[62] Safety Performance Report on Victorian Electricity Networks 2013, Energy Safe Victoria, June 2014, p. 7

 

minimum design criteria. These failures are as a consequence of latent conditional failures that functionally fail in wind events. The results are reflective of a distribution network with a history of a low repex spend and high calibrated average lives[63], resulting from a less conservative risk profile. Clearly, Essential Energy is not risk averse in its asset management approach contrary to statements in the AER Draft Decision.

Essential Energy's rural distribution network is designed for a minimum 50 year wind return period which is the equivalent of 925 Pa (140 kilometres per hour). A relatively flat average Customer Minutes Lost (CML) per outage up to 140 kilometres per hour could be expected to be seen if the Essential Energy network was performing as designed. However, Essential Energy's network begins to experience equipment failures at approximately 60 kilometres per hour (170 per annum) and an increase in the average CML per outage as wind speed increases, as shown in Figure 4-15. While the indicator of supply loss is used, it is a good indicator of network breakdowns which increases the possibility of fire starts or public contact with fallen conductors with increased breakdowns.

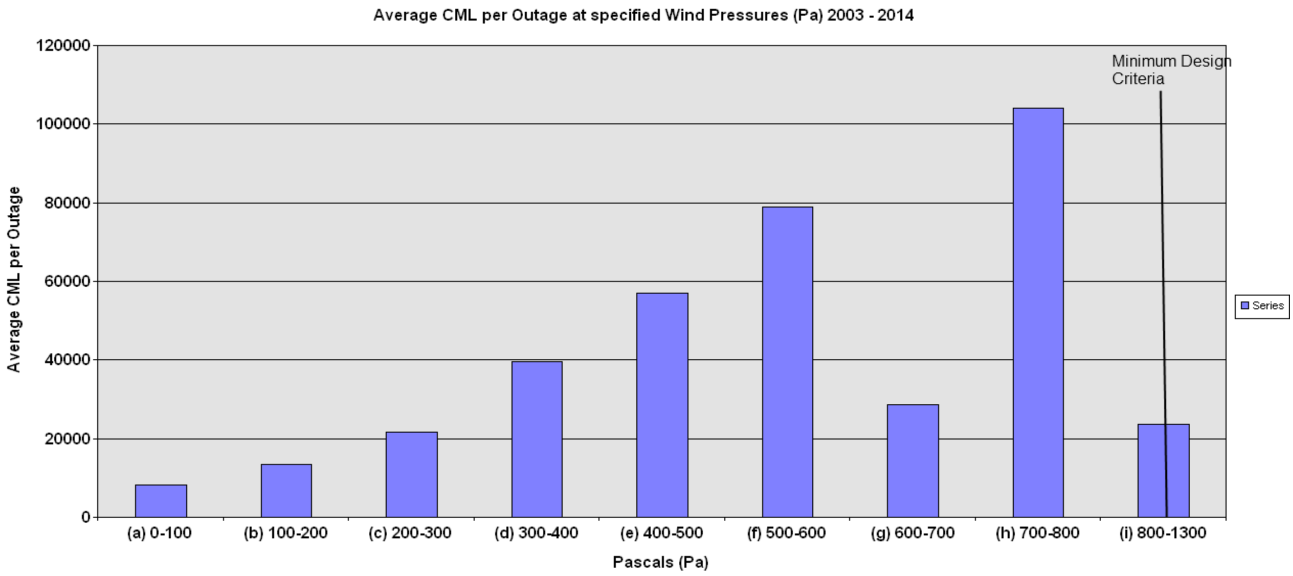


***Figure 4-15: Average CML by Wind Speed Pressure[64] [65]***

#### 4.6.2.4 Repex Outcomes

The investment in Essential Energy's repex replaces degraded assets, reducing risk and hence impacting on the network's service levels and maintenance costs. Essential Energy's replacement strategy aims to balance the reduction of risk from this investment, against the increase in risk brought about by degradation of assets to ensure that service levels are met and the outcomes are maintained at reasonable levels. At this point in time Essential Energy's overall outcomes are below those of their peers, reflective of the lower cost and less conservative risk strategy engaged.

Importantly, the proposed repex is not intended to improve the reliability performance of Essential Energy's network but simply maintain it at the current level. The average asset age is forecast to decline slightly as a natural result of addressing the increased forecast number of asset defects.

As detailed in Attachment 6.8 a new programme of inspection, Aerial Patrol and Analysis (AP&A) including LiDAR survey found relatively high volumes of opex related maintenance tasks which demonstrates a deteriorating network and further supports a need for increasing repex.

[63] See Table 4-10: Weighted asset calibrated life
[64] Essential Energy Wind Analysis, January 2015
[65] As Figure 4-15 has been constructed from outages data the apparent 'unusual' dip at 600 - 700 Pa is due to the low frequency of these events. In this case there is a reduction of outages due to wind pressures between 600 – 700 Pa (113km/hr – 121 km/hr). The limited number of outages has thus affected the average similarly for the 800-1300 Pa range.

Illustrating the prudency of Essential Energy's approach are the outcomes achieved. Suitable measures are:

- Escaped Asset Failure Fire starts
- Public shocks
- Reliability service levels.

**Escaped Fire starts**

Escaped fire starts are defined as fires with an ignition source from the network which spreads to surrounding vegetation.

The Royal Commission into the Victorian Black Saturday Bushfires in February of 2009 (VBRC) heard evidence that suggested that five fires on that day were attributable to network asset failures. Since the commission made its findings a further fire on that day (Murrundindi Fire) has been blamed on fallen conductors rather than arson, bringing the total network related fires causing destruction on that day to six. Three of the fires attributed to Electricity Distribution Networks involved significant fatalities and property losses. All six fires were associated with the two predominantly rural networks with no fires caused by Jemena, Citipower, or United Energy on that day. The Royal Commission also heard evidence that would suggest that the rural networks (Powercor and AusNet) of the Victorian DNSPs was of a similar age and construction to that of Essential Energy and both networks are experiencing similar systemic issues.

The VBRC recommended that the aged Single Wire Earth Return (SWER) lines be replaced over a ten year period or made safer via other means as investigated by the Powerline Bushfire Safety Taskforce. This has resulted in additional programmes of work and expenditure associated with fire mitigation for the two rural distributors. Recommendations from the VBRC have been considered by Essential Energy and whilst not legally bound to do this, it is appropriate for a prudent asset manager to consider the lessons learned. The recommendations were considered in the development of the replacement programmes put forward to replace those poles considered to be at the highest risk of failure due to age, fatigue or degradation. The bulk replacement of the network is not considered practical or economically affordable and as such Essential Energy continues to apply a risk based condition assessment approach to asset replacement.

Essential Energy's network has similar levels of escaped fire starts due to asset failures to both AusNet and Powercor, as shown in Table 4-12. Essential Energy's number of fire starts normalised by both network length and poles are less than Powercor, but greater than AusNet, as displayed in Table 4-12 and Figure 4-16. This suggests Essential Energy experiences a similar risk of escaped fire starts to that of the Victorian rural distributors and therefore requires repex investment to manage the number of conditional and functional failures.

*Table 4-12: Escaped Asset Failure Fire Starts*[66]

| Escaped Fire | Essential Energy | AusNet | Powercor |
|---|---|---|---|
| Number | 154 | 34 | 93 |
| Normalised by length (/km) | 0.0008 | 0.0007 | 0.00117 |
| Normalised by poles (/1000 poles) | 0.1121 | 0.0895 | 0.1722 |

[66] Safety Performance Report on Victorian Electricity Networks 2013, Energy Safe Victoria, June 2014 and Essential Energy TotalSAFE Network Performance Report

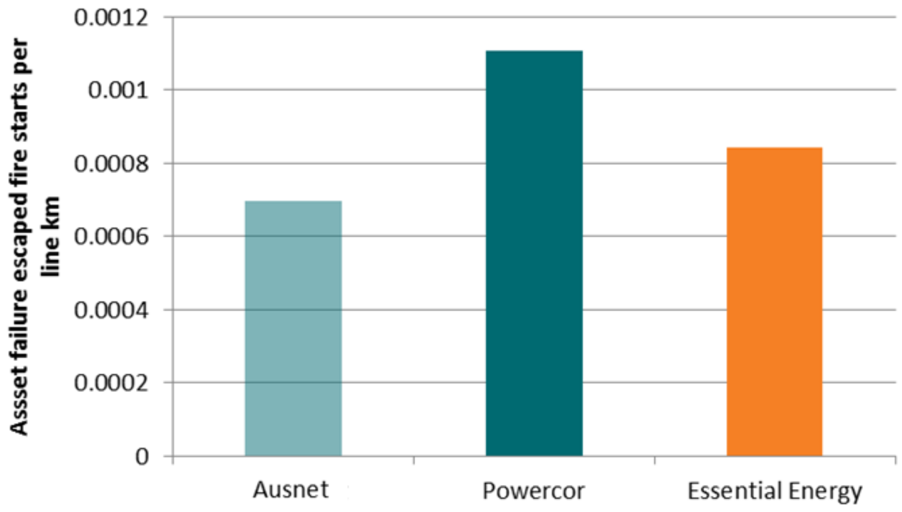


*Figure 4-16: Escaped asset failure fire starts normalised by network length (/kilometres)*

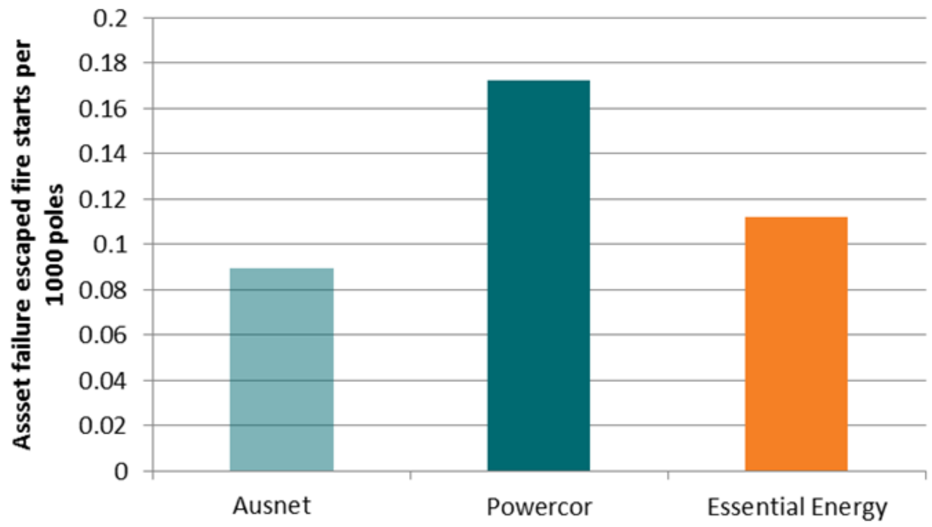


*Figure 4-17: Escaped asset failure fire starts normalised by number of poles (/1,000 poles)*

Essential Energy's total number of bushfire risk spans is significantly higher than all other DNSPs, as shown in Figure 4-18. The forecast repex in the Substantiative Regulatory Proposal is sufficient to maintain the number of fire starts.

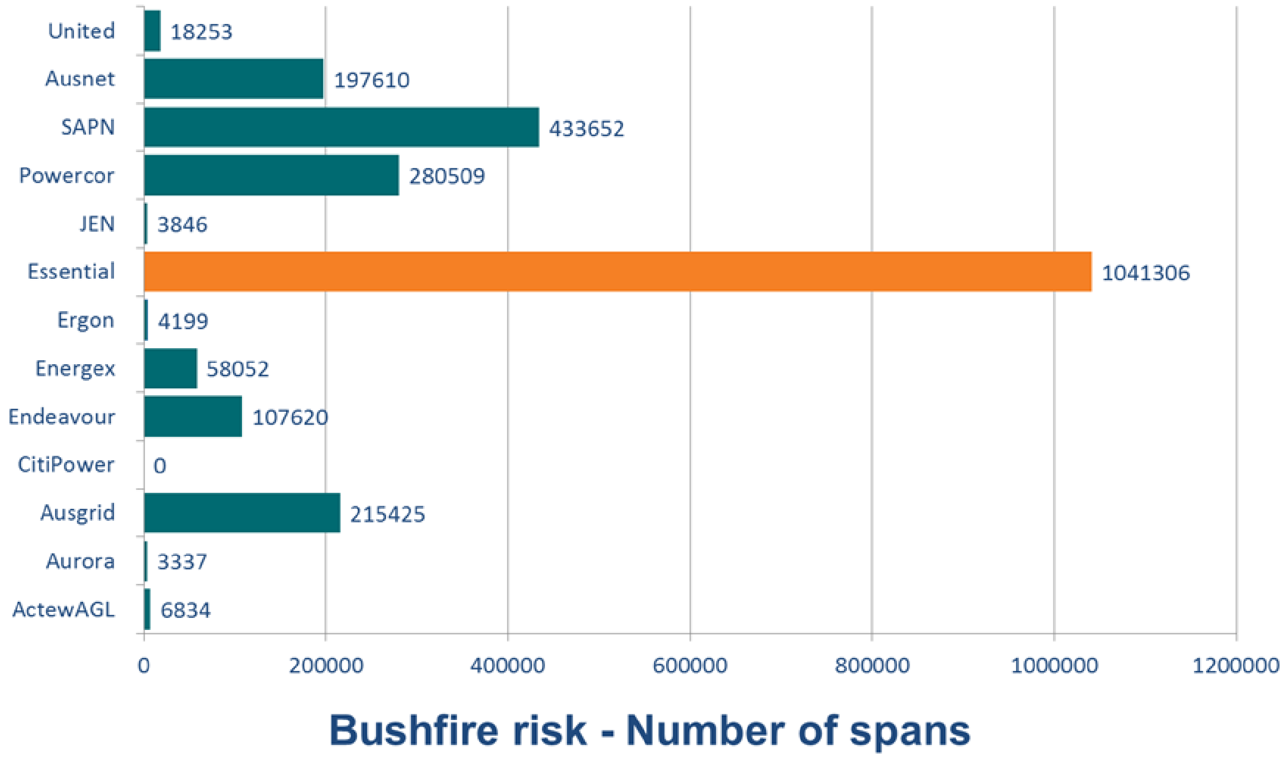


*Figure 4-18: Comparison of Economic Benchmarking RIN Bushfire risks*[67]

**Public Shocks**

Essential Energy has a higher rate of public shock incidents per customer due to network components than other DNSPs, as shown in Table 4-13 and in Figure 4-19. Essential Energy had 184 public shock incidents in 2013/14. The majority of incidents were caused by faulty or degraded network equipment. The rate of public shocks attributable to network components is likely to rise in trend with any repex reductions. For example the overhead service replacement programme is targeted at preventing the existing level of shocks from worsening.

*Table 4-13: Public Shock Incidents*[68]

| | Essential Energy 2013/14[69] | AusNet 2013 | Powercor 2013 | All Victorian DNSPs |
|---|---|---|---|---|
| Overhead related | 161 | 14 | 29 | 102 |
| Service line related | 23 | 40 | 78 | 228 |
| Number of incidents | 184 | 54 | 107 | 330 |

[67] Economic Benchmarking RIN, All DNSPs, 2014, Template 8, Table 8.2
[68] Energy Safe Victoria communication October 2014
[69] Total safe reports and Quality of Supply data Base 2013/14

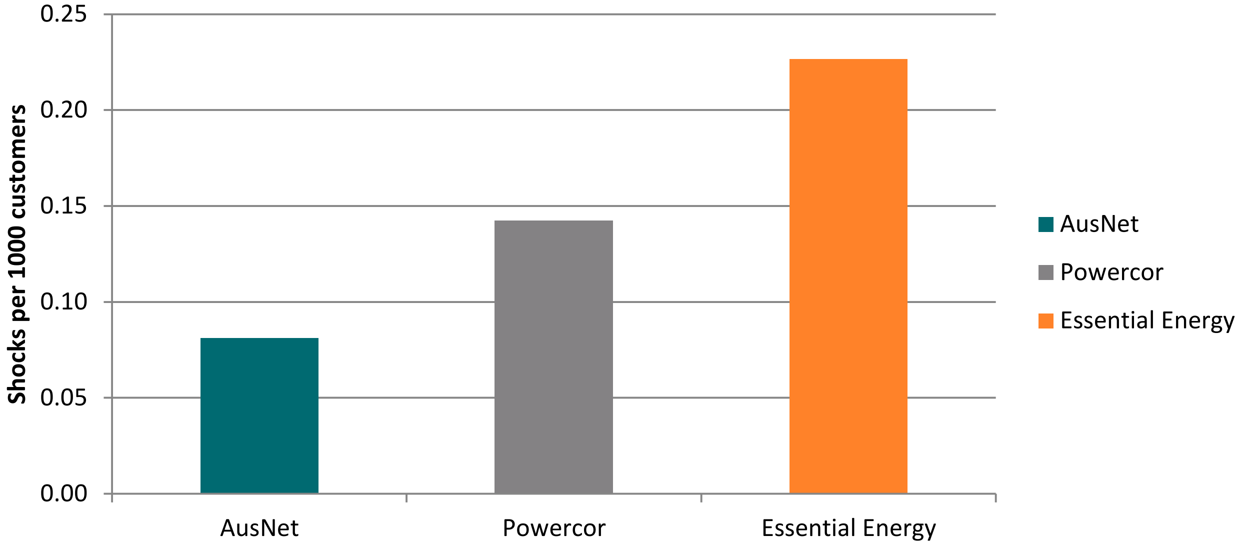


*Figure 4-19: Public Shock Incidents 2013/14 normalised by number of customers*

**Reliability Service Levels**

Investment in repex is not aimed at reducing outages or improving reliability, but rather based on conditional or functional failure. It is important to note that historical and current repex spend does not translate directly into reliability outcomes aside from maintenance of existing reliability. Repex expenditure is about ensuring the network behaves as it has been previously designed and built to behave thus maintaining reliability outcomes.

However reduced repex activities out of step with historical replacement activities, due to reduced expenditure, will impact on network reliability with commensurate increases in SAIDI and SAIFI. Essential Energy's reliability performance is trending lower which while being a positive trend is more to do with the benign weather conditions experienced rather than expenditure on improving the network. Essential Energy's network performance has a strong correlation to the weather[70]. A season with frequent widespread storms and the associated lightning strikes[71] and wind gusts can make the SAIDI and SAIFI figures increase significantly.

*Table 4-14: Essential Energy SAIDI performance[72]*

| Service Level | 2008-09 | 2009-10 | 2010-11 | 2011-12 | 2012-13 | 2013-14 |
|---|---|---|---|---|---|---|
| SAIDI | 267.1 | 196.5 | 235.1 | 237.5 | 232.5 | 181.2 |

[70] Essential Energy Wind Analysis, January 2015
[71] Essential Energy Lightning Analysis, January 2015
[72] Attachment 4 2014 Reset RIN Workbook Consolidated, Essential Energy, 2014, Template 6.2 Reliability and Customer Service Maintenance, Table 6.2.1 - Unplanned minutes off supply (SAIDI) - Actual, target and proposed reliability and Table 6.2.2 - Unplanned interruptions to supply (SAIFI) - Actual, target and proposed reliability

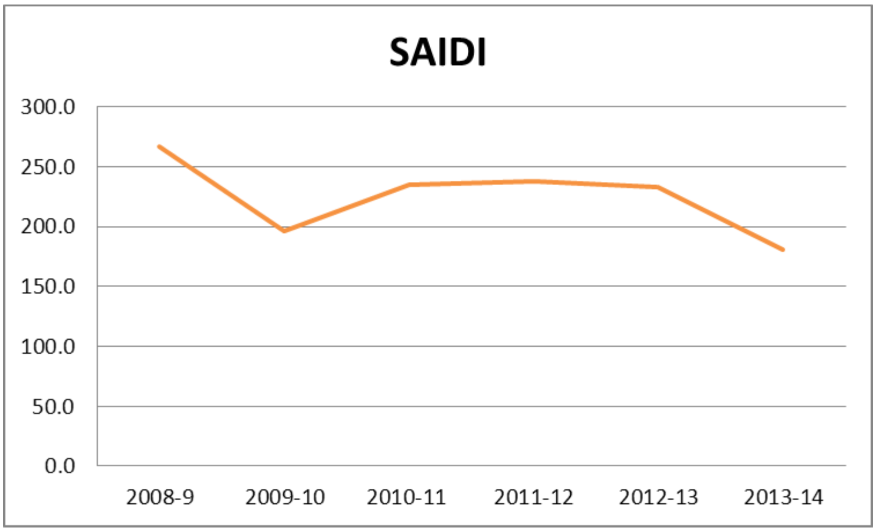


*Figure 4-20: Essential Energy SAIDI performance*

### 4.6.3 Risk Management practices are confused

The Draft Decision has commented on:

- Overly conservative risk assessments[73]
- The use of multiple risk assessment tools[74]
- Unreasonably high frequency assumptions for major and catastrophic consequences [75]
- A rudimentary approach to determining defect trends in the absence of replacement or refurbishment[76].

The basis of the decision is unreasonable for the following reasons:

- Essential Energy does not apply an overly conservative risk assessment, as the average asset life and failure rates are high when compared to its peers. Essential Energy's replacement strategy is a lower cost higher risk strategy than most of its peers, given the large network of aging assets and high failure rates. The quantum of Essential Energy's repex for the 2015-19 regulatory control period is comparatively less than its peers to undertake replacement of a large asset base.
- Essential Energy has utilised two complementary risk assessment tools to reach the required granularity to make informed risk based decisions.
- Consequence ratings are reflective of likely scenarios as they were informed by failure histories, insurance claims, outage data, information from like DNSPs or from case law; the staged risk assessment review process increases the relativity of the risk assessments and removes overly conservative assessment.

[73] Draft decision Essential Energy distribution determination 2015-16 to 2018-19 Attachment 6: Capital expenditure, AER, November 2014 , table 6-2, p.6-10
[74] Review of Proposed Replacement Capex in Essential Energy's Regulatory Proposal 2014 – 2019, EMCa / Strata Energy Consulting, *Oct 2014, Item 9*
[75] Review of Proposed Replacement Capex in Essential Energy's Regulatory Proposal 2014 – 2019, EMCa / Strata Energy Consulting, *Oct 2014, Item 9*
[76] Review of Proposed Replacement Capex in Essential Energy's Regulatory Proposal 2014 – 2019, EMCa / Strata Energy Consulting, *Oct 2014, Item 77*

> The vast bulk of replacement expenditure is as a consequence of asset inspection programmes where assets have been identified as conditionally failed. Conditionally failed assets can no longer fulfil their intended function should they be called upon to do so. In a distribution network the most common occurrence is a wind event where the asset or component cannot sustain the short term load it is subject to. It is incongruous to suggest that such conditionally failed assets should remain in service pending a functional failure. Essential Energy asserts that the historical defect trend on a statistically significant asset base is an effective method to inform future defect trends.

#### 4.6.3.1 Risk approach

Essential Energy's repex is at the higher end of the risk envelope, with a lower spend profile:

> Essential Energy has the longest weighted calibrated lives in the NEM with the exception of CitiPower, a non-comparable small underground city network.

> Essential Energy's network incurs failures at higher rates than its peer DNSPs for whom reliable failure data is readily available.

> Essential Energy's pole failure rate is high by industry standards at 1:9550 only exceeded by one DNSP. This DNSP has been the subject of multiple safety interventions by its safety regulator and is currently replacing poles in the order of four times the rate of Essential Energy.

> Essential Energy's proposed programmes fall well below the levels forecast by the AER's NEM benchmarked models.

> Essential Energy has a lower repex spend on a per asset basis than its peer DNSPs.

#### 4.6.3.2 The use of multiple Risk Assessment tools

Essential Energy has utilised two complementary risk assessment tools to reach the required granularity to make informed decisions, in accordance with its corporate risk policy. Employing an enhanced risk model for the Investment Cases produces a significant improvement in rigour associated with the risk assessments.

Essential Energy applies risk assessment practices (the Corporate Risk Model) as detailed in Operational Procedure Corporate Risk Management (CEOP2111)[77]. This policy stipulates the risk framework and methodology to be applied when developing investment cases and programmes of work.

Application of the Corporate Risk Model to the investment cases does not rank the investment cases by risk to the level required, or adequately quantify the risk considering likelihood. The Corporate Risk Model does not identify likelihood (probability and exposure), resulting in lower granularity in the risk assessment approach for the investment cases.

Essential Energy complemented the Corporate Risk Model with a probability and consequence level of detail to determine likelihood. This approach is consistent with CEOP2111 where it is recognised that refinement of the model may be required, as follows:

> *It may also be necessary to adapt the likelihood and consequence tables (see Step 2) to meet the prevailing circumstances for the analysis.* [78]

Essential Energy implemented a software tool called '*Riskex*' for use in the Investment Cases allowing a higher level of detail for likelihood based on the probability and exposure. The consequence table used in the '*Riskex'* tool was expanded to include consequences that were not listed in CEOP2111. In all other respects

[77] *Superseded by CEOP0002.21 on the 29/8/2014*
[78] CEOP2111 Operational Procedure Corporate Risk Management, 22 July 2011 Issue 4

the *'Riskex'* tool is the same as the corporate tool with the same risk categories. The *'Riskex'* approach removed a significant degree of subjectivity from the corporate approach.

Further detail on the Qualitative and Quantitative Risk Assessment techniques and Risk Governance is included in the full Risk Assessment report at APPENDIX C – RISK Assessment Methodology.

#### 4.6.3.3 Risk Rating

Through the staged review process for each investment case, the subjective nature of qualitative risk assessments has been moderated by the number of reviewers whom reviewed the risk assessment. It is Essential Energy's contention that this increases the relativity of the risk assessments and removed overly conservative assessment.

The risk assessment was informed by consequences based on network occurrences derived from asset failure histories, insurance claims or outage data. Thus the risk assessment is based on the service performance of the network Essential Energy manages. Where this information was not available or incomplete Essential Energy obtained information from like DNSPs or from case law to inform the risk model. Given the pedigree of the source information Essential Energy contends that the risk assessments are reasonable for the number of assets it manages and the risks thereof.

### 4.6.4 Capital Governance is inappropriate

*The Draft Decision states:*

*EMCa found that… Essential Energy's capital governance framework appears to be out of date. The application of this framework to its repex forecast is also inadequate. While enhanced practices imposed by the Networks NSW Board are evident, there remains gaps in Essential Energy's processes. Its framework presents a relatively rudimentary approach to project and program governance.*[79]

Attachment 6.2 Capital Governance notes that the Capital Governance framework referenced in the original regulatory proposal was out of date. Since NNSW formed in 2012, Essential Energy has subsequently adopted the NNSW capital governance framework and supporting process to develop the Network Portfolio during 2014 – in alignment with all NNSW DNSPs. The NNSW Investment Governance Framework drives prudent and efficient portfolio investment decision making.

Essential Energy's governance process uses a bottom-up forecast build, with several stages of top down challenge and review. The purpose of the top down review at Essential Energy is to incorporate a level of overall restraint, allow for interrelationships and synergies between programmes of work and to ensure that a holistic view is taken, delivering a balanced outcome across a range of often competing business objectives.

The overall portfolio was subject to several stages of review and challenge with iterative updates to incorporate these changes and optimise the efficiency and prudency of the proposed plan. The reviews were both top down and bottom up in scope.

Many changes were made over a 12 month period as a result of this review and challenge process. The AER was provided with information on the final stage of the NNSW top down review and Board approval process.

The finding by EMCa that aspects of the governance process were inadequate is based on an assessment of a legacy process and not the governance process actually in place. It also does not account for information provided by Essential Energy to EMCa to explain the process, and does not correctly identify the Board review as an integral part of that process.

[79] Draft decision Essential Energy distribution determination 2015-16 to 2018-19 Attachment 6: Capital expenditure, AER, November 2014 , table 6-2, p.6-61

Attachment 6.2 Capital Governance demonstrates that Essential Energy has adopted a robust challenge process and provides an explanation of the process undertaken. The report also provides further information to explain the top-down and bottom-up forecasting approach undertaken by Essential Energy.

#### 4.6.5 Quality of asset data is limiting good asset management

*The Draft Decision states Essential Energy's asset management systems, data quality and analysis do not adequately support prudent investment decision making justification.*[80]

Neither the EMCa Technical Review nor the AER Draft Decision identifies any of these asserted asset data deficiencies and access was not provided (nor was it requested) to Essential Energy's asset data to make this finding. The following short description may assist the AER to come to a different conclusion and had more detail been provided to EMCa they likewise may have formed a different view.

Essential Energy accepts that its asset data could be enhanced. Given the size, spread and age of the assets it is not possible nor will it be ever possible to have perfect asset history, however Essential Energy's asset data is adequate for that required to make good judgements in relation to repex as demonstrated in the following examples:

> For poles - the most important asset for a rural DNSP, the WASP Asset Management System (AMS) contains reliable age data for 99.4 per cent of in service assets. Further these assets have good condition data with full historical asset history typically in excess of 15 years. This history includes inspection results and records of corrective work tasks. It is an excellent basis to predict future requirements for pole replacement and pole top hardware replacement. As assessed at each inspection pole dimensions and calculated safety factors given the actual pole tip loads are recorded and available. The data on poles has been used by many industry researchers as it is the largest single timber pole data source in Australia and possibly worldwide. This data is extensively used by Essential Energy to formulate strategic asset management plans with regard to poles as shown in section 4.7.3.3. and APPENDIX D – Pole Asset Strategy and Serviceability criteria.

> For bare overhead conductor - all conductor segments carry an age in the GIS. This data shows that conductor age is on average eight years older than poles which is intuitively correct given that very little conductor has ever been replaced since installed. Conductor defects are recorded against the nearest pole in the WASP AMS and are a sound record of conditional failures. All repairs and replacements are recorded in the AMS and again good records are held of conditional failure history over the last 15 years.

> For Zone Substation assets – Full diagnostic test results are held for all primary plant including power transformers, instrument transformers, batteries and switchgear. These test results are recorded values from scheduled maintenance and inspection and from diagnostic samples sent to external laboratories. All data is held in the WASP AMS including age and other important attributes.

> Typically one of the greatest challenges for any DNSP is linking functional failure cause data to outages and assets. Essential Energy identified this shortcoming and in 2012 and implemented the Electricity Network Incident (ENI) database. ENI allows the capture of functional failure data and can be linked to outage events in the Distribution Management System (DMS), Power on Fusion (PoF) and the WASP AMS. While it is difficult to be confident that every single functional failure is recorded, the events recorded provide a highly statistically relevant indication of the condition of the assets and the failure modes to assist in making informed strategic asset management decisions.

Asset data is a challenging field to ensure the correct balance between the cost of data and its value, and while there are further improvements planned the current data is a significant aid to identifying the assets that require replacement. This is particularly so since the vast majority of repex is for conditional or functional

[80] Draft decision Essential Energy distribution determination 2015-16 to 2018-19 Attachment 6: Capital expenditure, AER, November 2014 , table 6-2, p.6-61

failure, where once identified as failed or not able to carry out the intended function the asset is allocated for the appropriate action of:

- Maintain;
- Repair;
- Life Extension; or
- Replacement.

These actions (work tasks) are all recorded in the AMS for future reference and for prediction of estimated future task volumes.

#### 4.6.6 Options Analysis not carried out

*The EMCa Technical Review raised concerns over options analysis and hence volumes of work[81].*

Essential Energy undertakes options analysis to determine the most appropriate solution for assets and has documented a combination of approaches:

- Presented different options in different investment cases.
- For some assets the reasonable options are limited to do nothing or replace on conditional failure.
- Some strategies are based on replacement at conditional failure following life extension.
- Economic analysis has been undertaken where required to evaluate options.

In some cases different options are presented in different investment cases. For instance, investment cases Zone Substation Power Transformer Replacement (ESS_71_S) and Zone Substation Power Transformer Refurbishment (ESS_70_S) are two different options for strategies to address zone substation transformer asset management. Transformers have been allocated to different investment cases depending on the best strategy for the transformer under consideration; the refurbishment investment case therefore contains limited consideration of replacement and the replacement investment case contains limited consideration of refurbishment or replacement.

In many cases the reasonable options are limited to “do nothing” or “replace on conditional failure” and the options analysis is more about the timing of the replacement action, which is in accordance with a risk based serviceability criteria rather than on a case by case basis. Because there are no other feasible cost options which continue to meet our legislative requirements, Essential Energy has not presented any other alternative options. The absence of these less than feasible options in the investment cases should not be taken to mean they were not considered. Essential Energy took the view that it was sensible to present the most feasible economic options rather than crowd the investment cases with fanciful options that would not be prudent or fiscally acceptable.  The “do nothing options” generally do not meet a legislative requirement or present an unacceptable risk to the public. In these cases Essential Energy has not provided detailed cost benefit analysis, as these drivers force action, and in most cases the only reasonable option is refurbishment.

Replacement options include life extension strategies where possible. For example, the two options for ESS_17 and ESS_46 Pole Replacement and Reinforcement (ESS_17 and ESS_46) are “do nothing” and “replacements and reinforcements to the pole failure target failure rate”. The preferred option includes life extension by reinforcement where possible; there is no need for a third reinforcement option. For bare

[81] *Review of Proposed Replacement Capex in Essential Energy’s Regulatory Proposal 2014 – 2019*, EMCa / Strata Energy Consulting, Oct 2014, Items 4, 6, 7, 10, 11, 12, 71, 80, 81, 85, 86

overhead conductors the "conductor replacement" option includes life extension by installing splices where possible when conductors have failed. Alternate options of life extension versus replacements are not presented, as the optimal strategy of life extension where possible has already been included in the preferred option.

Where appropriate, investment cases do include alternative volumes of work. For instance options where repair of lower risk defects is deferred into the future versus all defects being rectified in the five year regulatory period are included in Two Pole Substation Safety Programme (ESS_38_S).

#### 4.6.7 Approach to cost estimation not understood

*EMCa weren't able to establish how Essential Energy constructs its estimates*[82]

Forecasts of expenditure are made for a number of categories and programmes of work. The methodology utilised to derive forecast costs for each programme of work involves determining the unit of measure, the approach to costing each unit, the approach to costing the programme and determining the cost elements (labour, materials, other).

The approach to costing each programme is determined according to the type of programme, or the individual projects contained within a programme, as well as the nature and scale of the works within it. The approach is also dependent on historical delivery of similar sets of work and the accessibility of historical information. Depending on the nature of the programme, there are numerous avenues for producing unit costs, refer to Table 4-15 for specific details:

- Bottom up programme estimates – These estimates are used for programmes where there are likely to be substantial variations in the scope of each project or where there are not substantial historic costs for overall programmes. Components of the programmes are costed individually and added to create the programme. Historical actual costs are obtained from historical information held in WASP or current contracts. Bottom up estimates are compared against actual similar projects where possible and reconciled as necessary once understanding of any differences is developed.

- WASP cost estimates – These estimates come from Essential Energy's Works, Assets, Solutions, People asset and works management system. These estimates use actual current material costs and labour rates and labour hours originally determined by expert input and updated to reflect real project history. The result of this is similar to an historic cost average of recent work.

- Historic unit rate estimates – These estimates are used for programmes consisting of lower cost, higher volume projects where there is little variation in scope between specific components of projects. Depending on the nature of the programme and the information available, the costs associated with materials and labour of the products are developed and kept up to date in a variety of ways, utilising:

  - historic average costs

  - one-off historic costs

  - market costs

  - market estimates

  - the expert knowledge of Essential Energy SMEs (Subject Matter Experts).

[82] *Review of Proposed Replacement Capex in Essential Energy's Regulatory Proposal 2014 – 2019*, EMCa / Strata Energy Consulting, Oct 2014, Items 88 and 89.

> Historic cost average Programme Estimate – These estimates are used for programmes where it would be inappropriate to develop a bottom up forecast for each project. Historical actual costs are obtained from historical information held in WASP or current contracts.

The approach by which expenditure forecasts are broken down into cost elements (labour, materials, other) is determined by the nature of the source data used to create the estimate. Where the cost estimate has involved a bottom up build each of the cost elements is identified in building the cost estimate. Where historical or market data is used, the actual cost for each element is used. Where an average of historical data is used, the ratio of each element is applied to the forecast.

Volumes of replacement or work are in general based on estimated number of conditional failures based on available information about the current populations and condition, or known works requirements.

The process of checking bottom up estimates against real projects or using historic cost averages ensures that cost estimation is robust, and therefore that cost estimating is sufficiently accurate to ensure that efficient strategies and outcomes are selected.

*Table 4-15: Estimating method for Primary Systems investment cases*

| Programme Type | Costing Methodology | Programme No. | Programme Name | Costs (5 year) |
|---|---|---|---|---|
| High Volume, Low Cost | Bottom up estimate | 30 | Condition Based Transformer Replacement | $5.947M |
| | | 83 | Zone substation surge diverter replacement | $2.8M |
| | | 12 | Pole top Switchgear Replacement | $15.2M |
| | | 2028 | Pole top refurbishment of Taree to Forster 66 kV feeders | $2.07M |
| | | 2029 | Pole top refurbishment of Dubbo – Nyngan 132 kV feeders | $4.1M |
| | | 22 | Crossings of Navigable Waterways | $12.5M |
| | | 80 | Zone substation battery replacement | $3.8M |
| | | 14 | Pole top Recloser Refurbishment Replace Controllers and Replace Switchgear | $18M |
| | | 81 | Zone substation voltage transformers | $1.96M |
| | | 87 | Zone substation earthing system refurbishment studies | $1.86M |
| | | 78 | Zone Substation Circuit breaker replacement | $15.5M |
| | | 4009 | Subtransmission Polymer Termination Replacement | $0.8M |
| | | 16 | Replacement of Bare OH Conductor | $78.9M |
| | Historical average cost | 4005 | Pole top Refurbishment - Distribution | $21.4M |
| | | 31 | Enclosed Substation Refurbishment Programme | $29M |
| | | 32 | Distribution Overhead Substation Refurbishment | $37.6M |
| | | 41 | Low Voltage Switchgear and Pillar Replacement | $2.5M |
| | | 17/46 | Pole Replacement and Reinforcement | $274M |
| | | 29 | Overhead Rural Low Voltage Conversion to Underground | $23.8M |
| | | 76/86 | Environmental Compliance and PCB contamination | $6.6M |
| | | 45 | Subtransmission Pole top Refurbishment | $15.9M |
| | | 13 | High Voltage Regulator Replacement | $7.7M |
| | WASP costs estimates | 23 | Low Voltage Spreader Installation | $7.2M |
| | | 40 | Unplanned Underground Cable Replacement | $2.5M |
| | | 42 | High Voltage Cast Pothead replacement | $2.7M |
| | Actual Contract Rate | 26 | Service Overhead Replacement | $31.2M |

| Programme Type | Costing Methodology | Programme No. | Programme Name | Costs (5 year) |
|---|---|---|---|---|
| | Survey by professional consulting firm, bottom up estimate | 89 | Zone substation Building refurbishment | $7.6M |
| | Project estimate based on SME experience | 88 | Zone substation Civil refurbishment | $0.55M |
| Medium Volume, Medium Cost | Bottom up estimate | 4004 | Zone Substation Outdoor Bus and Isolator Replacement | $6.6M |
| | | 82 | Zone substation current transformers | $5.8M |
| | | 85 | Zone substation protection | $5.2M |
| | | 75 | Zone Substation Perimeter Fencing and Security Refurbishment and Replacement | $1.4M |
| | | 2006 | Capacitor Bank Replacement | $2.2M |
| | | 84 | Unplanned equipment failure | $4.4M |
| | | 70 | Zone Substation Power Transformer Refurbishment | $7.3M |
| | Wasp cost estimates | 43 | Low Voltage CONSAC replacement | $18.9M |
| | Average costs of past projects | 38 | Two Pole Substation refurbishment | $4.8M |
| Low Volume, High Cost | Bottom up estimate | 71 | Zone Substation Power Transformer Replacement | $30.8M |
| | | 72 | Zone Substation Power Transformer Unplanned Failure | $7.8M |
| | | 79 | Zone substation indoor Switchboards | $45.7M |
| | Historical average cost | 2009 | Utility Blackspot Plan | $7.8M |

### 4.6.8 Multiple contingencies are used

*The Draft Decision Contingency allowances are unclear with multiple contingency allowances used.*[83]

Essential Energy's estimates as presented in the Investment Cases are aimed to be accurate for an average project, and where possible have been compared against previous projects to ensure they are realistic, or are based on past average costs. Essential Energy does not list contingency amounts, as some projects will be more expensive, and others less expensive. That is the use of or comparison with historic costs accounts for contingency events at the actual rates which they occur within the pricing. Although these events may not occur for every project, this will reconcile at a programme level, and provide the appropriate amount of contingency at the expected frequency over the whole of the programme.

The AER's consultant, EMCa, did not make a finding in their report on Essential Energy in regard to excessive contingency amounts but has made this finding in their report on the two other NSW DNSPs. It is suggested that this finding has been incorrectly allocated to Essential Energy.

### 4.6.9 Procurement cost efficiencies have not been included

*The EMCa Technical Review noted that the NNSW $170M reduction in procurement costs across the three NSW DNSPs through to 2016 has not been built into Essential Energy's repex forecasts.*[84]

[83] *Draft Decision Essential Energy distribution determination 2015-16 to 2018-19 Attachment 6: Capital expenditure*, AER, November 2014, p. 6-11.

The NNSW document “Delivering efficiencies for our Customers” page 17 shows a saving of $123M through strategic sourcing across the three distributors.

The Essential Energy share of this saving relevant to repex is anticipated to be only a few per cent of Essential Energy’s annual repex materials:

- Essential Energy will not see a large impact from economies of scale; it currently purchases higher volumes of assets than Ausgrid and Endeavour Energy and already has period contracts at attractive rates for standard items. The savings benefits will vary across the three distributors.
- There will be a focus on information technology, fleet and property rather than reductions in purchasing overall. Savings also will be spread across opex, capex and overheads.
- The scale of the benefits was set using a baseline with significantly higher expenditure than is currently being sought. Therefore the benefits achieved are likely to be lower than projected due to diminished volumes.

A comparison of the current Essential Energy purchase price for poles to the NNSW contract shows a decrease of nine per cent for a typical pole. This is the only detailed NNSW procurement contract relevant to repex that has been finalised, and will result in a less than one per cent reduction in the cost of replacing a pole which is not material in the accuracies of realistic cost estimation.

#### 4.6.10 Deliverability constraints

*The Draft Decisions raises doubts that repex program can be delivered.*[85]

Deliverability of the proposed capital works is a low risk. Essential Energy’s delivered capital work in the 2009-2014 regulatory period is more than the proposed capital work for the 2014-2019 regulatory period.

Attachment 6.11 Deliverability discusses in detail the forecast replacement capital work can be delivered as evidenced by:

- The total capex works programme, including replacement, is less than the peak workload delivered in 2011/12 and subsequent years.
- Maintenance (excluding vegetation management which is a specific outsourced activity) is forecast at similar levels to 2012/13, a programme of work that was delivered.
- The reduction in greenfield work and in augmentation work more than compensates for the increase in brownfield work and in the replacement work, allowing the work to be completed by internal and external resources. There is in effect minimal greenfield work in any case as the vast proportion of augmentation capital is carried out on the existing in service assets. The resource skill set is transferrable from greenfield and augmentation work to brownfield and replacement work.

### 4.7 Engineering review

The AER Draft Decision was supported by a technical review undertaken by EMCa. This chapter provides information and clarification to address specific concerns raised in the EMCa Technical Review. Cross reference to the response to each issue is provided in section 4.7.8 Table 4-28.

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[84] *Review of Proposed Replacement Capex in Essential Energy’s Regulatory Proposal 2014 – 2019*, EMCa / Strata Energy Consulting, Oct 2014, Item 94.

[85] Draft decision Essential Energy distribution determination 2015-16 to 2018-19 Attachment 6: Capital expenditure, AER, November 2014 , table 6-2, p 6-61

### 4.7.1 Subtransmission Assets

The EMCa Technical Review raised concerns that subtransmission replacement and refurbishment is justified by age. This is not an accurate finding by the technical consultant. Refurbishment strategies at Essential Energy are condition based on the following:

- Age where mentioned in an investment case, serves as a proxy across the population to estimate what quantities may reach a state of conditional failure in the next five years.
- Building refurbishment justification is dependent on the results of an audit of buildings by consultant firm Macutex. Works were prioritised according to importance, and by the consequences of failure. Out of a total of $13.16M (2012 dollars) of identified works, $7.563M was classified as high priority to be undertaken in this regulatory period, with the remainder deferred to future regulatory periods.
- Other typical sub-transmission equipment investment cases such as circuit breakers, current transformers, voltage transformers are justified based on known failure modes of known equipment types, including explosive failures, etc.
- The power transformer replacement and refurbishment business cases are also based on transformer condition.
- Zone Substation battery replacement is based on measurable loss of capacity, which correlates closely with age.
- Indoor switchboard replacement is based on replacement of switchboards which can no longer be relied upon in their current condition; this includes high levels of maintenance, existing defects, type faults and safety issues rather than age.

### 4.7.2 Apparent 20 per cent Increase in Pole, Conductor and Service Estimates

In the original RIN data, the total estimated spend on line related work for 2014-19 ($2013/14), is 20.1 per cent higher than total spend for the 2009-14 period ($2013/14). Essential Energy does not have historic expenditure data for the 2009/10 – 2013/14 period divided into the categories required by the AER (i.e. overhead conductors, poles, pole top structures, services). In calculating the historic RIN data, expenditure was allocated between overhead conductors, poles, pole top structures, services using the same proportions as had been estimated for the 14/15 to 18/19 period. Therefore the 1:1.201 ratio between the total spends in these five year periods is translated into the identical ratios between the 2009-14 and 2014-19 spends in all four categories.

The EMCa inference that the forecast across these four asset groups was a simple 20 per cent increase on history is consequently invalid. Rather the historical expenditure split was created from the forecast estimates as this was considered the most accurate method of providing the AER with a reasonable number that was not otherwise recorded.

### 4.7.3 Pole Replacement and Staking

In the Essential Energy Draft Decision (November 2014) and associated consultants reports the (AER) raised concerns about the accuracy, investment prudency and options analysis around the pole replacement and reinforcement investment strategy:

- The flat pole reinforcement (staking) expenditure and volume profile in conjunction with the increasing rate of pole replacements shown in both the RIN graph and Table 4 is not adequately explained by Essential Energy.[86]

- Ratio of pole reinforcement to replacement.

- Justification of revised strategy.

- Potential deliverability issues.

The Draft Decision proposes a total of $204M for expenditure on pole replacement and reinforcement compared to total proposed expenditure as submitted by Essential Energy of $312M.

This expenditure proposal is insufficient to manage assets that have an increasing average age, particularly given that Essential Energy has the highest failure rate in the NEM for poles.

The EMCa Technical Review recognised the need for increased pole replacement and reinforcement. What appears to be in contention in this paragraph is the quantum of replacement / reinforcement and the cost.

> *In summary, we acknowledge that Essential needs to progressively increase the number of poles it replaces and reinforces. However, it has not made a sufficiently robust case for its adherence to its current inspection and serviceability criteria, nor for the cost effectiveness of its current and proposed strategies. With a change in strategy, we believe there is the potential for a lower overall cost of wood pole management over the course of the 2015-19 RCP through a higher reinforcement/replacement ratio.*[87]

An increase in reinforcement rate higher than what Essential Energy proposed is in fact more costly (Table 8-3).

Essential Energy has proposed a moderate increase in repex to arrest future pole failures in conjunction with a higher reinforcing rate. The AER Draft Decision places a reasonable asset strategy at significant risk and would seem to be at odds with the findings of the EMCa Technical Review which recommends a higher replacement and reinforcement rate for Essential Energy poles.

Essential Energy notes that the Draft Decision for Endeavour Energy repex is within a few million dollars substantially the same as that for Essential Energy. This seems to be indicating a fundamentally flawed model as repex is predominantly driven by asset condition and asset volumes.

- Essential Energy has 1.2 Million timber poles and Endeavour Energy has 266,466 timber poles (approximately a fourth).

- Essential Energy's average pole age is 33.4 years approximately ten years older than Endeavour Energy, which is 24.4 years for pole assets[88].

Similar outcomes are found when the Ausgrid Draft Decision is examined. Based on the Draft Decision the AER is signalling that it expects Essential Energy to be at least twice to three times as efficient with regards to repex pole management than Endeavour or Ausgrid. This is patently not realistic or possible given Essential Energy's current pole performance and operating environment.

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[86] Review of Proposed Replacement Capex in Essential Energy's Regulatory Proposal 2014 – 2019, EMCa / Strata Energy Consulting, *Oct 2014, Item 110*
[87] Review of Proposed Replacement Capex in Essential Energy's Regulatory Proposal 2014 – 2019, EMCa / Strata Energy Consulting, *Oct 2014, Item 116*
[88] Essential Energy and Endeavour Energy Reset RIN data 2013

#### 4.7.3.1 Flat Pole Reinforcement (staking) Expenditure

The EMCa Technical Review raised concerns that '*the flat pole reinforcement (staking) expenditure and volume profile in conjunction with the increasing rate of pole replacements shown in both the RIN graph and Table 4 is not adequately explained by Essential Energy'*[89].

Whilst there is variation in expenditure year to year, the volumes are stable for pole inspections and reinforcements. Naturally expenditure at a project level is affected by the environment and type of job activity occurring, so individual project costs can be expected to vary.

There is no expected improvement in the pole replacement rate for this regulatory period due to the higher reinforcement rate. There is no change in the condemnation criteria; for every year of this regulatory period; approximately 350,000 poles will be inspected of which between 8,000 and 10,000 will be replaced primarily due to low wall thickness and 1,280 will be reinforced. The poles inspected each year will be a unique and distinct set that have never had the new serviceability criteria applied to them. There may be some future benefit in the next regulatory period with regard to the replacement rate as a result of the increased reinforcement rate, but none is or can be expected in this regulatory period due to the step change in serviceability criteria.

#### 4.7.3.2 Ratio of Pole Reinforcement to Replacement

The EMCa Technical Review suggested that a higher pole reinforcement rate should lead to lower cost. However the reinforcement rate from a peer utility cannot arbitrarily be applied to Essential Energy without the associated serviceability criteria from that DNSP. It is not correct that the higher pole reinforcement rate of some other distributors is indicative of a lower cost overall strategy, and modelling demonstrates that adoption of such a regime has an unsustainable high expenditure outcome.

Refer to section 4.3.2.2 for further details.

#### 4.7.3.3 Revised Pole Management Strategy

The EMCa Technical Review raises concerns that Essential Energy has not sufficiently justified its proposed strategies; specifically that the 1:20,000 pole failure aspirational target is not justified: Essential Energy has the highest pole failure rate in the NEM and modelling shows an increased failure rate if the pole serviceability criteria is not modified. The selection of a 1:20,000 pole aspiration failure rate was the result of a detailed end to end review of pole management. Essential Energy's plan to transition to this target is intended to be achieved by administrational controls, a moderate change in serviceability criteria, and a reasonable increase in pole reinforcements, (refer to APPENDIX D – Pole Asset Strategy and Serviceability criteria).

#### 4.7.3.4 Programme Delivery and Forecast Volumes

The EMCa Technical Review raised concerns around programme delivery and the forecast volumes in relation to the pole replacement and reinforcement investment case.[90]

Essential Energy maintains that the replacement and reinforcement programme has low deliverability risk for the following reasons:

> Essential Energy has historically performed pole inspection, replacement and reinforcement work over the 2008/09 to 2012/13 period.

> The measure of delivery relates to units of work delivered not expenditure year to year.

[89] Review of Proposed Replacement Capex in Essential Energy's Regulatory Proposal 2014 – 2019, EMCa / Strata Energy Consulting, *Oct 2014, Item 110*

[90] Review of Proposed Replacement Capex in Essential Energy's Regulatory Proposal 2014 – 2019, EMCa / Strata Energy Consulting, *Oct 2014, Item 91, 103 and 115*

 

- Delivery of the programme in full occurred for 2008/09, 2011/12 and 2012/13; 2009/10 and 2010/11 are not indicative of Essential Energy's resource capability because of unusual inclement weather for 2010/11 (strongest La Nina pattern on record for decades which resulted in flooding, see Figure 4-22) and a temporary resource constraint issue in 2009/10. The resource issue in 2009/10 was resolved for later years (11/12 – 12/13) such that these years represent the number of poles inspected on average.

The measure of delivery relates to units of work delivered not expenditure year to year. In terms of poles inspected, replaced and reinforced Essential Energy has met the targets with no outstanding activities. Expenditure profiles in Essential Energy's network are influenced by numerous factors:

- Programming of work, work identified in one year may be completed in another.
- Environmental factors resulting in work activities rolling over into subsequent years or being advanced to accommodate weather influences.
- Resource balancing where some activities may occur all in one year for convenience.
- Reductions in unit rates due to changes in material costs or changes in work practices.
- Packaging of work into blocks of activity to address work in a more efficient manner.

With regard to pole reinforcement and replacement Essential Energy has no outstanding tasks thereby demonstrating capacity to deliver. Additionally since the original proposal Essential Energy has augmented its pole reinforcement resource capability with contract resources to deliver the increased reinforcement programme.

As noted prior there are variations in 2009/10 and 2010/11 to the delivery of the pole replacement and reinforcement programmes, shown in Figure 4-21. Volumes in these years were lower than forecast and this was a result of two main factors:

- Weather during 2010/11, floods and wet conditions restricted access to poles for the purposes of inspection.
- Some temporary resource constraints in 2009/10 which occurred as resources were allocated to other activities. This was rectified in 2011 and pole inspection volumes were restored.

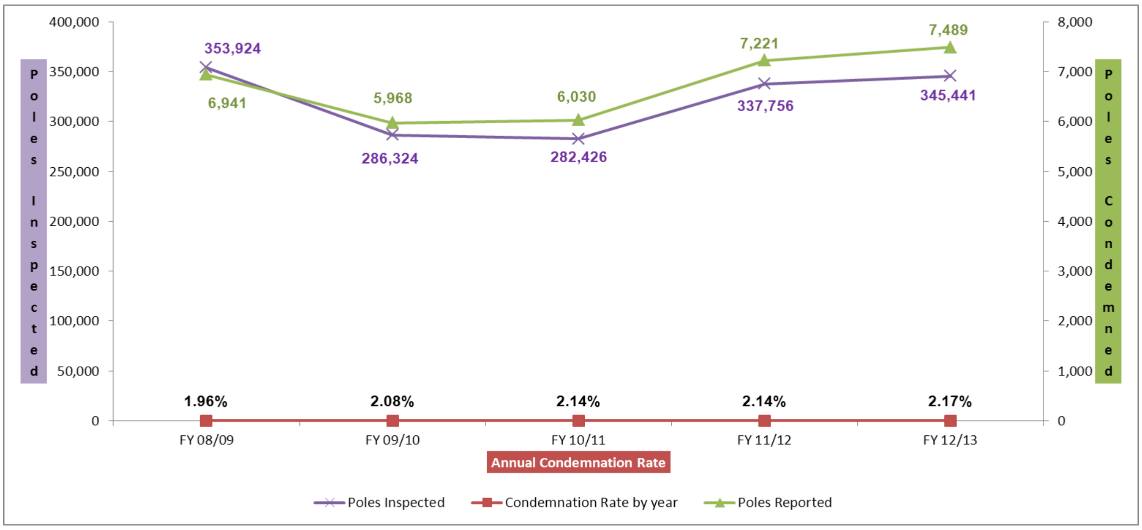


*Figure 4-21: Total Poles inspected and condemned 2008/09 to 2012/13*

Bureau of Meteorology Data shows that a good portion of 2010/11 was covered by one of the strongest La Nina weather patterns on record, refer to Figure 4-22. La Nina weather patterns are characterised by higher than average rain fall.

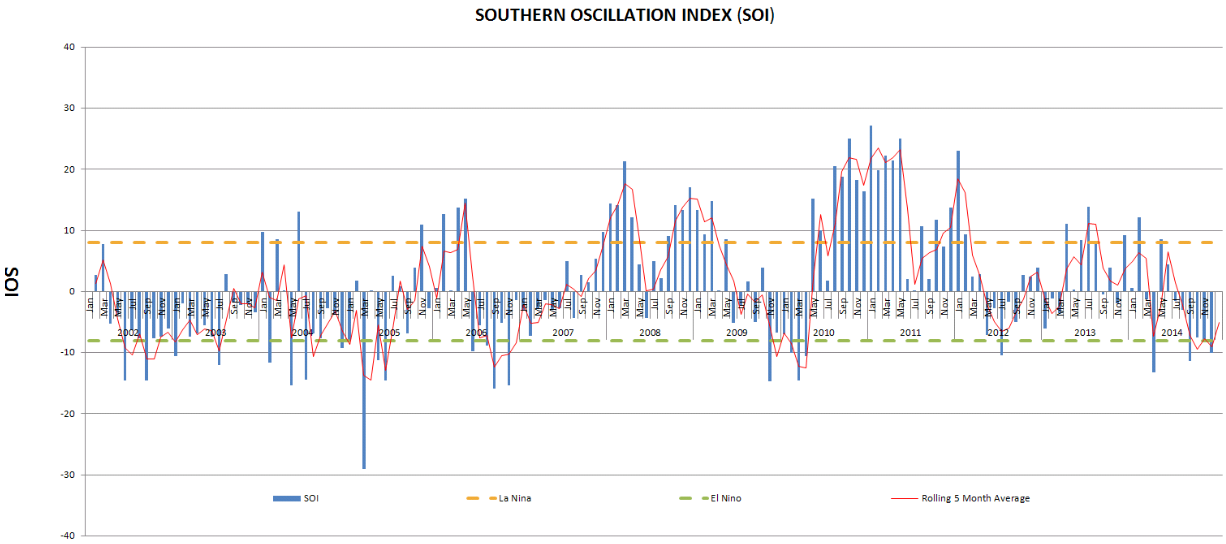


***Figure 4-22: BOM Southern Oscillation Index 2002 - 2014[91]***

### 4.7.3.5 Forecast Pole Failure Modelling

Statistical modelling of predicted pole replacement rates indicates an increasing replacement rate over time as the life of the average pole is consumed in conjunction with natural events such as wind, refer to ESS_17 and ESS_46.

As poles age there is a natural process of fibre strength reduction irrespective of loading[92], the working load on the pole also reduces the strength capacity of the pole over time. Environmental and geographical conditions such as termites and wind influence the replacement rate. Variabilities in the pole in the way that it has grown can affect its life performance (i.e. knots, low sap wood depth etc).

A timber pole has a high probability of failure based on wind return periods with a safety factor of 2 This is demonstrated by modelling of the impact of wind return periods using Coefficient of Variance of 15 per cent to account for variations in the fibre strength, refer to Section 8.3.2 Safety Factor & Failure Probability in ESS_17.

Given the variations for wind based (Figure 4-23) failure around a safety factor of 2. Essential Energy's revised serviceability criteria for reinforcing a pole between a safety factor of 1 and 3 will reduce pole failures due to the wind return periods when compared to the prior regime where a pole was considered for reinforcement if it had a safety factor between 1 and 2. This fact provides evidence that addresses the EMCa Technical Review concern that the revised serviceability criteria are not justified.[93]

Modelling to confirm this utilising Monte Carlo techniques in a Bootstrap random sampling model as presented in ESS_17 (Figure 4-23) shows demonstratively that the prior approach to reinforcement exposed poles to risk of failure due to wind return periods. The advancement of reinforcements as defined in the revised serviceability criteria lifts the safety factor of poles to the extent that a lower failure rate is achieved

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[91] Chart constructed from SOI data available at http://www.bom.gov.au/climate/current/soihtm1.shtml
[92] Spencer, N. J. Hilston Feeder Reinforcement Review. Newcastle : URI Engineering 2014
[93] Review of Proposed Replacement Capex in Essential Energy's Regulatory Proposal 2014 – 2019, EMCa / Strata Energy Consulting, *Oct 2014, Item 116*

approaching the target of 1:20,000 when compared to the current 1:10,000 failure rate. The model provides further justification to address the EMCa Technical Review concern.[93]

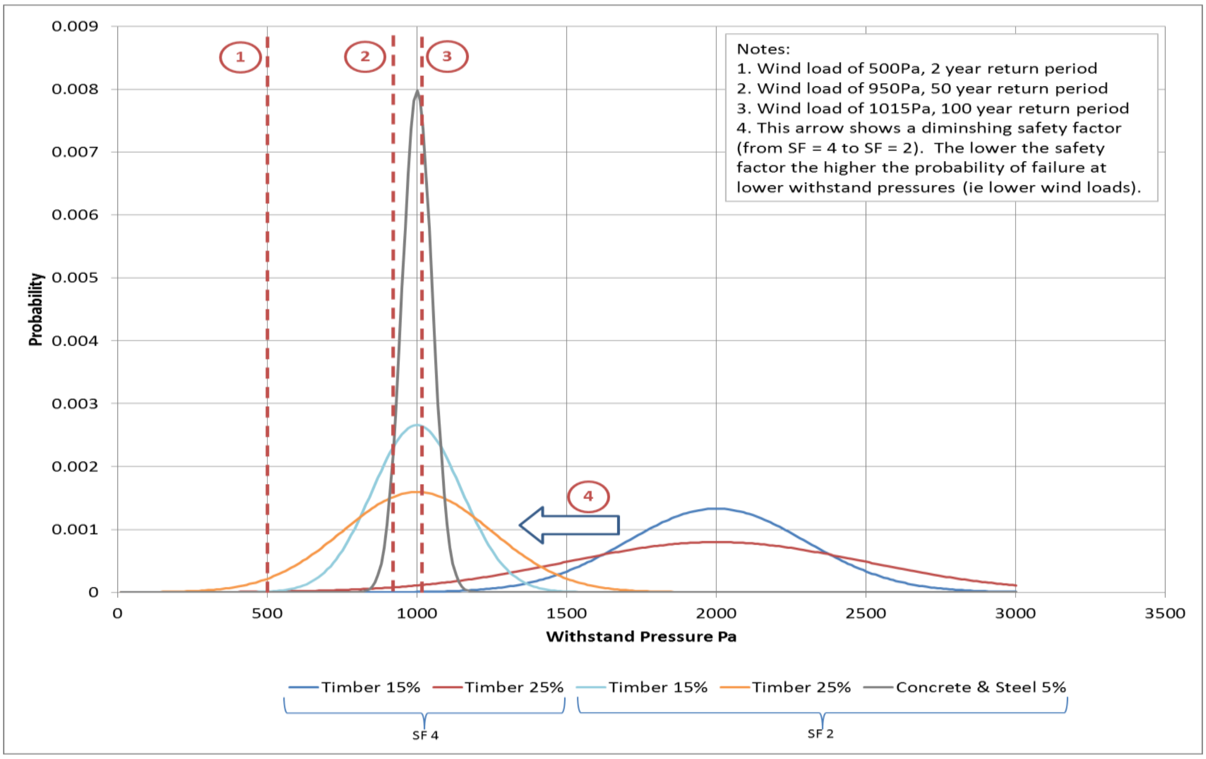


*Figure 4-23: Pole Failure Probability with Wind Return Periods*

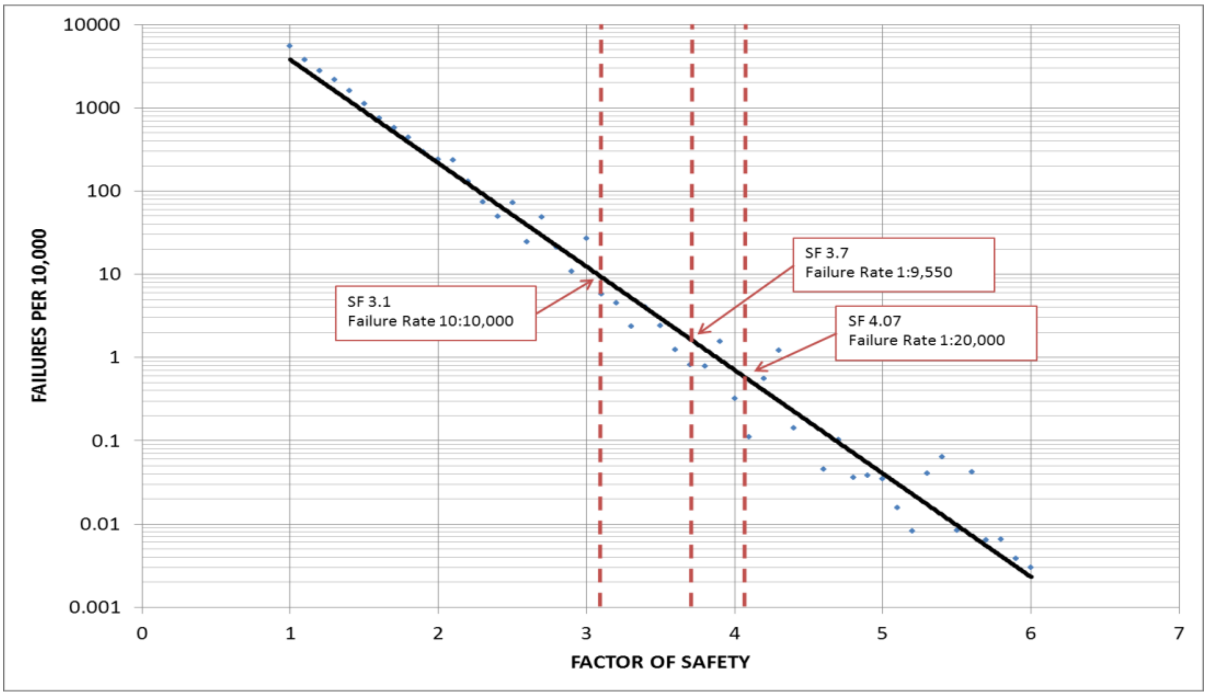


*Figure 4-24: Pole Safety Factor vs Failure Rate*

#### 4.7.3.5.1 Forecast Pole Replacement

Modelling supports the change in Essential Energy's serviceability criteria and shows that both the pole reinforcement rate and pole replacement rates are currently low.

Essential Energy applied a Weibull function to model pole replacements with historical replacement rates (2009/10 to 2013/14) and age calibration (characteristic age of 68). This has been modelled to fit a normal distribution with a mean estimated life expectancy of 74 years. The correlation to a normal distribution has been performed as Essential Energy is aware of the AER's Repex Model utilising a normal distribution, it is reasonable to suggest that the mean of 74 years is optimistic. Nevertheless even with optimistic parameters and a match to a normal distribution the forecast for pole condemnation rates increases from 0.55 per cent to 0.68 per cent in 2018/19. Given the aging population this provides a reasonable prediction at least for the coming 5 year period of the likely pole condemning rate, refer to section 8.3.8 Forecast Pole Replacements - Weibull in ESS_17.

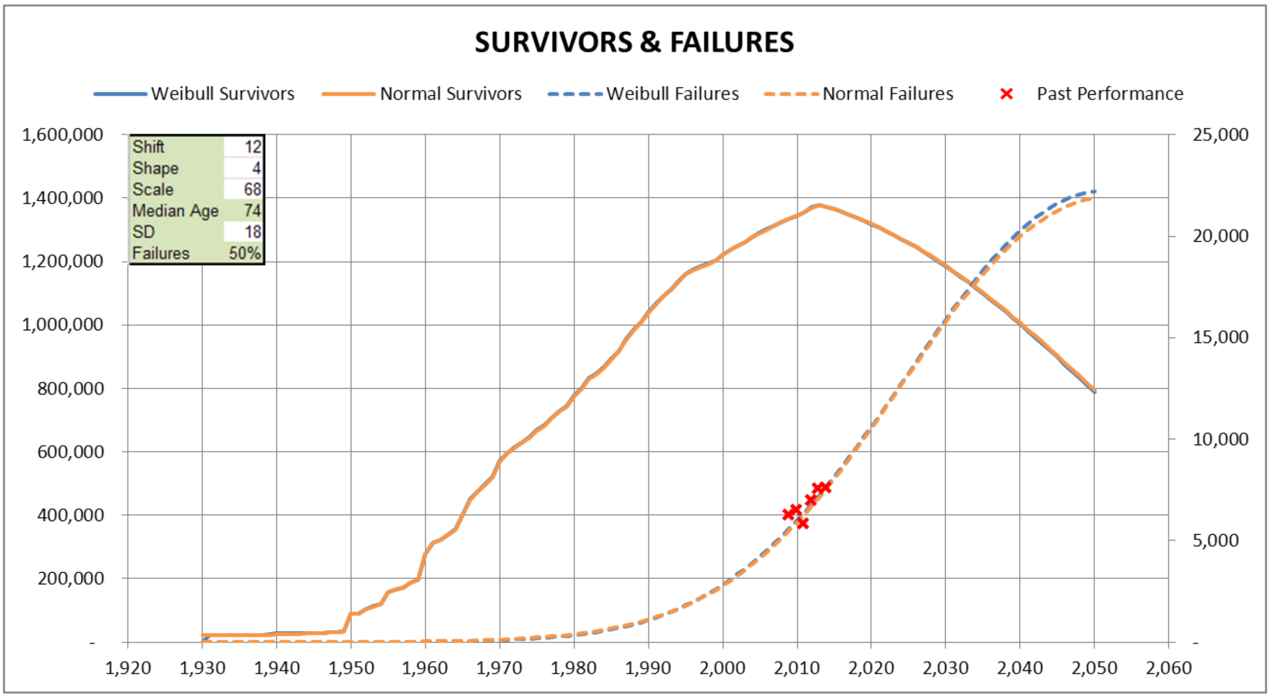


*Figure 4-25: Conditional Pole Failures - Weibull / Normal Distribution Prediction*

The AER / EMCa Technical Review contend that a higher reinforcement rate leads to lower cost.

> *If a higher ratio of pole reinforcement to replacement was prudent, it would deliver a lower overall programme cost. Based on an average pole reinforcement cost of one-sixth to one-seventh of the average pole replacement cost, industry-common life extension results for Essential should lead to a superior economic outcome for equivalent risk.*[94]

This would apply only if the pole population was static, however the average age of Essential Energy's pole population is on the increase over time as replacement rates are not high enough to result in a static pole average age. A portion of poles that are assessed as being suitable for reinforcement will not arrest the increase in average age. From a modelling perspective the number of 'found' poles per annum that are suitable for reinforcement will be constant for this regulatory period as the pole population has yet to reach a stage where the average wall thickness is at a run-away point (notionally this is around 30mm of wall

[94] Review of Proposed Replacement Capex in Essential Energy's Regulatory Proposal 2014 – 2019, EMCa / Strata Energy Consulting, *Oct 2014, Item 113*

thickness where after this point the wall thickness rapidly decays leading to failure). However the pole replacement rate will increase for a number of reasons:

- The average age of the pole population is increasing over time.
- Prior reinforced poles continue to experience timber decay resulting in eventual replacement.
- Poles suitable for reinforcement are expected to remain relatively constant for this regulatory period due to the step change in serviceability and the current point in the expected lifecycle of the average pole. For each year of this regulatory period the poles inspected are a unique set, therefore the same percentage of suitable candidates for reinforcement is to be expected. Subsequent regulatory periods may indeed be different, but for this regulatory period this is a step change in reinforcement practices.

#### 4.7.3.5.2 Implications of Reduced Repex Spend

Essential Energy has the highest pole failure rate in the NEM. It is also not practical to attain a higher efficiency than peer organisations in the magnitude that the proposed allocation would require.

Based on RIN data Essential Energy already has competitive and efficient unit rates for pole replacement and reinforcement as shown in Table 4-16 and Table 4-17. Essential Energy has the lowest unit rate for reinforcement in the NEM and a competitive rate for pole replacement considering the geographical challenges facing Essential Energy (third lowest in the NEM).

*Table 4-16: RIN Unit Rates 2013*

| Unit Rates (2009-13) | Ausgrid | Ergon | Endeavour | Powercor | AusNet | Essential | SA Power | Source |
|---|---|---|---|---|---|---|---|---|
| **Pole Staking** | $ 1,214 | $1,354 | | $828 | $1,529 | $634 | | CA RIN Table 2.2.1 |
| **Poles** | $13,901 | $4,312 | $11,119 | $9,880 | $8,827 | $7,179 | $2,914 | CA RIN Table 2.2.1 |

*Table 4-17: Forecast RIN Unit Rates 2015-2019*

| Forecast Unit Rates (2015-19) | Ausgrid | Ergon | Endeavour | Powercor | AusNet | Essential | SA Power | Source |
|---|---|---|---|---|---|---|---|---|
| **Pole Staking** | $967 | N/A | | N/A | N/A | $800 | | CA RIN Table 2.2.1 |
| **Poles** | $12,789 | N/A | $11,120 | N/A | N/A | $6597 | N/A | CA RIN Table 2.2.1 |

Given that the unit rates are competitive there is no reasonable opportunity to decrease unit rates to maintain the required volumes for pole repex. This leaves a reduction in volumes as the only available option as a shift in reinforcement volumes requires implementation of a higher level of serviceability criteria which leads to higher costs.

If Essential Energy attempts to maintain the same historical ratio of pole reinforcements to replacement in order to contain costs then the projected volumes for each task with a $203M allowance over five years (approximately $40M per annum) are as per Table 4-18.

*Table 4-18: Pole Reinforcement and Replacement Volume Forecast Draft Decision*[95]

| Financial Year | Replacement Volume | Replacement Cost | Reinforcement Volume | Reinforcement Cost | Total |
|---|---|---|---|---|---|
| 2014/15 | 5800 | $34.18 | 911 | $0.80 | $34.98 |
| 2015/16 | 6000 | $35.36 | 942 | $0.83 | $36.19 |
| 2016/17 | 6600 | $38.89 | 1036 | $0.91 | $39.80 |
| 2017/18 | 7300 | $43.02 | 1146 | $1.01 | $44.03 |
| 2018/19 | 8050 | $47.44 | 1264 | $1.11 | $48.55 |
| **Total** | | **$198.89** | | **$4.66** | **$203.55** |

With an average replacement of 6,750 poles per annum and a population of 1.2 Million poles this gives an inferred service life based on age alone of 179 Years, clearly no timber pole will last that long and this is an unsustainable investment arrangement.

Utilising this replacement figure, the average age of the pole population will increase and it is not probable that Essential Energy will be able to even maintain a 1:10,000 pole failure rate, entrenching Essential Energy as the worst DNSP in the NEM with regards to pole failure.

Essential Energy holds grave concerns that over time the pole failure rate will deteriorate under such an investment regime to the point where a regulatory body is forced to intervene to correct the situation, resulting in excessive future cost in order to recover the network performance and ensure safety.

#### 4.7.3.6 Examination of AER Cost Modelling

Essential Energy has examined the AER's application of the information contained in the proposed regulatory submission and RIN data. During this examination Essential Energy has noted some assumptions and omissions that materially affect the AER's modelling with regard to poles. Broader issues with the Repex Model as applied by the AER are noted section 4.3.

##### 4.7.3.6.1 Modelling Assumptions as Applied by the AER

Essential Energy has determined that the calculation basis for the Draft Decision in regard to poles applied by the AER has assumptions that materially affect the outcomes. In regards to poles there are two issues of concern:

- The AER has applied the Ausgrid LV pole staking rate of 47 per cent to Essential Energy's pole replacement population. It is not possible to mix and match reinforcement rates across DNSPs without using the associated serviceability criteria. As demonstrated in Table 8-3 application of the Ausgrid serviceability criteria in Essential Energy carries significant cost implications (approximately $607M over the regulatory period).

- There has been a misinterpretation of the data supplied in the Reset RIN by the AER and subsequently applied by the AER in the Repex Model. In the Reset RIN Asset category the line item "STAKING OF A WOODEN POLE" was filled out by Essential Energy with the number of poles it intends to reinforce in the regulatory period. Essential Energy has determined that the AER has

[95] Unit rates are from ESS_17, table prepared on a simple basis with no allocation for labour or material cost escalations. Inclusion of such costs would clearly year to year reduce the volumes.

interpreted this line item as the number of reinforced poles Essential Energy intends to replace. Consequently this quantity of pole replacements is not included in the modelling.

Essential Energy has not adjusted the forecast quantity of pole replacements however it has adjusted for what Essential Energy believes is an unreasonable substitution of serviceability criteria. As such, the pole replacement expenditure has been reforecast with unit costs based on a staking rate consistent with the rest of Essential Energy's serviceability criteria, 18 per cent.

#### 4.7.3.6.2 Revised Repex Model

Repex Modelling with the assumptions corrected is as per Table 4-19.

*Table 4-19: Pole Investment Revised Modelling Outputs*

| Investment Proposal Source | Model Source | Proposed 5Yr Expenditure $M | Validity Comments |
|---|---|---|---|
| Essential Energy | RIN | $311.619 | Based on reported unit rates and volumes. Includes Investment Case ESS_17 and 46 and also includes several proposed reconstruction projects where the pole replacement component has been allocated in the pole category of the RIN |
| Essential Energy | Investment Case ESS_17 and 46 | $274.261 | Bottom up model based on historical failures, reinforcements and forecast modelling fitted to historical asset performance data |
| AER | Repex Model | $203.989 | Flawed due to the application of Ausgrid 47 per cent reinforcement criteria without the associated serviceability criteria. Utilises blended costs and has no allocation for the misunderstand around 'STAKED POLE' volumes in the Reset RIN |
| Essential Energy Modelling | Repex Model | $253.214 | Corrected reinforcement rates to 18 per cent (ie removed Ausgrid assumption) Utilises blended costs and has no allocation for the misunderstanding around 'STAKED POLE' volumes in the Reset RIN |
| Essential Energy Modelling | Repex Model | $265.305 | Uses calculated unit costs based on forecast expenditure and replacement quantities |

The information presented in Table 4-19 demonstrates the variability in the output from the Repex Model dependent on the input assumption. Given the variability in the Repex Model outputs and range of expenditure outcomes, Essential Energy maintains that the Repex Model cannot be applied in a prescriptive fashion. Further analysis of the sensitivity in the Repex Model as presented in section 4.4 demonstrates a wide degree of expenditure output from the Repex Model. Given the range of expenditure outcomes from The Repex Model and the quantum in variability, Essential Energy's original proposal seems to be well within the realm of reasonableness.

### 4.7.4 Switchgear

For the purposes of the proposal, switchgear assets have been categorised into circuit breakers, switches and fuses. The switchgear category covers assets utilised at both distribution and sub-transmission voltages, located within zone substations and within the distribution network. The switchgear replacement strategies for individual asset types are set out in a number of system investment documents.

The EMCa Technical Review raised concerns around:

> The replacement strategy.

> Step change in the forecast expenditure.

> Increase in proposed expenditure for switchboards and 11kV circuit breakers.

> The application of risk assessment.

> Asset condition information, options analysis and unit costs.

Essential Energy places a high reliance on the safe and reliable operation of its switchgear for a number of interrelated reasons:

> Given the higher equipment failure rates Essential Energy experiences when compared to peers, Essential Energy considers the reliable operation of switchgear imperative to safe operation of its network.

> Essential Energy has an overall low replacement rate and subsequently lower repex per cent spend against the asset base. Essential Energy considers that investment in reliable switchgear manages the safety risk of asset failure; therefore a reduction in switchgear repex compromises Essential Energy's risk appetite. In order to maintain the same risk appetite, Essential Energy would need to consider programmes of work to improve the asset failure performance. This carries considerable cost when compared to a prudent switchgear repex programme.

> Essential Energy operates a radial network with little redundancy in the event of a switchgear failure. Due to the network scale, Essential Energy is heavily dependent on reliable and functional switchgear assets. Essential Energy therefore requires reliable switchgear assets as there is limited switching capability compared to that of a meshed network.

> Switchgear failures have a tendency to cause substantial collateral damage; this is problematic on a radial network as supply cannot be restored via other means. This is particularly the case for indoor switchgear; when a failure occurs generally the entire switchboard is damaged or requires major rectification works, during which time there is no supply to customers. On Essential Energy's network this could amount to days without supply.

The proposed switchgear repex in the Draft Decision is inadequate to undertake the programmes because:

> Essential Energy has assessed a variety of options in each system investment document.

> Essential Energy undertakes a condition-based approach to switchgear replacement.

> Essential Energy has employed initiatives to reduce overall programme costs, by grouping of several asset replacements within the one replacement programme.

> Essential Energy has individual drivers and replacement strategies for different asset categories. The replacement strategies are informed by conditional and functional failure data, historical performance, diagnostic testing and are assessed by risk where known type faults exist.

- The risk assessments undertaken in the system investment documents comply with the risk assessment methodology outlined in CEOP2111.

#### 4.7.4.1 Replacement Strategy

The EMCa Technical Review raised concerns about the switchgear replacement strategy:

- The absence of robust options analysis bias towards the replacement option.
- The absence of a more targeted condition-based approach to switchgear replacement and refurbishment.
- There is little or no meaningful economic comparison.
- The absence of initiatives to reducing overall programme costs.
- Justification for proposed treatment plans is inadequate.

Essential Energy has assessed a variety of options in each system investment document. For low cost assets such as fuses and switches the default option is generally replacement where the asset has been conditionally assessed as defective. For high value assets such as circuit breakers, the system investment document proposes several viable options such as replace, vacuum retrofit, replace components (refurbish) or convert from outdoor to indoor.

Essential Energy undertakes a condition-based approach to switchgear replacement. For distribution network switchgear assets such as switches and fuses, a condition based assessment is undertaken before the asset is identified for replacement. ESS_32 states that *"the refurbishment programme is a condition based programme driven predominantly from the asset inspection programme which has been running since October 2010".* Similarly for assets, such as reclosers, circuit breakers and switchboards, there is a condition based replacement approach implemented that involves long term condition monitoring via diagnostic testing and periodic maintenance regimes. This condition based replacement approach is evident in investment document ESS_78 and ESS_79. The replacement strategy is formulated based on a bottom-up approach that focuses on the asset condition, history and performance.

By utilising a condition based replacement approach, Essential Energy has proposed to deliver an efficient and low cost replacement programme. This is evident by benchmarking Essential Energy's forecast unit costs for switchgear with the NEM benchmarked costs and the Essential Energy historical costs. As shown in Table 4-20 the forecast replacement costs are favourable and are indicative of a prudent and efficient replacement programme.

***Table 4-20: Average Unit Costs***

| | NEM Benchmarked Costs ($000's) | Essential Energy Forecast Costs ($000's) | Essential Energy Historical Costs ($000's) |
|---|---|---|---|
| Fuses | 2.3 | 2.1 | 3.8 |
| Switches | 41.3 | 36.5 | 46.5 |
| Circuit Breakers | 100.1 | 125.3 | 182.8 |

Furthermore, Essential Energy has employed initiatives to reduce overall programme costs. Essential Energy has achieved this by grouping of several asset replacements within the one replacement programme. An example is the pole top switchgear replacement programme (ESS_12).

Programme justification is adequate and is clearly identified in the various system investment documents. For high value assets such as circuit breakers and switchboards, each asset model has been individually justified based a condition assessment, conditional and functional failure history and known type faults. The programme timing is clearly identified in relation to the volume of work being undertaken and in relation to historical levels.

For lower value assets such as fuses, switches and distribution reclosers, a general programme justification is evident in each system investment document. Generally for these types of assets, replacement at historical levels is maintained unless there is an increase or decrease in the failure rate or failure experience.

The EMCa Technical Review raised a specific concern regarding pole top switchgear replacement[96]. As indicated in ESS_12 – Pole top Switchgear Replacement, a specific asset replacement initiative began in 2007 to replace high voltage air break switches (ABS) with fully enclosed switchgear. This programme focused on the high risk ABS devices that were conditionally assessed as defective. The programme expenditure ramped up each year until 2013/14. The proposed programme strategy is to maintain a steady rate of replacement, removing high risk porcelain ABS from the network.

#### 4.7.4.2 Forecast Replacement Quantity

The EMCa Technical Review raised concerns that the strategy for replacement of switchgear was primarily to continue the current replacements based on historical levels. The replacement strategies are informed by conditional and functional failure data, historical performance, diagnostic testing and are assessed by risk where known type faults exist. Essential Energy has individual drivers and replacement strategies for different asset categories which are discussed below:

- Generally for high quantity, low cost switchgear assets located within the distribution network such as ABS, links, fuses and reclosers, Essential Energy proposes to maintain historical levels of replacement. This strategy is applicable to a simple asset category where historical constant failure rates are being experienced. In some cases, Essential Energy has proposed a reduced level of forecast replacements due to a decline in failure rates due to technology changes.

- Generally for low quantity, high cost assets located within zone substations such as circuit breakers and switchboards, Essential Energy does not propose to maintain historical levels of expenditure. Essential Energy considers it would not be prudent or appropriate to use historical levels of replacement for these assets. Each asset proposed for replacement has been conditionally assessed using information from periodic maintenance regimes and inspections. These assets are then forecast for replacement when they are no longer in a serviceable and safe condition.

As shown in Figure 4-26 the aggregated switchgear replacement is consistent and below historic levels. Consideration has been given to the quantum of the previous switchgear replacement programmes when developing the forecast replacement programme.

[96] Review of Proposed Replacement Capex in Essential Energy's Regulatory Proposal 2014 – 2019, EMCa / Strata Energy Consulting, *Oct 2014, Item 129*

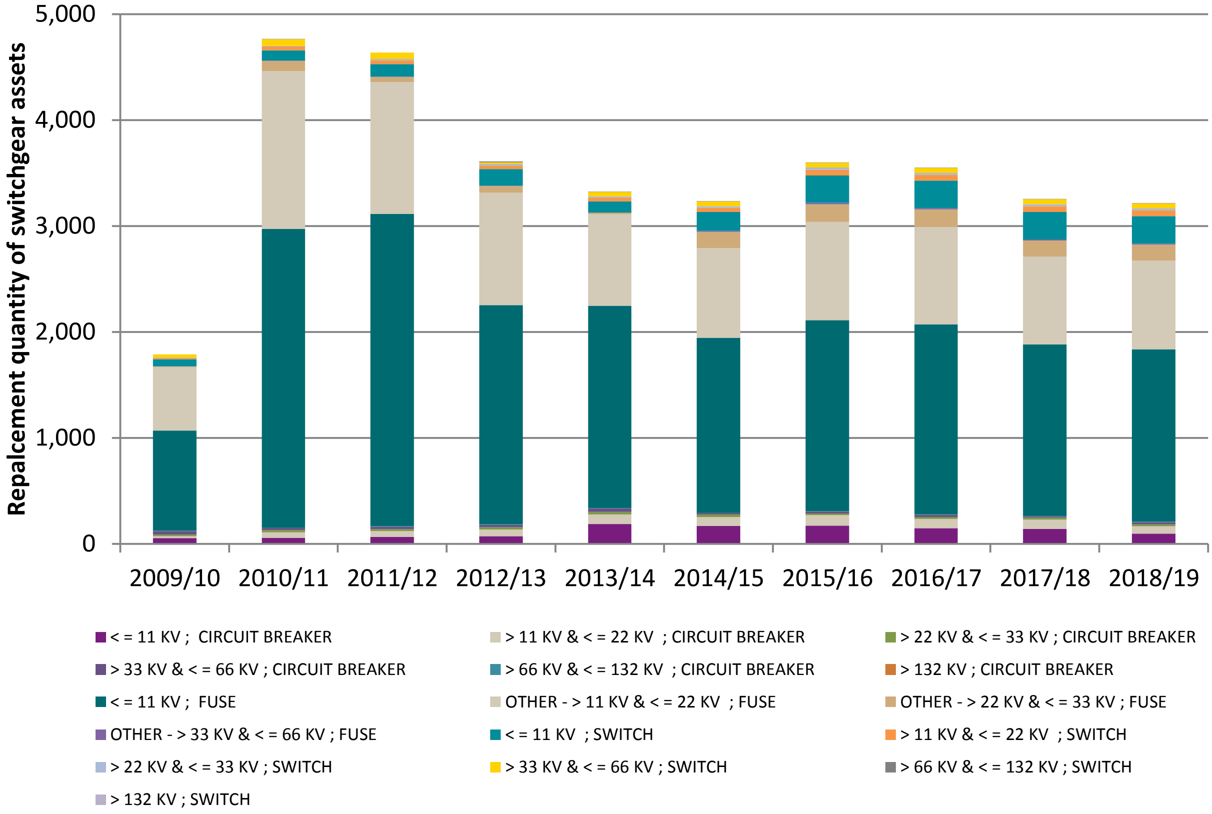


***Figure 4-26: Switchgear replacement quantity***

#### 4.7.4.3 Forecast Repex

The EMCa Technical Review has raised concerns over the forecast switchgear repex:

- The proposed expenditure in the RIN is not aligned with the replacement approaches set out in the investment proposals.
- Expenditure for 11kV circuit breakers has increased with the step increase evident in 2013/14 not adequately explained.
- There has been a significant increase in proposed expenditure for switchboards and reduced expenditure for circuit breakers.
- Insufficient quantitative analysis to support the proposed step change in replacement expenditure for 11kV circuit breakers.

As shown in Figure 4-27, the proposed expenditure in the RIN aligns with the fuse, switch and circuit breaker replacement approaches set out in the investment proposals.

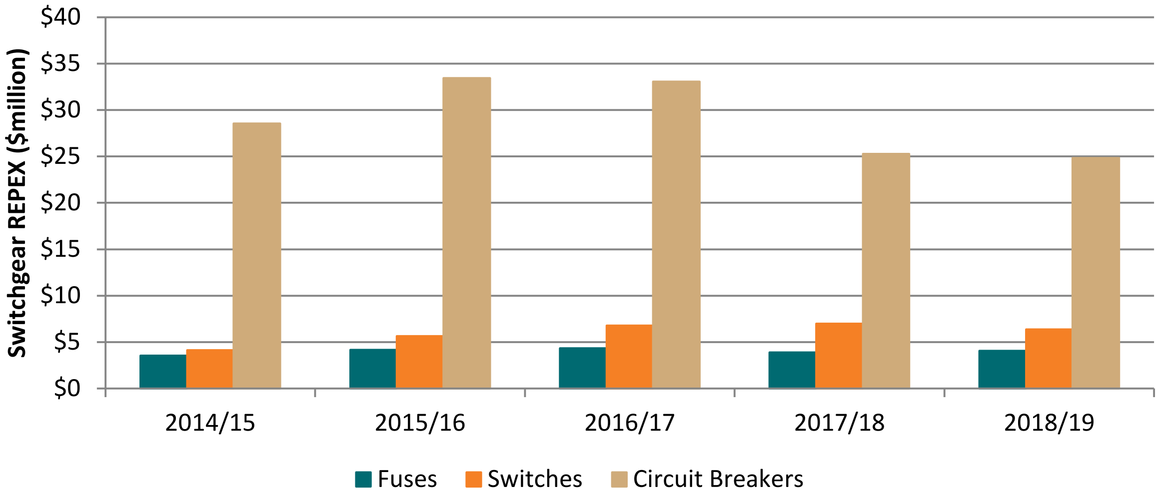


*Figure 4-27: Proposed switchgear expenditure from the RIN*

**Fuses**: As shown in Figure 4-27, the RIN indicates the proposed expenditure for fuses is relatively constant across the 2014/15 to 2018/19 regulatory control period. This expenditure aligns with the replacement approach outlined in ESS_32 – Distribution Overhead Substation Refurbishment. ESS_32 is a replacement programme formulated from a condition based assessment of the overhead substation high voltage components and switchgear. The programme proposes a stable replacement forecast across the 2014/15 to 2018/19 regulatory control period as conditional failure rates remain consistent with historical experience.

**Switches:** As shown in Figure 4-27, the RIN indicates the proposed expenditure for switches is lowest in 2014/15, while remaining relatively constant for the remainder of the 2014/15 to 2018/19 regulatory control period. The proposed expenditure directly aligns with the replacement strategy outlined in ESS_12 – Pole top Switchgear Replacement. The replacement strategy involves *"… 210 devices for the initial year of the regulatory period and then 314 devices per year for the remainder of the regulatory period…".* This is a reduction on the previous replacement programme due a large quantity of defective switches being replaced in the 2008/09 to 2013/14 regulatory control period.

**Circuit Breakers:** As shown in Figure 4-27, the RIN indicates the aggregated expenditure for circuit breakers is relatively consistent with historical levels. Figure 4-28 identifies a step increase in proposed repex for 11kV circuit breakers which is aligned with the replacement approach identified in ESS_78 and ESS_79. Each 11kV circuit breaker has been individually assessed in the investment cases ESS_78 and ESS_79 as part of a bottom–up assessment approach to determine the most appropriate form of investment.

Condition based analysis such as the Failure Mode, Effect and Criticality Analysis (FMECA) has combined Essential Energy failure experience with industry failure experience to identify common failure modes of assets. This analysis has provided Essential Energy with a deeper understanding of its circuit breaker fleet and condition. Essential Energy deems the replacement of the identified 11kV circuit breakers to be prudent, efficient and in line with current industry practices.

As the circuit breaker population ages, it is becoming increasingly difficult and expensive to purchase and install failed components for older circuit breaker models. Essential Energy has over 8,300 circuit breakers (including distribution reclosers) installed from over 40 manufacturers. In some cases only single units remain in-service with little or no available spare components. As shown in the Net Present Value (NPV) analysis in ESS_78, refurbishment of these circuit breakers is not an economically viable option.

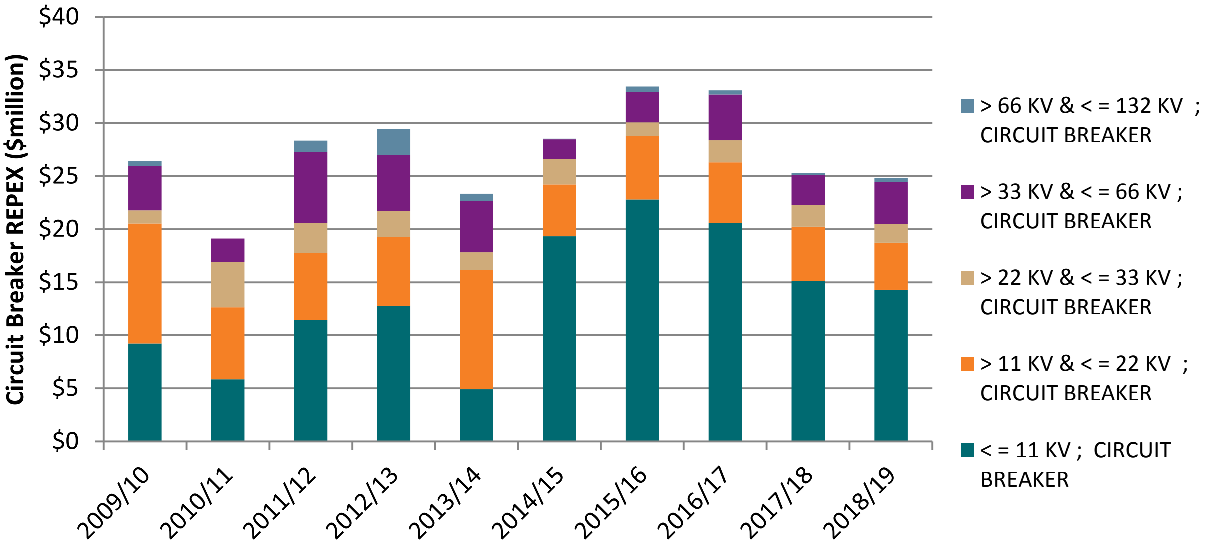


***Figure 4-28: Repex for circuit breakers 09-18***

At the time of the EMCa Technical Review, the 2013/14 data was a forecasted estimate. The category analysis RIN has since been updated with the actual repex for the 2013/14 financial year. As shown in Figure 4-28, there was no step increase in repex in 2013/14 and the aggregate repex for circuit breakers is relatively consistent across the 2014/15 to 2018/119 regulatory control period.

The increased expenditure for 11kV circuit breakers is a reflection of the poor asset class condition. All circuit breakers are conditionally assessed via diagnostic testing to determine their serviceability and priority for replacement. Essential Energy has proposed an increase in 11kV circuit breaker repex due to the ongoing deterioration of that asset class. The primary drivers for circuit breaker replacement are:

- To replace oil-filled circuit breakers which are at their end of serviceable life and present a high risk of failure.
- To replace circuit breakers that have known type faults that present a high frequency of conditional or functional failures.

Essential Energy has proposed to increase investment in indoor circuit breakers (switchboards) while reducing expenditure in outdoor circuit breakers. The shift in expenditure can be attributed to a change in circuit breaker replacement strategy. Essential Energy has sites where it is more prudent and efficient to replace end of life outdoor circuit breakers with indoor switchboards. Historically, Essential Energy would perform a like for like replacement of outdoor circuit breakers. This replacement option has technical, operational and economic benefits and is referred to as a conversion from outdoor to indoor. This investment approach is discussed in ESS_79.

A second reason for increased switchboard expenditure is the implementation of a vacuum retrofitting programme. In the 2014/15 to 2018/19 regulatory control period, Essential Energy proposes to implement vacuum retrofits to switchboards that contain end-of-life oil circuit breakers. Vacuum retrofitting a switchboard is only an option for a select number of models. Eleven (11) retrofits were trialled in the 2008/09 to 2013/14 regulatory control period and have proven to be an economically viable replacement option for serviceable switchboards that contain end-of-life circuit breaker trucks. The expenditure for vacuum retrofits has increased from $550,000 in the 2008/09 to 2013/14 regulatory control period to $6,250,000 in the 2014/15 to 2018/19 regulatory control period. This investment approach is discussed in ESS_79.

#### 4.7.4.4 Application of Risk Assessment

The EMCa Technical Review raised concerns about:

- The asset condition information, risk assessment, unit cost assumptions and options analyses provided are individually and collectively insufficient to conclude that Essential has selected the prudent and efficient approach, timing and volume of activity.
- Risk assessment in the various Investment Cases in this category is based on a risk framework that differs from the Corporate Matrix.
- The assessed risk consistently appears to be biased towards conservatism.
- The risk assessment was not relied upon in developing the balanced programme.

Condition information for the majority of switchgear assets is more than adequate and accurate due to periodic maintenance and inspection regimes as well as diagnostic testing (refer to section 4.7.4.1).

The risk assessments undertaken in the system investment documents comply with the risk assessment methodology outlined in CEOP2111 (refer to section 4.6.3).

The forecast unit cost information is typically lower than the NEM average and is lower than the Essential Energy historical unit costs (refer to section 4.7.4.1 and Table 4-20).

The EMCa Technical Review raised a specific concern, stating:

*the application of the risk assessment factors in the ESS_78 investment case leads to business interruption risk being rated as 'very high' (the highest possible rating). The risks are added together to give an overall risk that is also rated as 'very high';* [97]

Regarding business interruption risk, Essential Energy in many cases is limited to distribution network switching in order to restore supply from adjacent feeders. Due to the network size and length, restoration is further limited by voltage constraints. Using the risk assessment criterion set out in CEOP2111, the business interruption risk is calculated to be 'very high'. When aggregated with the other risks (financial, safety, environmental, reputational) the risk remains at 'very high'. As indicated in ESS_78 and ESS_79, Essential Energy has had experience with explosive failure of circuit breakers. The risk assessment completed in system investment documents complies with the risk criterion set out in CEOP2111 and is an appropriate illustration of the hazards and risks presented during a circuit breaker explosive failure.

Furthermore, Essential Energy operates a radial network with a high equipment failure rate (see Table 4-11), consequently Essential Energy places significant reliance on the reliable and safe operation of its circuit breakers. This is critical to reduce risk to the public, and limit the scale of the outage. Given the asset fault density that Essential Energy has compared to its peers, it is clear that Essential Energy's circuit breakers are operated more frequently on average than its peers. This frequency of operation is directly linked to the expected service life of the circuit breaker mechanically and electrically.

The EMCa Technical Review raised a specific concern, stating:

*the ESS_79 investment case for switchboards only considered the failure of a bulk oil circuit breaker, which suggests the risk assessment was not relied upon in developing the balanced programme;* [98]

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[97] Review of Proposed Replacement Capex in Essential Energy's Regulatory Proposal 2014 – 2019, EMCa / Strata Energy Consulting, *Oct 2014, Item 129*

[98] Review of Proposed Replacement Capex in Essential Energy's Regulatory Proposal 2014 – 2019, EMCa / Strata Energy Consulting, *Oct 2014, Item 129*

The risk assessment methodology, was relied upon in the development of the indoor circuit breaker replacement programme (refer to section 4.6.3.2). Considering that 270 of the 353 circuit breakers identified for replacement are oil filled, Essential Energy deemed it most appropriate to include a risk scenario which covered the majority of assets proposed for replacement.

### 4.7.5 Conductor

The EMCa Technical Review raised specific issues about Essential Energy's conductor replacement programmes:

> The quantity of replacement.

> Deliverability.

> Estimating accuracy.

> Options analysis.

The conductor programme will be delivered at the proposed rates and associated expenditure:

> Essential Energy models the forecast failures over the five year period and is delivering as planned for the 2014/15 forecast.

> Deliverability is a low risk issue in terms of volume of work and associated expenditure.

> The average cost to deliver reconductoring projects to November 2014 was $45,192/kilometre of conductor. This is only 3.5 per cent higher than the programme estimate of $43,604/kilometre.

> Essential Energy has assessed options to replace conditionally failed small conductors, decommission redundant small conductors and support customers moving off-grid where it is economically efficient.

Further, the basis of the programme has been misinterpreted in the EMCa Technical Review.

#### 4.7.5.1 Basis of Programme

The programme is for condition based replacement of bare overhead conductors. The flat profile reflects the expected rate of failure and is not constrained by delivery.

The EMCa Technical Review states (EMCa 139):

*The expenditure forecast clearly aligns with Essential's strategy to focus on ≤11kV conductor replacements. The flat profile across the RCP is consistent with the Investment Case which denotes that the programme is delivery constrained, not based on asset condition or age*.

Condition assessment is the optimal method to determine conductor replacement need. Essential Energy utilises inspection data in conjunction with outage data to identify conductors that are failing and are in need of replacement. The vast majority of the spend profile is for thin gauge conductors such as steel and copper. Essential Energy has found that corrosion related failures for steel and copper conductors is highly prevalent on the coast up to approximately five to ten kilometres from the sea line (this is approximate and varies from location to location). For inland areas, the main concern is the loss of galvanising on steel conductors, once the galvanising has been consumed, the failure rate of the conductor accelerates.

On a project by project basis justification is required that details the problem with the conductor (i.e. annealing, broken strands, excessive failures or corrosion). An example project justification that considers these factors is included in APPENDIX B – Project Justification Example.

The flat profile for replacement volume is an averaged profile; it is not possible to determine in advance year to year variations in the actual spend profile based on conductor replacement priority driven from a bottom up project basis. The programme is not delivery constrained, it is condition based.

#### 4.7.5.1.1 Criteria for a Conditional Failure

Once conductors are determined to be conditionally failed they must be replaced to prevent functional failure which would be at a higher cost to Essential Energy and the community. If these conductors are left in service the following unacceptable risks remain:

> If the conductor is repaired repeatedly, eventually it will be unable to be restrung without breaking, resulting in an extended outage to customers while the conductor is replaced.

> Risk of a fatality through direct contact with a live fallen conductor.

> Risk of a fatality through close proximity or transferred potential (which a member of the public cannot predict) from a live fallen conductor.

> Risk of a bushfire with fatalities.

Relevant strategy documents include:

> CEOP8022 Network Management Plan – Bushfire Risk Management Plan.

> CEOP8029 Network Management Plan – Network Safety and Reliability.

Conditional failure is determined from:

> The asset inspector’s defect reports.

> Information from any further inspection.

> Failure rate of the line.

> Identification as a poor performing feeder.

> Amount of repairs to the line already apparent (for example number of splices).

> Condition of similar conductors already removed in the area (where available).

### 4.7.5.2 Level of Expenditure

The EMCa Technical Review raises concerns about the optimisation and deliverability of the level of expenditure.

Essential Energy has compared the forecast failures to a mathematical model to ensure optimisation over the five year period and is delivering as planned for the 2014/15 forecast.

#### 4.7.5.2.1 Forecast Volumes

The volume of small conductors which will conditionally fail is estimated from present and historical condition and failure and defect data. Mathematical modelling using age as a proxy for condition of small conductors has been used to provide a check of the proposed replacement volume.

Historically failure volumes on average are increasing at five per cent per year, as shown in Figure 4-29. For the past four years, despite the existing replacement programme, the defect rate of broken strands and corroded conductors requiring action is increasing at five per cent per year in spite of benign weather conditions. This is after the start of the current reconductoring programme. The upward trend is also evident for in service failures of conductors that are condition related (corrosion, decay, mid span splice failure, fatigue, vibration) since the start of the reconductoring programme, as shown in Figure 4-30.

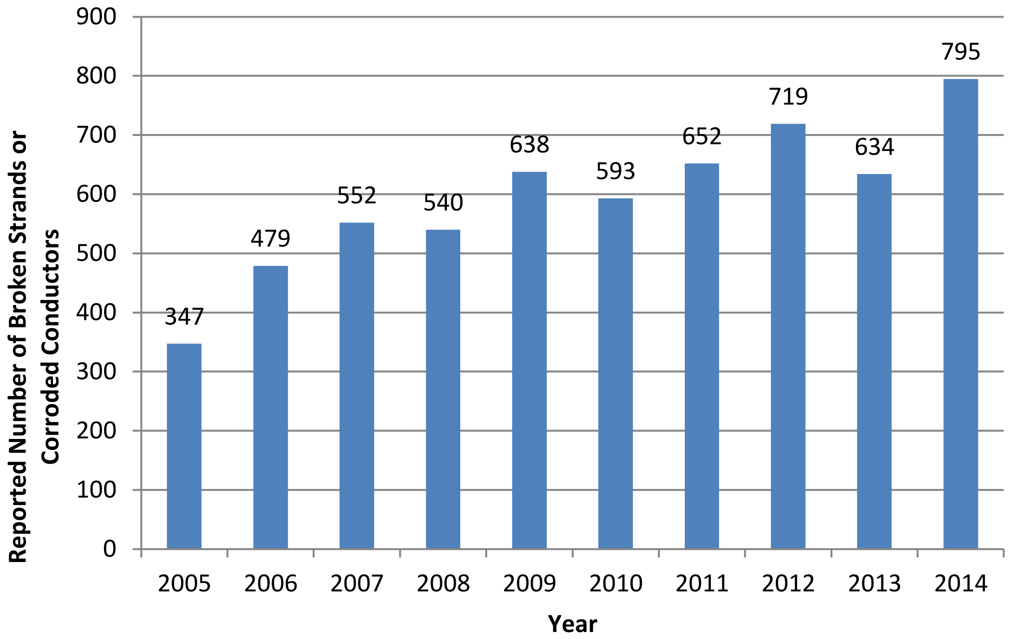


*Figure 4-29: Broken Strands and Corroded Conductors reported by year*[99]

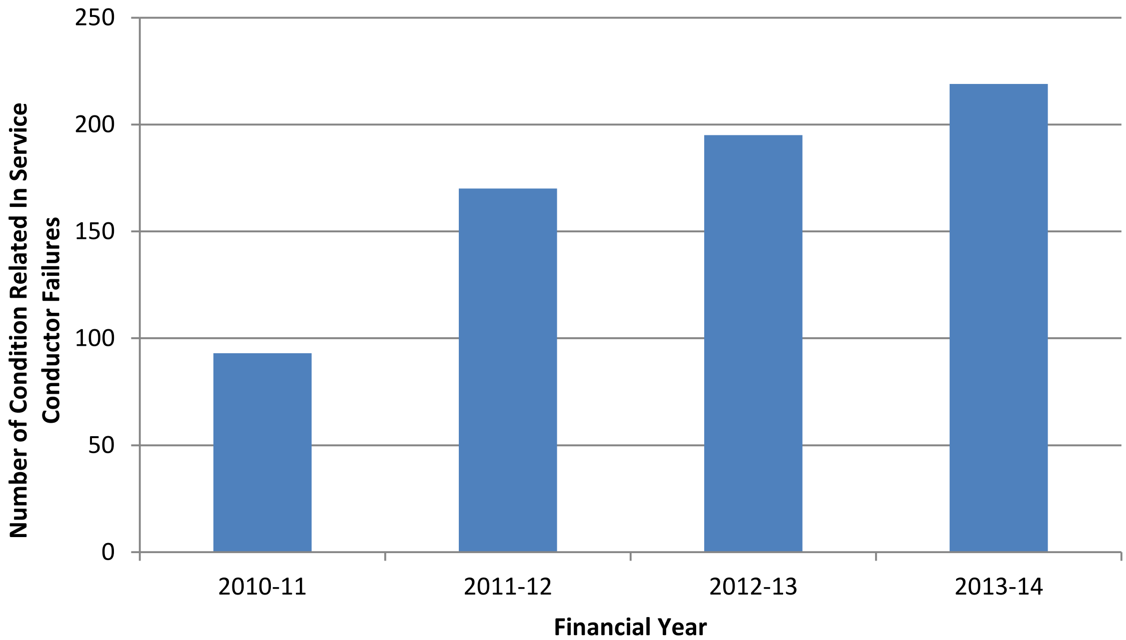


*Figure 4-30: Network Failures – Conductors – Condition Related*

[99] 2014 data estimated from Jan-November 2014 data as 11.75/11 * actual November figure to allow for December – assuming minimal inspection work in last week of December 2014

The forecast conditional failure volume and associated repex profile are shown in Table 4-21.

*Table 4-21: Forecast reconductoring programme*

| | 2014/15 | 2015/16 | 2016/17 | 2017/18 | 2018/19 | Total |
|---|---|---|---|---|---|---|
| Replacement volume (km) | 275 | 306 | 345 | 385 | 433 | 1,744 |
| Unit Rates ($/km) | 43,604 | 43,604 | 43,604 | 43,604 | 43,604 | 43,604 |
| Forecast repex ($m 2013/14) | 12.0 | 13.3 | 15.0 | 10.8 | 18.9 | 76.0 |

The programme is based on the average across the five years period (350 kilometres/year):

- The relationship between age and condition is not precise and is only used to develop a forecast.
- Replacement will be determined by the condition of the conductors and therefore will vary from the proposed programme year to year.

Essential Energy's mean age to replacement is 85.5 years based on the modelling used above when calibrated for all conductors, rather than just small conductors. This is favourably comparable to other DNSPs, as shown in Table 4-22.

*Table 4-22: Average age to replace conductors*[100]

| | CitiPower | Powercor | AusNet | Jemena | United Energy | Aurora | Benchmark |
|---|---|---|---|---|---|---|---|
| Asset replacement age | 86 | 79 | 87 | 68 | 85 | 61 | 76 |

### 4.7.5.3 Deliverability

The EMCa Technical Review raises concerns around deliverability of the reconductoring programme and the step changes.

Deliverability is a low risk issue in terms of volume of work and associated expenditure:

- Essential Energy is already achieving the required volume of work this financial year.
- There is no significant step change in the total programmes requiring resources used for reconductoring. Any step change in the reconductoring programme is not significant for deliverability.
- Essential Energy has previously delivered these expenditure levels.
- Essential Energy's organisational structure and reporting systems facilitate the monitoring of projects delivered on this programme of work and associated expenditure, and implement change as necessary to ensure that expenditure and volumes of work delivered remain on track over the five year period.

#### 4.7.5.3.1 Essential Energy is Achieving the Required Volume of Work

Essential Energy is already achieving the required volume of work.

The reconductoring programme estimate is for 330 kilometres of distribution reconductoring and 20 kilometres of subtransmission reconductoring.

[100] Nutall Consulting, Report – Principle Technical Advisor, Aurora Electricity Distribution Revenue Review, Nov 2011 – data based on 2004/05 to 2008/09 period

44 reconductoring projects[101] were completed in the 2014/15 financial year to mid November 2014; this accounts for $5.809M expenditure for the first 140 days of the year, and includes scoping, design and construction. This rate of expenditure in $/kilometres is in accordance with the proposal, and equates to $15.1M at the end of the financial year. The expenditure this financial year is on track to achieve the proposed annual expenditure of $15.78M, as shown in Figure 4-31.

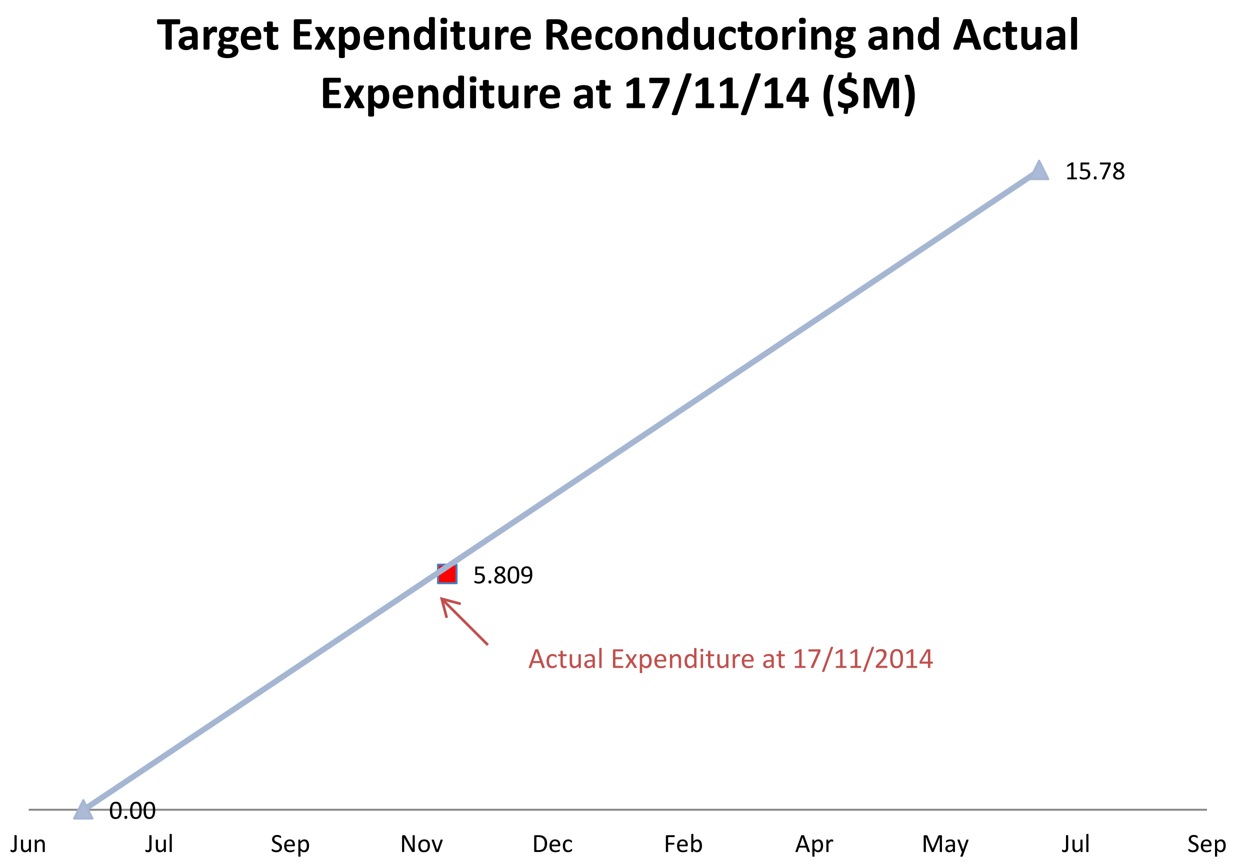


*Figure 4-31: Target Expenditure on Reconductoring vs Actual*

#### 4.7.5.3.2 Step Change is not Significant for Deliverability.

An increase in the volume of reconductoring programme does not represent a threat to deliverability.

The total augmentation and replacement capital expenditure on lines and cables (ie: excluding zone substations and zone substation switchgear, SCADA and communications, land purchases) is less than the levels delivered during the 2009 -14 regulatory period, as shown in Figure 4-32.

[101] Essential Energy 100% reconductoring projects (PIP 16)

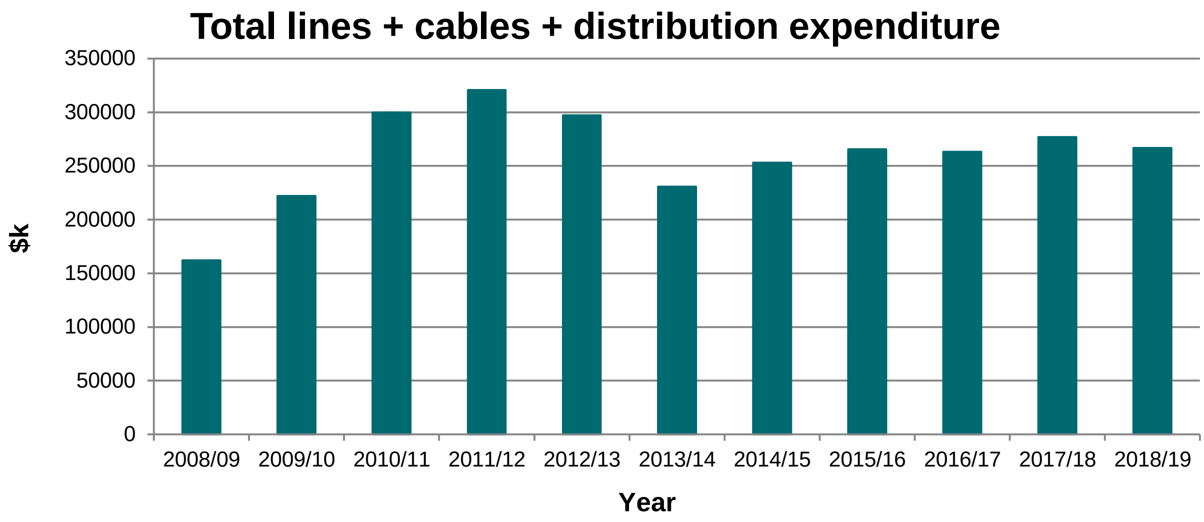


***Figure 4-32: Total lines, cables and distribution expenditure***

#### 4.7.5.4 Estimating Accuracy

The EMCa Technical Review raised concerns about the estimating accuracy.

The average cost to deliver reconductoring projects to November 2014 was $45,192/kilometre of conductor. This is only 3.5 per cent higher than the programme estimate of $43,604/kilometre.

Whilst this is an indicative costing and may be impacted by design parameters on an individual project basis, at a programme level the average cost will be similar to the base costing. Although estimated from the bottom up, the estimate was reconciled against real projects to ensure it was realistic.

#### 4.7.5.5 Options Analysis – More Innovative Approaches

The EMCa Technical Review raised concerns about options analysis and lack of innovative approaches.

Essential Energy intends to:

- Replace conditionally failed small conductors.
- Decommission redundant small conductors.
- Support customers moving off-grid where it is economically efficient.

The current replacement rate gives an implied life of some 312 years, which is obviously not viable. It is evident that the number of kilometres of small conductors reaching conditional failure will increase in future decades and based on current NPV analysis the replacement rates for this conductor type will need to increase in future decades.

The planned reconductoring at conditional failure, as the single option against run to functional failure, is the only reasonable option. Option 2 of the Investment Case[102] describes the approach to be taken for the significant portion of the work required, which will be reconductoring.

[102] Essential Energy System Investment Document ESS_16 Replacement of Bare OH Conductor

A small proportion of the conductors targeted for replacement will be removed as during the five year period they become redundant. The average expected rate has been used in developing the unit rates and therefore is accounted for in the costings. The proportion is very small and it is reasonable at this stage not to estimate this cost separately.

Essential Energy is open to new technologies to allow customers to be grid independent, where it is economically efficient. The impact on the proposal forecast in the five year regulatory period will not be significant because:

> Essential Energy cannot force[103] a customer onto an off grid independent electricity supply. There is no evidence or forecast of customers choosing to leave the grid.

> The Net Present Cost difference for Essential Energy to supply a typical light rural customer[104] in this manner is presently over $120,000 in favour of reconductoring on a 40 year basis. It is not expected to close significantly within this regulatory period.

> It remains the case that new customers[105] are still connecting to the grid as this remains the cheapest alternative for reliable electricity supply. Customers will not choose to go off grid as the gap between the cost of off grid power versus grid power is too great.

> Customers in the west of the state under the Far West Electrification scheme are unlikely to accept leaving the grid. These customers lobbied for grid connection, and paid more than $40,000 per homestead, and actual cost for additional connections.

Essential Energy will where possible use alternatives to reconductoring with customers; the number of such customers will not be significant. For instance, Essential Energy is working with one customer with a radio site for the customer to be grid independent in return for the grid independent supply cost being covered by Essential Energy. However this situation is unusual in that:

> The line length requiring reconductoring is six kilometres long.

> There are only two customers on the line, the other of which no longer takes supply.

> The radio site demand is less than 1.6 kWh / day.

> The customer only requires only 1.4 kWh of battery storage.

> The customer has other radio sites and is skilled in the management of remote area power supplies.

> The installed cost of this system is only approximately $30,000.

#### 4.7.6 Transformers

The EMCa Technical Review raised specific issues around Essential Energy's transformer repex:

> The documentation provided does not adequately justify the difference in the RIN expenditure profiles between the 2008/09 to 2013/14 and 2014/15 to 2018/19 regulatory control period.

[103] The National Energy Retail Law (NSW) Division 2 clause 66(1) states "A distributor must, subject to and in accordance with the energy laws, provide customer connection services for the premises of a customer – (a) who requests those services (b) whose premises are connected, or who is seeking to have those premises connected to the distributor's distribution system."

[104] The average demand profile of even a very lightly loaded (not typical) rural feeder is around 4 kWh / day per customer, with peak demand around 2 kW and there is around one customer / kilometres. The cost of a system to give reasonable reliability (ie: it must provide adequate supply through a five day period without significant sunlight) and therefore at least 20 kWh, would be $65,000. (The battery cost is currently around $5,000 per 3kWh)

[105] A recent customer in the west of the state constructed 8 kilometres of SWER line to the grid to supply their property (which has a peak demand of 13 kW and a maximum daily usage of 76 kWh).

- The transformer repex forecast for the 2014/15 to 2018/19 regulatory control period is based on rudimentary assumptions about optimal refurbishment rates (e.g., two per cent per annum) or replacement rates based on historical levels, with qualitative reference to costs and benefits.
- No evidence of a robust cost-benefit analysis of the various options for all transformer classes.
- No economic justification of standard size transformers for replacement units.

These findings were based on a review that contained repex for non-transformer assets.

#### 4.7.6.1 Definition of Proposed Programme

The programmes reviewed under the transformer asset class are not all direct replacements of transformers. As a result of this clarification Essential Energy believes that on review of these programmes and given the lifetime's assets they relate to, the programmes represent prudent expenditure

The EMCa Technical Review has assessed four repex programmes for transformers:

- ESS_70 - zone substation power transformer refurbishment ($7M);
- ESS_71 - zone substation power transformer replacement ($31M);
- ESS_31 - enclosed substation refurbishment programme ($30M); and
- ESS_32 - overhead substation refurbishment programme ($38M).

Two of the four sub-programmes detailed within the review are not driven by transformer replacement:

- ESS_31 - enclosed substation refurbishment programme is driven by the need to address associated equipment including switchgear and enclosures. However it does involve some transformer replacement when significant conditional failures, such as defective tank or defective housing are identified as part of a specific condition assessment.
- ESS_32 - overhead substation refurbishment programme is designed to address the shorter lifetime and significant safety issues that are created by the equipment associated with a pole top substation to extend the life of the pole substation to the life of the pole structure. The programme is designed to complement our much smaller condition based transformer replacement programme (ESS_30) and Essential Energy's general approach of run to functional failure for the pole top transformer asset class.

Zone substation power transformer replacement (ESS_71) and zone substation power transformer refurbishment (ESS_70) both specifically relate to replacement or refurbishment of power transformer assets.

#### 4.7.6.2 Stability of Forecast Transformer Expenditure

The repex profiles for distribution transformers are stable, whilst the repex profile for power transformers reflects large components of expenditure at specific points in time.

There are two clear types of transformer assets within the RIN repex, both of which have different expenditure profiles, as shown in Figure 4-33:

- The distribution assets (including all pole top transformer assets and kiosk assets) which have a stable and predictable investment profile as one would expect. As this investment is related to identified conditional failures of a large stable asset population.

> Larger power transformers which display a year to year shift in expenditure. This asset class goes through peaks and troughs of investment as each asset is a high cost long lived asset that is subject to specific condition monitoring to defer large investment until required.

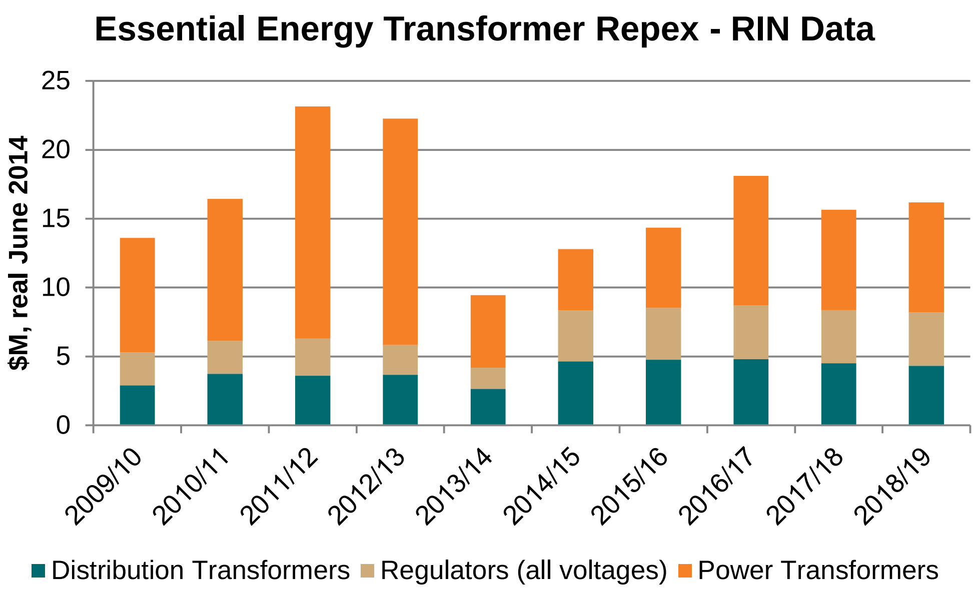


*Figure 4-33: Essential Energy transformer repex as presented in RIN data used by EMCa*

#### 4.7.6.3 Refurbishment Rate for Substation Equipment

The overhead substation refurbishment programme (ESS_32) is a condition based distribution substation equipment refurbishment programme; the pole top transformers and poles do not form part of this refurbishment programme, but are contained in ESS_30. The refurbishment rate of two per cent is a top-down sensibility check, rather than the defined criteria that drives the programme.

The need for this programme is underpinned by the difference in lifetimes of the core substation assets (pole top transformer and pole) to the surrounding equipment (EDO fuses, surge diverters, droppers, connections, shrouds, earthing etc.). The pole top substation and pole estimated mean lifetime is 74 years. Refurbishment of the specific pole top assets (not transformers) that have deteriorated is required to achieve the full service life of the pole and pole top substation. The two per cent estimated rate, along with the current fault and emergency equipment rate, provides an asset lifetime of 39 years, which is at the limit of the average functional age limit of the targeted equipment.

#### 4.7.6.4 Replacement Strategy

The EMCa Technical Review noted that Essentials Energy's strategy of standardising transformer sizes has not been well justified. Essential Energy has reviewed its transition to a standardised power transformer model and identified quantifiable capital savings and yet to be quantified operational savings.

Historically there has been little commonality across the fleet of power transformers due to the historic amalgamation of the network. This means operational savings in terms of spares holding and standardisation of secondary equipment design are hard to quantify but are likely to be realised as Essential Energy continues on its approach.

The measureable savings based on efficiency of design and acquisition have been identified through quantifying an analysis of past power transformer procurements and typical overheads for the procurement and design of power transformers the following costs savings have been identified:

> Procurement overheads ≈5 per cent – these include the development and adjustment of a tender specifications as well as the costs of following the procurement process; including drafting of T&C, assessing offers, etc.

> Manufacturing design ≈8 per cent – this is the typical cost associated with providing a design for an individual transformer in the typical size range for Essential Energy's network (this data has been sourced from Essential Energy's standard supply partners).

> Type testing ≈3 per cent - this is the cost associated with the additional tests that are required for a new transformer design (this data has been sourced from Essential Energy's standard supply partners).

The cost savings outlined above have proven typical for Essential Energy's common transformer size, and resulting in a reasonable average cost saving on standardisation to allow multiple unit procurement of between 11 per cent - 17 per cent (a range is provided as the exact percentage change varies between specific procurements and projects). Note that this data does not consider the additional savings that can be realised through economics of scale by leveraging our purchasing power due the increased volumes within standard sizes as well as the operational benefit of having standardised transformer; which are hard to quantify at this stage of the standardisation process.

From an asset management perspective standard sizes and designs avoid complications with regard to faults, maintenance and installation that are apparent with a bespoked size and design. Thus by utilising a standard design and size Essential Energy is minimising future maintenance and operational costs by standardising its fleet of transformers.

Essential Energy has determined the basic standardised size range of 2.5/3MVA, 5/8MVA, 10/16MVA, 20/30MVA along with designs for standard fitment integrate well into the existing zone substation network; helping to avoid added civil construction expenditure. At these sizes the typical price differential between standard sizes is similar to costs that are likely to be incurred in going to market for a design between the listed standard sizes. These standard sizes save between 26 per cent and 28 per cent in capex cost as shown in Table 4-23.

*Table 4-23: Example indicative cost estimated - sourced from investment case ESS_71*

| Rating (MVA) | Voltage (kV) | Indicative cost estimates | Estimated cost for non-standard transformer between standard sizes[106] # | **Variance** |
|---|---|---|---|---|
| 2.5/3 | 66-33 / 33-22-11 | $420,000 | $531,100 | 26% |
| 5/8 | 66-33 / 33-22-11 | $520,000 | $661,050 | 27% |
| 10/16 | 66-33 / 33-22-11 | $650,000 | $830,550 | 28% |
| 20/30 | 66-33 / 33-22-11 | $820,000 | $1,050,900 | 28% |
| 24/30 | 132 / 33-22-11 | $1,040,000 | $1,040,000+ | - |

#### 4.7.6.5 Cost-Benefit Analysis

As discussed in Section 4.6.6 the Investment Cases ESS_31 – enclosed substation refurbishment programme ($30M) and ESS_32 - overhead substation refurbishment programme ($38M) are not transformer replacement programmes. These programmes are related to replacement in the main of conditionally failed switchgear components and substation enclosures.

Zone substation power transformer replacement (ESS_71) and zone substation power transformer refurbishment (ESS_70) both specifically relate to replacement or refurbishment of power transformer assets. Both programmes are condition based with works prioritised based on a ranking process that

[106] based on the midpoint cost between standard sizes with additional one off costs for transformer procurement/design typically being 13%

considers the condition of Essential Energy's entire power transformer fleet. In assigning assets between both of these programmes there is a condition assessment followed by an economic assessment that uses a generalised risk profile based of Essential Energy's historic failure data. By using both of these assessments as part of the management of the Essential Energy power transformer fleet the lowest lifecycle costs are delivered for the transformer fleet.

### 4.7.7 Cables

The EMCa Technical Review raised specific issues around the cable replacement programme:

> Historical expenditure provided in the RIN appears not to be reliable for cables.

> Proposed underground conversions are for lines that are not owned by Essential Energy, but by private landowners.

> Absence of sufficiently robust economic analysis providing evidence that the apportionment of costs between the specific rural customers (benefiting from the change from overhead to underground) and Essential Energy's other customers is reasonable.

> As Essential has a relatively immature fault record (twelve months' data) it seems to have relied on the experience of its peers to determine the risk posed by CONSAC cables and its strategy.

> The options analysis is very rudimentary – only one option is considered, with no cost-benefit analysis.

> The cost estimate is also rudimentary and there may be opportunities to reduce the average unit rate by combining the work with other planned work.

Essential Energy in response provides the following:

> The step change in the forecast expenditure is not reflected by the Repex Model, as the historical data is inaccurate.

> The incentive offered to change overhead to underground is equivalent to the cost not incurred for maintenance. No additional outlay by the general electricity consumer is required.

> Essential Energy is proposing to mitigate the CONSAC cable risk by undertaking 14 projects per year at a cost of approximately $270,000 per project. For the 2014/15 to 2018/19 regulatory control period this equates to $18.9M.

#### 4.7.7.1 Historical Expenditure

The step change in the forecast expenditure is not reflected by the Repex Model, as the historical data is inaccurate:

> Historical data has not been captured accurately in accounts for individual CONSAC replacement projects.

> A refurbishment and replacement programme has been implemented recently to remove cables as they become problematic.

> Rural overhead mains defects are exhibiting an increasing failure trend necessitating a strategy for replacement or undergrounding.

#### 4.7.7.2 Proposed Underground Conversions

The EMCa Technical Review raised concerns about the Overhead Rural LV Conversion to Underground (ESS_29_S).

The incentive programme has been extended to all rural overhead LV mains, of which only a small percentage have been identified as being truly dedicated private infrastructure.

Rural dedicated low voltage assets fall into four categories:

> Category 1. Assets that were constructed by the DNSP and predecessors and have always been owned, maintained and replaced by the DNSP.

> Category 2. Assets which were originally constructed by various parties but DNSPs or their predecessors have elected to take ownership of the assets for maintenance and replacement management.

> Category 3. A smaller volume of low voltage assets where it is not possible to establish private ownership and as such Essential Energy must act as if we do own the assets and therefore are obliged to maintain and replace them. This places additional resource burden on Essential Energy to meet its regulatory obligation to safely manage these services.

> Category 4. Which is a smaller subset of LV dedicated assets that are privately owned which Essential Energy inspects only and the owner funds the maintenance and replacement.

The programme for undergrounding rural low voltage assets refers to Categories 1, 2 and 3 considered to be LV mains for which there is an ongoing obligation for Essential Energy to manage.

Asset ownership is not well defined as many of these assets were managed by local council supply entities when installed which is evident in the asset age profile presented in figure 16 in ESS_29_S.

The incentive based programme adopted by Essential Energy benefits the community as a whole by reducing the risk of bushfires and a reduction in the maintenance liability for these assets. Essential Energy agrees with Powercor's principle in reference to the 2009 Victorian Bushfires Royal Commission that:

*… an obligation to investigate the benefits associated with undergrounding to reduce fire danger both from a stand point of ensuring it meets its own objectives, but also from a societal perspective given the benefits from undergrounding largely accrue to the community as a whole.* [107]

Land owners that have rural low voltage overhead assets that Essential Energy is responsible for located on their properties and the assets identified as requiring replacement or significant maintenance due to asset condition, safety hazards associated with low conductor spans and or ongoing vegetation management issues are offered an incentive to underground the asset. Further data collated over the 2013/14 fiscal year has provided additional clarity into the apportionment of costs to Essential Energy's customers. The incentive offered is the total amount calculated to return the overhead network to a serviceable 'like for like' standard after inspection when conditional failures or safety issues are identified. Either Essential Energy carries out the 'like for like' works or Essential Energy provides an incentive payment equal to the required 'like for like' restoration works for the land owner to contribute to installing underground low voltage mains.

For example, if the cost of the required rectification works on an overhead LV network 'like for like' is calculated to be $10,000 then this sum of money is offered to the landowner as the incentive to underground the asset. No additional outlay by Essential Energy is required and there is no cross subsidisation through network tariffs by other customers as Essential is required to incur an equivalent expense regardless which

107 Exhibit 578 – Response to Essential Services Commission Electricity Distribution Price Review 2006–2010 Position Paper – Undergrounding (PAL.019.001.2095) at 2097–2098

option is selected by the land owner. Essential Energy believes that this is a fair and equitable arrangement that benefits the community as a whole.

***Table 4-24: NPV of the Overhead Rural LV Conversion to Underground***

| | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|
| **Count of poles rebated/year** | 626 | 626 | 626 | 626 | 626 |
| **Incremented cost of pole rebate/pole** | $5,504.36 | $5,628.36 | $5,755.36 | $5,885.36 | $6,018.36 |
| **Total pole rebate cost** | $3,445,729.36 | $3,523,353.36 | $3,602,855.36 | $3,684,235.36 | $ 3,767,493.36 |
| **Pole removal cost escalated** | $2,582.00 | $2,693.03 | $2,809.38 | $2,931.35 | $3,059.21 |
| **NPV of pole removal** | $2,213.65 | $2,137.81 | $2,064.98 | $1,995.03 | $1,927.82 |
| **Total pole removal costs** | $1,385,744.17 | $1,338,269.60 | $1,292,678.10 | $1,248,886.13 | $1,206,814.15 |
| **Grand total of PRP/year** | $4,831,473.53 | $4,861,622.96 | $4,895,533.46 | $4,933,121.49 | $4,974,307.51 |
| **Grand total rebate** | **$4,590,272.47** | **$4,614,988.23** | **$4,643,333.58** | **$4,675,225.02** | **$4,710,582.98** |
| **Total Incentive Cost for regulatory control period** | **$23,234,402.28** | | | | |

The forecast cost of $23.23M for the proposed programme has been averaged over the 2014/15 to 2018/19 regulatory control period which equates to $4.65M per annum. Table 4-24 details the output resulting from an economic analysis conducted using the LV Overhead to Underground model[108].

Based on historical records, Essential Energy has been removing approximately 600 poles per annum that attract the overhead to underground conversion rebate. The proposed replacement of 626 poles per annum for the 2014/15 to 2018/19 regulatory control period is therefore considered to be achievable.

#### 4.7.7.3 CONSAC

In review of the Low Voltage (LV) Concentric Neutral Aluminium Conductor (CONSAC) Replacement (ESS_43), Essential Energy has noted that the per unit cost of replacing these cables was underestimated.

At the time the ESS_43 PIP was determined, limited installation cost data was available. Recent project expenditures for nine projects that included CONSAC cable replacements provide an updated unit cost of $572,935 as detailed in Figure 4-34. This is a significant variation to the initial per kilometre cost estimate.

Due to the environmental diversity of the nine projects analysed, the estimated replacement cost per kilometre has a significant standard deviation and therefore provides a reasonable average cost.

[108] Essential Energy - LV OH 2 UG_edited_Incentive to Underground - Model v3.0.xlsx

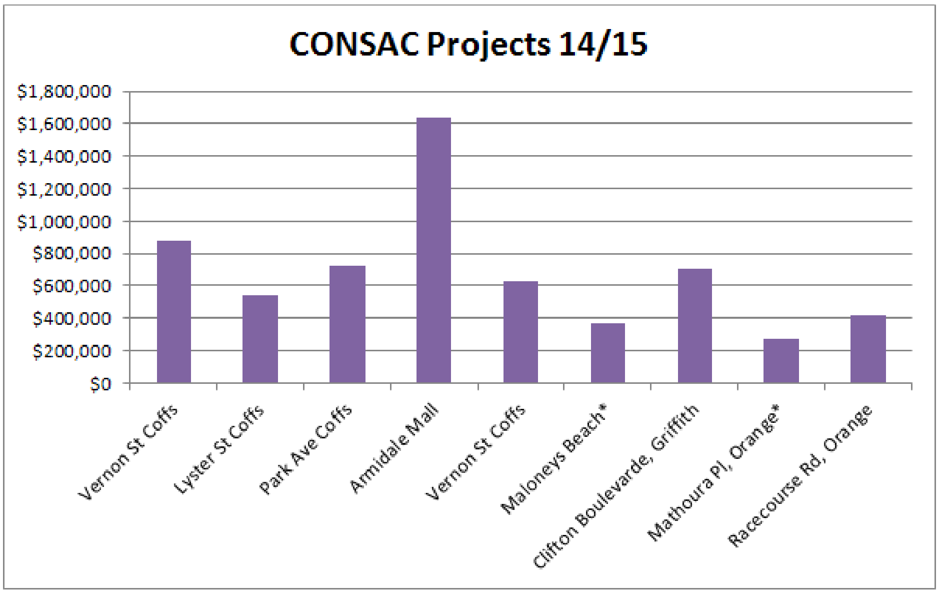


*Figure 4-34: CONSAC Projects 2014/15 Cost per kilometre*

*Table 4-25: CONSAC Expenditure by Project Cost per kilometre*

| Project | | Type of Work | Forecast Total project expenditure | Forecast CONSAC Expenditure | Metres of CONSAC | $/km |
|---|---|---|---|---|---|---|
| 668546 | Vernon St Coffs | CBD, cables already in ducts | $97,021 | $97,021 | 110 | $882,009 |
| 665568 | Lyster St Coffs | CBD, cables already in ducts | $161,680 | $161,680 | 300 | $538,933 |
| 668104 | Park Ave Coffs | CBD, cables already in ducts | $95,921 | $95,921 | 132 | $726,674 |
| 644668 | Armidale Mall | CBD, abandon existing and trench | $390,301 | $390,301 | 239 | $1,633,059 |
| 668178 | Vernon St Coffs | CBD, cables already in ducts | $537,222 | $537,222 | 854 | $629,066 |
| 685313 | Maloneys Beach* | Residential, abandon existing and underbore | $419,940 | $335,952 | 910 | $369,178 |
| 683104 | Clifton Boulevarde, Griffith | Residential, abandon existing, mix trench and underbore | $214,638 | $214,638 | 306 | $701,431 |
| 689425 | Mathoura Pl, Orange* | Residential, abandon existing and underbore | $164,289 | $83,787 | 310 | $270,282 |
| 696058 | Racecourse Rd, Orange | Residential, abandon existing and underbore | $281,327 | $281,327 | 675 | $416,781 |
| **Total** | | | **$2,362,339** | **$2,197,849** | **3836** | **$572,953** |

Essential Energy has utilised information from peer DNSPs for its options analysis. Industry experience in applying alternative strategies to prolong the operational life of LV CONSAC cable networks has proven to be ineffective in improving ongoing service reliability. The option analysis has resulted in a reactive run to failure replacement programme which provides the most cost effective outcome. Based on Essential Energy data and a review of other DNSP practices with regard to CONSAC this option has been determined as good industry practice and is exercised by Australian DNSPs (Ausgrid[109], Aurora Energy[110], ActewAGL[111],Ergon, Energex[112]) having similar CONSAC cable network integrity issues.

A comprehensive industry option analysis conducted by Ausgrid provides detail on the management strategies available for CONSAC cables. Essential Energy's methodology associated with CONSAC cable

[109] Ausgrid - ACAPS4030 LV Underground CONSAC Cables_FINAL.pdf
[110] Aurora Energy - AE029 - Management Plan 2011 - Underground System.pdf
[111] ActewAGL - B17.3 Asset Specific Plan - Underground Cables - 2014.pdf
[112] Energex Regulatory proposal 2009

management aligns closely with Ausgrid, which itself aligns closely with the greater electricity industry. A number of options are available to manage the risk and economic burden that CONSAC cables present:

- **Option 1: Do nothing.** This involves the continual repair of failed cable sections and is an ineffective method in the mature management of this infrastructure. A number of disadvantages are inherent with this strategy. These include resource constraints due to the work being emergency restoration of service, disturbing the asset which leads to increased likelihood of future faults, increased number of joints where faults can manifest, no planned strategy for future augmentation and increased risk with time.

- **Option 2: Planned Replacement in 2015.** This is an extremely low risk high fiscal burden option. Apart from the deliverability constraints with labour and materials, the disruption to the network would be considerable.

- **Option 3: Planned Replacement in 2014/15- 2018/19 regulatory control period.** Similarly to option 2, this is a low risk high fiscal burden option, although the deliverability constraints could be managed; however additional labour resources would be required to supplement this planned replacement option.

- **Option 4: Planned Replacement over 15 years.** This is a medium risk having a moderate fiscal burden.

- **Option 5: Reactive Replacement Upon Failure.** This is a high risk strategy involving the complete replacement of the failed cable and associated furnishings. This strategy attracts a low to moderate fiscal burden requiring the reactive availability of labour and material resources.

The run to failure strategy (option 5) adopted by Essential Energy proposes to replace only cables that exhibit failure in the 2014/15 to 2018/19 regulatory control period as this option is supported by the failure rates recorded. Essential Energy deems the systematic replacement of all CONSAC cables in the regulatory control period to be unnecessary based on the failures experienced. Expenditure evaluation over the balance of this period may identify the longer term strategy required for future regulatory control period submissions.

To manage the ‘run to failure’ CONSAC replacement a project selection guide (draft) has been recently developed as a revised strategy and details a method of identifying and prioritising these networks based on five parameters; history of faults, highly disruptive situations, high repair cost, other network benefits and the planners knowledge of the asset. Each parameter is weighted using a point system ranking them into four risk categories; low, medium, high and very high. Essential Energy’s strategy to address the business risk associated with CONSAC cables is to replace the networks attracting a very high and high risk evaluation when they fail, detailed in Table 4-26 and Table 4-27.

*Table 4-26: CONSAC Cable Risk Evaluation Parameters*

| Criteria | | Allowance |
|---|---|---|
| **Fault History** | Project includes CONSAC assets that have experienced a fault | 4 |
| | A fault has occurred due to the mid-run deterioration undisturbed CONSAC cable | 3 |
| | Additional CONSAC faults | 1 point for each additional fault |
| **Disruptive Situations** | A fault has the potential to cause consumer damage, disruption of local community, business, high profile or a large number of customers, pose a safety risk | 2 |
| **Repair Cost** | The repair of a fault could incur a high cost but does not significantly improve the value of the asset | 1 |
| **Aged Asset Replacement** | The project includes replacement of other aged assets | 1 |
| **Additional constraints/ benefits** | Efficiency gains in project consolidation, access implications, staff resources and customer consultation / objection. | Max 2 |

*Table 4-27: CONSAC Cable Project Priority Ranking*

| Project Priority | Score |
|---|---|
| Very High | 10+ |
| High | 7 – 9 |
| Medium | 4 – 6 |
| Low | Less than 4 |

From October 2012 to October 2014, 36 CONSAC cable failures have been recorded in Essential Energy's Electrical Network Incident (ENI) database which equates to 18 per annum. Given the detail provided in Table 4-25 and the failure rate data available a programme investment plan of $18.9M ($2012/13) for the 2014/15 to 2018/19 regulatory control period is required.

### 4.7.8 Cross Reference to the Specific Responses

Cross reference to the response to each issue is provided in Table 4-28.

*Table 4-28: Specific Issues Identified in the EMCa Technical Review*

| Ref | Issue | Section |
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| 1 | In our view, the scale of the adjustment applied by the NNSW Board (i.e., a 16 per cent reduction to the capex allowance first developed by Essential Energy) indicates that Essential Energy's internal management challenge process for its proposed expenditure, was inadequate, either in terms of the prudency of the repex work (volume and timing) and/or the cost of the work. | Attachment 6.2 Capital Governance<br><br>4.6.4 |
| 2 | From the information provided to us, it is evident that Essential Energy followed the CASH/PIP methodology as prescribed by NNSW when assembling and approving its proposed repex portfolio. However, it is unclear what approach Essential Energy used to recast its portfolio following the 16 per cent reduction in overall capex imposed by the NNSW Board. Moreover, it is not clear by what proportion (if any) the repex component of total capex was reduced. | Attachment 6.2 Capital Governance<br><br>4.6.4 |
| 3 | The 'Capital Governance Framework' provided to us by Essential Energy appears to be out of date (updated in 2011) and does not reflect our understanding that the framework should operate in accordance with the NNSW Board's requirements. | Attachment 6.2 Capital Governance<br><br>4.6.4 |
| 4 | Essential Energy's governance approach includes an asset management framework which does not yet align with good industry practice. We found material issues with its implementation of portfolio management, investment planning and delivery management approaches. Whilst we found that Essential Energy has sufficient asset information to determine which assets need attention, we are concerned that poor data quality and options analysis compromise its decision making. | Attachment 6.2 Capital Governance<br><br>4.6.4, 4.6.5 |
| 5 | Essential Energy has proposed increasing repex for the 2014/15 to 2018/19 regulatory control period. This is likely to be different from historical work due to higher volumes of brownfields work. It does not appear to have applied sufficient consideration to deliverability risks when planning its repex programme. In particular, we would expect to see a resourcing and delivery strategy that identified the inevitable resourcing challenges and set out strategies for their mitigation. We would expect the repex programme to be scoped in line with such a strategy. | 4.6.10 |
| 6 | Essential Energy's repex activity forecasts are developed on a bottom-up basis. However, the quality of supporting data and analysis is questionable. We found that its approach has:<br>> material issues with the quality of its asset data and its asset knowledge base;<br>> over-reliance on simplistic forecasting in some asset classes; and<br>> overly conservative risk assessments. | 4.6.5<br><br>4.6.3 |
| 7 | It was not always clear how Essential Energy derived the prescribed volume of work to be undertaken, or how any associated delivery risk was considered and whether it was mitigated adequately. | 4.6.6<br><br>4.6.10 |
| 8 | There was a lack of compelling justification of the need for step changes in activity from the 2004/05 to 2008/09 regulatory control period to the 2014/15 to 2018/19 regulatory control period and of the total volume of work required. This casts doubt on the prudency (i.e., volume, timing and cost) of its proposed repex programmes. | 4.5 |
| 9 | Essential Energy's risk-based repex justifications are a cause for concern, due to Essential Energy's use of a variety of risk assessment tools and an apparently over-conservative application of risk criteria. This reduces our confidence that its risk rankings are internally consistent, in turn reducing the likelihood of selecting the optimal mitigation action(s). Its approach to risk assessment often appears to be overly conservative due to unreasonably high frequency assumptions for major and catastrophic consequences. | 4.6.3 |

| Ref | Issue | Section |
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| 10 | In general, Essential Energy's repex strategies are not subject to robust options analysis. The quality of options assessment varied greatly between asset groups and asset classes:<br>> In many cases only a perfunctory review of the 'do nothing' option was presented, typically declaring that the option was dismissed as it led to intolerable risk; and<br>> In many cases only the recommended option was discussed as an alternative. | 4.6.6 |
| 11 | We would expect that Essential Energy would evaluate a range of options, considering life extension strategies and hybrids of replacement and life extension strategies, together with scenarios of alternative work volumes and/or deferral. | 4.6.6 |
| 12 | In the available information, we found a lack of robust cost-benefit analysis, even for preferred options. Commensurate with the magnitude of the repex proposed, we would expect to see comprehensive cost-benefit analyses based on robust input data for a range of credible options. The lack of robust cost-benefit analysis for credible options diminishes the prospect of Essential Energy selecting the correct strategy. | 4.6.6<br><br>4.7.6.5 |
| 13 | The proposal documentation does not provide adequate visibility of Essential Energy's cost estimation process. Essential Energy did not provide a standalone cost estimation methodology document. We needed to infer its approach from the AMPs and Investment Cases that we reviewed. It is also unclear how Essential Energy's project estimates treat estimation risk that might arise due to its scope creep experience in the 2008/09 to 2013/14 regulatory control period. We did not see compelling evidence of Essential Energy's claims that is was pursuing more efficient unit costs. We remain unconvinced that the cost estimation approach is sufficiently robust. | 4.6.7 |
| 35 | From this data, it can be seen that the three major asset groups targeted for expenditure are: poles and pole top structures ($319M); switchgear ($155M); and overhead conductors ($79m). Collectively, these three programmes equal $553M or 64 per cent of total forecast repex. These proposed expenditures can be seen to generally reflect a continuation of major programmes undertaken in the 2008/09 to 2013/14 regulatory control period. It is also evident from this information that the proposed repex for the three 'poles and wires' categories (i.e., poles and pole top structures, overhead conductors and service lines) has been calculated simply as a 20 per cent increase on prior period expenditure. | 4.7.2 |
| 37 | Essential Energy's proposed repex of $863M for the 2014/15 to 2018/19 regulatory control period reflects an increase of $166M (24 per cent) compared to actual repex of $697M for the 2008/09 to 2014/15 regulatory control period. From Figure 2 below, it can also be seen that the proposed expenditure allowance would, if the work is undertaken, reverse the decline trend in repex that has occurred since 2011/12. | 4.6.2 |
| 42 | The AER noted significant proposed expenditure of $109M on refurbishment / renewal /replacement of sub-transmission equipment, including zone substation buildings, with little justification other than age. | 0 |
| 43 | The AER also flagged that Essential Energy proposes a 17 per cent increase in proposed pole replacements, with a lower rate of reinforcement than other DNSPs and unwarranted additional conservatism inherent in the way that it specifies safety factors. | 4.3.2.2 |
| 44 | Whilst enhanced governance practices imposed by the NNSW Board are evident, there remain gaps between Essential Energy's governance processes and what we would consider appropriate for a DNSP of its size. | 4.6.4 |
| 45 | Essential Energy's asset management systems, data quality and analysis do not adequately support prudent investment decision-making and justification. | 4.6.5 |
| 46 | We have not seen evidence that Essential Energy has considered how to efficiently deliver the increasing level of repex it has proposed. This risk is exacerbated by the increasing levels of brownfields work in the 2014/15 to 2018/19 regulatory control period. | Attachment 7.6<br><br>4.6.10 |
| 51 | Essential Energy's Capital Governance Framework appears to be out of date – it was last updated in 2011 – and does not reflect our understanding of the governance framework that now operates in the context of the NNSW Board. Whilst it provides information on project governance, it is largely silent on the approach Essential Energy used to formulate and then recast its capex portfolio to incorporate the 16 per cent capital expenditure reduction imposed by the NNSW Board. | Attachment 6.2 Capital Governance<br><br>4.6.4 |

| Ref | Issue | Section |
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| 52 | We understand from discussions with management that Essential Energy was required to adopt the CASH/PIP methodology for rating and ranking its proposed expenditure for submission to the NNSW Board. CASH/PIP produces project scores and rankings using a relatively simplistic risk assessment that is prone to subjectivity. We would expect Essential Energy's management team, in assembling its repex sub-portfolio and in addition to the information contained in the CASH/PIP tool, to have reviewed:<br>> the investment strategies, volume, cost and benefit assumptions and conclusions for at least the major repex projects (based on the best available information);<br>> justifications for material step changes in repex;<br>> the expected impact of the repex programme on the state of the network and its performance;<br>> sensitivity analyses that help demonstrate that increased or reduced repex would be sub-optimal in achieving its business objectives; and the delivery strategy and plan. | 4.6.4<br>4.5<br>4.6.2<br>4.6.2.3<br>4.6.10 |
| 54 | We understand that the NNSW Board decided to reduce the overall capital expenditure forecast originally developed within Essential Energy by 16 per cent. The advice received from the DNSPs indicates that this decision was informed by the CASH/PIP methodology and was in response to the NNSW Board's objective of reducing expenditure, but only to the extent that a prudent risk level would be maintained. | Attachment 6.2 Capital Governance<br>4.6.4 |
| 55 | The -16 per cent capex portfolio adjustment imposed by the NNSW Board indicates that whatever 'challenge' process was used by Essential Energy was inadequate, either in terms of the prudency of the repex work proposed (volume and timing) or the cost of the work. | Attachment 6.2 Capital Governance<br>4.6.4 |
| 56 | Two questions arise from the NNSW Board's 16 per cent capex reduction:<br>> Does it result in a reasonable forecast (prudent and efficient) or does further excess proposed expenditure remain?<br>> Does Essential Energy have a firm understanding of the risk implications of the reduction? | Attachment 6.2 Capital Governance<br>4.6.4 |
| 57 | Essential Energy believes that the resulting 84 per cent of its original forecast is sufficient to meet its objectives and maintain risk at current levels. The fact that a 16 per cent reduction could be made to forecast capital expenditure, without a material impact on network risk, suggests that Essential Energy's planning process delivers an overestimated repex forecast. We asked for, but have yet to receive, information on the process it used to revise its portfolio of expenditure to accommodate the reduction. | Attachment 6.2 Capital Governance<br>4.6.4 |
| 59 | However, we have not seen compelling evidence: (i) that the Board was provided with information of sufficient quality to make a fully informed decision; and/or (ii) that Essential Energy has an adequate understanding of its network condition or has undertaken a sufficiently robust investment analysis and portfolio optimisation approach to ensure that its expenditure is optimised. The extent of the Board's reduction indicates that any information it did receive was not compelling. Moreover, it is not clear what proportion (if any) of the overall capex reduction was applied to the initially-proposed repex. | Attachment 6.2 Capital Governance<br>4.6.4 |
| 62 | Essential Energy acknowledges that improving knowledge of its assets during the 2008/09 to 2013/14 regulatory control period was a factor in reducing its expenditure. However, it is clear from the improvement initiatives denoted in its NAMP and the quality of data and analysis supporting its AMPS that Essential Energy does not yet have an effective asset management system capable of producing the right data to support quality analysis and investment decision-making. The lack of a comprehensive asset management system impacts on the management of data, metrics, expenditure and asset management activities and causal analysis. | 4.6.5 |
| 63 | Essential Energy's Capital Governance Framework presents a relatively rudimentary approach to project and programme governance. Refer to Figure 3 below. Whilst it contains the basic elements, we query the effectiveness of the peer and other review processes during the project development lifecycle given both the NNSW Board's and our findings about its proposed expenditure. Project plans that are not rigorously tested during the approval process for both prudency and efficient delivery are likely to lead to failure to realise the intended benefits. | Attachment 6.2 Capital Governance<br>4.6.4 |

 

| Ref | Issue | Section |
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| 64 | Essential Energy advises that it has not yet developed a Delivery Strategy or Plan for its proposed portfolio of work. However, it appears confident that be able to deliver the proposed repex with a combination of its own staff and external service providers. | Attachment 6.11 Deliverability<br><br>4.6.10 |
| 66 | We have not found evidence that Essential Energy has considered these issues adequately or taken them into account when considering the deliverability of its proposed repex. In particular, we would have expected to see a delivery strategy that incorporated the following components: (i) identification of resourcing challenges in moving from greenfields capex to brownfields repex; (ii) mitigation strategies for identified challenges; (iii) an implementation plan; and (iv) the expected efficiencies to be realised from using external resources and other practices. | Attachment 6.11 Deliverability<br><br>4.6.10 |
| 67 | We contrast Essential Energy's position and information with Endeavour Energy. Endeavour has a fully developed Delivery Plan for the 2014/15 to 2018/19 regulatory control period and advises that, during the course of the 2008/09 to 2013/14 regulatory control period, it was able to reduce the cost of internal resources by 30 per cent by leveraging off its experience with use of external resources. | Attachment 6.11 Deliverability<br><br>4.6.10 |
| 68 | In the absence of such a strategy it is inevitable that Essential Energy will be operating in a reactive rather than proactive manner and that this will lead to inefficiencies in delivering the planned repex programme. | Attachment 6.11 Deliverability<br><br>4.6.10 |
| 69 | Essential Energy has not provided compelling justification for the extent by which it proposes significantly increasing its repex in the 2014/15 to 2018/19 regulatory control period. This casts doubt on the prudency of the programmes. | 4.6<br><br>4.7 |
| 70 | Essential Energy's risk-based repex justifications are a cause for concern, particularly due to its apparent over-conservative application of its risk criteria. | 4.6.3.3 |
| 71 | In general, Essential Energy's repex strategies were not informed by robust options analysis or adequate cost-benefit analysis. | 4.6.6 |
| 72 | It is unclear, at a detailed level, how Essential Energy has estimated its proposed repex programme. We are unconvinced that the cost estimation approach is sufficiently robust to ensure efficient outcomes. | 4.6.7 |
| 75 | Essential Energy uses a combination of asset age, defect rates, and condition assessment to determine the need for proactive or reactive replacement of its assets. We found that:<br>> Essential Energy has material issues with the quality of its asset data and its asset knowledge base for most asset classes – it acknowledges the need to progressively improve the quality of asset data and information management and intends to pursue a number of improvement initiatives in 2014-19.<br>> there is a reliance on asset age in some asset classes in the absence of quality condition data, noting that age-driven strategies can result in an over-estimation of overall asset replacement activity and reduced risk reduction (i.e., through not targeting the highest risk individual assets). | 4.6.5 |
| 76 | Whilst in broad terms we believe Essential Energy has enough asset information to determine which assets need attention and to inform its intervention strategy, we are concerned that the following data quality shortcomings compromise its decision-making:<br>> Detailed asset strategies (e.g., run-to-fail versus replace/refurbish at an asset sub-category level and life extension versus replacement ratios);<br>> Risk assessment (discussed below); and<br>> The justified volume of activity over time (also discussed below). | 4.6.5 |

| Ref | Issue | Section |
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| 77 | We reviewed a number of large repex programmes with a primary focus on the reasonableness of the risk assessment. We found that:<br>> The Essential Energy Corporate Risk Matrix is consistent with the NNSW equivalent and presents a reasonable categorisation and allocation of tolerable / intolerable risk;<br>> Essential Energy has taken into account changes in the external environment (e.g., customer and owner expectations and requirements, and changes to standards) and takes account of new or improved asset information in its risk assessment;<br>> Essential Energy uses at least three risk assessment methodologies - this reduces our confidence that Essential Energy's risk rankings are consistent, in turn reducing the likelihood of selection of the optimal risk mitigation activity; Essential Energy's approach to risk assessment appears to be overly conservative in some cases due to the application of an unreasonably high assumed frequency of occurrence to major or catastrophic consequences; and<br>> Essential Energy typically applies a rudimentary approach to determining defect trends in the absence of replacement or refurbishment. | 4.6.3 |
| 78 | This does not necessarily mean that a particular repex programme is not required. However it does lead to a bias towards over-estimating activity volumes as the resultant intolerable risk ratings all require 'immediate' action according to Essential Energy's and NNSW's Corporate Risk Framework. | 4.6.3 |
| 79 | In general, we found the quality of Essential Energy's options analysis to be inadequate due to a lack of: (i) robust input data and assumptions, including needs and risk assessment; (ii) options considered; (iii) robust cost-benefit analyses; and (iv) process visibility for considering deliverability of the proposed programme. | 4.6.6<br>4.6.10 |
| 80 | In the available information, we found that the quality of option analysis varied greatly between asset groups and asset classes:<br>> In some cases, only a perfunctory review of the 'do nothing' option was presented, typically declaring the risk posed by 'doing nothing' to be dismissed as presenting intolerable risk to the business;<br>> In some cases only one other option (i.e., the recommended option) was discussed. | 4.6.6 |
| 81 | We would expect that for investment programmes of the magnitude proposed, Essential Energy would evaluate a range of options, considering the impact on risk of options based on:<br>> life extension strategies;<br>> hybrids of replacement and life extension strategies; and<br>> alternative volumes of work (i.e., deferral or advancement). | 4.6.6<br>4.7.5.5 |
| 82 | At the very least, these approaches would provide sensitivity analysis of the preferred option and should be coupled with a robust cost-benefit analysis to demonstrate that Essential Energy has chosen the optimal path to mitigating risk to an ALARP level. | 4.6.6<br>4.7.6.5 |
| 83 | From the information reviewed, it was not always clear how Essential Energy derived the prescribed volume of work. Most Investment Cases included statements to advise how factors such as resource availability and risk severity were taken into account. However, in some cases, there was a lack of detailed justification of the need for a step change in activity from the 2008/09 to 2013/14 regulatory control period to the 2014/15 to 2018/19 regulatory control period, or of the total volume and timing of work required. | 4.7.3<br>4.7.4<br>4.7.5<br>4.7.6<br>4.7.6.5 |
| 84 | Sensitivity analysis to show an increase or reduction in risk with volumetric adjustments, coupled with a compelling view of the overall resourcing strategy and plan, would provide more confidence in the recommended expenditure. | Attachment 6.11 Deliverability<br>4.6.10 |

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| 89 | We have not been able to establish how Essential Energy constructs its estimates. For example, it is not clear whether (or how) Essential Energy applies contingency costs at either a project or portfolio level. | 4.6.7 |
| 92 | The AMPs and ICs state that Essential Energy's repex programmes are at an early stage of estimation. In high-volume works continued from the 2008/09 to 2013/14 regulatory control period, we would expect the estimate to be of reasonable accuracy (± 10-15 per cent). However, based on our interpretation of Essential Energy's capital approval process, it is not until approval gate "Cap 3" that works must be estimated with accuracy of ± 10 per cent. This is not as restrictive as other utilities where final approval to proceed is based on firm estimates. Essential Energy's approach to applying contingency amounts to projects in practice is not clear. | Attachment 6.2 Capital Governance<br><br>4.6.7 |
| 93 | We noted in discussions with Essential Energy that increasing volumes of units to be replaced should allow some discounts to be realised. Essential Energy considered that this would not be the case. | 4.6.9 |
| 94 | We also note that NNSW has set a target to reduce procurement costs by $170M across the DNSP businesses through to 2016. We have not seen evidence that the pro-rated impact of this has been built into Essential Energy's repex forecasts. | 4.6.9 |
| 95 | These factors, combined with the relative immaturity of the estimates in the Essential Energy repex programmes we have reviewed, means there is likely to be considerable scope for improving its bottom-up estimates. | 4.6.7 |
| 97 | We found the sub-programmes of work had one or more of the following issues:<br>> Inadequate justification for the strategy adopted;<br>> Inadequate justification of the timing for resolving the condition-based issues (and therefore the volume of activity in the 2014/15 to 2018/19 regulatory control period) either because of inadequate risk assessment or inadequate economic analysis (or both);<br>> Inadequate justification for the extent of the step-change evident in expenditure proposed at the sub-category level;<br>> Inadequate evidence of efficient costs, and<br>> Lack of robust delivery risk management. | 4.7.3<br>4.7.4<br>4.7.5<br>4.7.6<br>4.7.6.5 |
| 98 | We note that Essential Energy's Investment Cases rely on the repex calculator and a risk assessment framework that differs from the Corporate Framework. The Corporate Framework makes no reference to the repex calculator nor to the alternative risk assessment framework which casts doubt on the prudence of the corresponding assessment. We observed a conservative approach to risk assessment and a lack of economic analysis in support of replacement as the recommended option in the sample we reviewed. We consider that these factors have resulted in a bias for over estimation of replacement activity in the regulatory control period. | 4.6.3.2 |
| 110 | However, the flat pole reinforcement (staking) expenditure and volume profile in conjunction with the increasing rate of pole replacements shown in both the Reset RIN graph and Table 4 is not adequately explained by Essential Energy. | 4.7.3.1 |
| 113 | If a higher ratio of pole reinforcement to replacement was prudent, it would deliver a lower overall programme cost. Based on an average pole reinforcement cost of one-sixth to one-seventh of the average pole replacement cost, industry-common life extension results for Essential Energy should lead to a superior economic outcome for equivalent risk. | 4.7.3.2 |
| 114 | Essential Energy states an aspirational pole failure rate target of 1 in 20,000 which is approximately half the current failure rate[1]. Whilst the strategy does not purport to be driven by this target, the changes to serviceability criteria appear to be the result of changes associated with this target. We did not find sufficient justification to support adoption of this revised strategy. | 4.7.3.3 |
| 115 | The increasing (poles) forecast expenditure, when compared to a declining actual expenditure during the 2008/09 to 2013/14 regulatory control period suggests potential deliverability issues that have not been adequately addressed. | 4.7.3.4 |

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| 116 | In summary, we acknowledge that Essential Energy needs to progressively increase the number of poles it replaces and reinforces. However, it has not made a sufficiently robust case for its adherence to its current inspection and serviceability criteria, nor for the cost effectiveness of its current and proposed strategies. With a change in strategy, we believe there is the potential for a lower overall cost of wood pole management over the course of the 2014/15 to 2018/19 regulatory control period through a higher reinforcement/replacement ratio. | 4.7.3 |
| 119 | Our onsite discussions confirmed the view obtained from documentation that Essential Energy's strategy for replacement of switchgear was primarily to continue the current replacements based on historical levels. | 4.7.4 |
| 123 | The aggregated expenditure for 11kV circuit breakers in the 2014/15 to 2018/19 regulatory control period has increased over the prior period with the step increase evident in 2013/14 not adequately explained. Overall the switchgear repex remains relatively constant across the regulatory control periods. | 4.7.4.2 |
| 124 | There has been a significant increase in proposed expenditure for switchboards, whilst Essential Energy has reduced expenditure for circuit breaker replacements from the levels in the 2008/09 to 2013/14 regulatory control period, stating:<br><br>"Essential Energy has deemed this to be a prudent reduction in expenditure which still allows the risk to be managed at a level that is within the risk tolerance of the business." | 4.7.4.2 |
| 125 | We are not convinced that the proposed expenditure in the RIN is aligned with the replacement approaches set out in the investment proposals. Whilst the investment proposals present an aging asset portfolio that is likely to develop an increase in end of life failure rates, we have seen insufficient quantitative analysis to support the proposed step change in replacement expenditure for 11kV circuit breakers evident in the RIN. | 4.7.4.2 |
| 126 | The asset condition information, risk assessment, unit cost assumptions and options analyses provided are individually and collectively insufficient to conclude that Essential Energy has selected the prudent and efficient approach, timing and volume of activity. | 4.7.4.1 |
| 127 | Risk assessment in the various Investment Cases in this category is based on a risk framework that differs from the Corporate Matrix. The assessed risk consistently appears to be biased towards conservatism. | 4.6.3 |
| 128 | The absence of robust options analysis tends to compound the bias towards essentially 'defaulting' to the replacement option. There is little or no meaningful economic comparison in the Investment Cases reviewed. | 4.6.6<br><br>4.7.4.1<br><br>4.7.5.5 |
| 129 | The application of the risk assessment factors in the ESS_78 Investment Case leads to business interruption risk being rated as 'very high' (the highest possible rating). The risks are added together to give an overall risk that is also rated as 'very high'. | 4.7.4.4 |
| 129 | The ESS_79 Investment Case for switchboards only considered the failure of a bulk oil circuit breaker, which suggests the risk assessment was not relied upon in developing the balanced programme. | 4.7.4.4 |
| 129 | The pole top switchgear replacement is forecast to continue at a relatively constant rate throughout the 2014/15 to 2018/19 regulatory control period. We note that there is a significant decrease in 2014/15 from historical levels and a flat profile through the remainder of the regulatory control period. Whilst we acknowledge the prioritisation criteria provides some discrimination amongst switchgear types (e.g., not all air break switches will be replaced with enclosed switches), Essential Energy's basis for selection of the volume in the current RCP is not clear, nor the relationship to risk levels…." | 4.7.4.4 |

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| 130 | Essential Energy has not demonstrated that it has fully explored whether a more targeted condition-based approach to switchgear replacement and refurbishment based on asset risk assessment would deliver a lower cost and acceptable risk outcome and greater overall asset fleet risk reduction. | 4.7.4.1 |
| 131 | For a programme which represents over $150M expenditure in aggregate, we would also expect to see evidence that initiatives to reducing overall programme costs had been explored, quantified and adopted (or assumed benefits built into forward estimates). | 4.7.4 |
| 132 | In summary, whilst we find that Essential Energy has presented a reasonable case for the selection of the various asset classes and sub-classes to focus on, its justification for its proposed treatment plans (option selection, including the timing/volume of activity) is inadequate. | 4.7.4 |
| 135 | The strategy includes consideration of a single preferred option, being conductor replacement at a rate of 350 kilometres per year based on the success of the existing programme. | 4.7.5.5 |
| 137 | The aggregated expenditure for conductors in the 2014/15 to 2018/19 regulatory control period has increased from a declining trend over the 2008/09 to 2013/14 regulatory control period. The current RCP profile suggests a marked step change due to ≤11kV bare overhead conductor replacement. | 4.7.5.2 |
| 138 | Whilst these levels have been achieved previously, the extent of the step change suggests there may be deliverability challenges. | 4.7.5.3 |
| 139 | The expenditure forecast clearly aligns with Essential Energy's strategy to focus on ≤11kV conductor replacements. The flat profile across the regulatory control period is consistent with the Investment Case which denotes that the programme is delivery constrained, not based on asset condition or age. | 4.7.5.1 |
| 140 | Whilst we accept the need for ongoing conductor replacement focusing on small gauge steel and copper clines during the 2014/15 to 2018/19 regulatory control period, we remain unconvinced that the level expenditure profile is optimal and, given historical levels, represents the programme that will actually be delivered. | 4.7.5.2<br>4.7.5.3 |
| 141 | Essential Energy's options analysis is very limited, noting that the smaller conductor classes tend to be in rural locations with low customer density. Essential Energy acknowledges that the quantity of replacement will not resolve the ongoing issue with its small-diameter overhead power line population. However, we would expect to see some indication that it is looking also at more innovative approaches than advising that future replacement rates are highly likely to escalate significantly. | 4.7.5.5 |
| 143 | Whilst acknowledging the challenges of estimating expenditure on line work due to the variables involved, this casts further doubt on Essential Energy's ability to achieve its target volumes. | 4.6.7 |
| 145 | In summary, we acknowledge the need for expenditure on the selected overhead conductor classes but we are not convinced that Essential Energy will deliver the nominated volume of work, given its record in the 2008/09 to 2013/14 regulatory control period, the uncertainty over the cost of undertaking the work, and the lack of analysis about how to improve the overall programme effectiveness. | 4.7.5 |

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| 148 | Essential Energy's repex programmes for transformers is comprised of four sub-programmes: ESS70 - zone substation power transformer refurbishment ($7M); ESS71 - zone substation power transformer replacement ($31m); ESS31 - enclosed substation refurbishment programme ($30M); and ESS32 - overhead substation refurbishment programme ($38M). | 4.7.6.1 |
| 153 | The documentation provided does not adequately justify the difference in the RIN expenditure profiles between the 2008/09 to 2013/14 regulatory control period and the 2014/15 to 2018/19 regulatory control period. Transformer replacement should be relatively stable and easy to predict. It may be that improvements in Essential Energy's maintenance regime and/or condition assessment and asset information is delivering lower costs and/or has extended the predicted lives of the transformer fleet. | 4.7.6.2 |
| 154 | However, the transformer repex forecast for the 2014/15 to 2018/19 regulatory control period is based on rudimentary assumptions about optimal refurbishment rates (e.g., 2 per cent pa 42) or replacement rates based on historical levels, with qualitative reference to costs and benefits. What is not evident is a robust cost-benefit analysis of the various options for all transformer classes. | 4.7.6.3 |
| 155 | We note that the replacement strategy includes the use of standard size transformers for replacement units. As a result, there are many projects where a larger transformer is included for replacement. Again, Essential Energy has not provided the economic justification for this approach. 43 For such a large investment, we would expect a cost/benefit analysis associated with provision of additional capacity, including consideration of planning requirements where there is an opportunity to replace transformers with a smaller capacity unit, and potential for retirement or consolidation of transformer units. | 4.7.6.4 |
| 157 | In summary, whilst it would appear Essential Energy has a sound approach to assessing the condition of its assets, it has not provided compelling evidence that it has derived a prudent and efficient replacement/refurbishment expenditure forecast for its transformer fleet. | 4.7.6 |
| 163 | Historical expenditure provided in the RIN appears not to be reliable for cables. The 2014/15 to 2018/19 regulatory control period forecast shows a step change from the progressive reduction of cable expenditure in the 2008/09 to 2013/14 regulatory control period profile, driven entirely by the 11kV and below replacement programmes. | 4.7.7.1 |
| 164 | . We support the need for an overarching strategy that promotes safer outcomes to consumers and that seeks to identify lower whole-of life-cost options for the management of rural LV poles. We understand that the proposed underground conversions are for lines that are not owned by Essential Energy, but by private landowners. However, ownership may not be well defined in legal documents. | 4.7.7.2 |
| 165 | We have not observed a sufficiently robust economic analysis providing evidence that the apportionment of costs between the specific rural customers (benefiting from the change from overhead to underground) and Essential Energy's other customers is reasonable. We note that the proposal is a continuation of a policy established in 2010, including an adjustment to reflect actual costs. | 4.7.7.2 |
| 166 | As Essential Energy has a relatively immature fault record (twelve months data) it seems to have relied on the experience of its peers to determine the risk posed by CONSAC cables and its strategy. | 4.7.7.3 |
| 167 | The risk has been assessed as very high (the highest risk category), with financial risk the highest individual category. According to its risk management system, the risk must be removed. Essential Energy propose commencing with the highest risk cable (as assessed by its limited failure/defect data, primarily). The options analysis is very rudimentary – only one option is considered, with no cost-benefit analysis. | 4.7.7.3 |

| Ref | Issue | Section |
|---|---|---|
| 168 | The cost estimate is also rudimentary, with '2014/15 used as a pilot year to help determine accurate unit costs and more CONSAC condition reports.' However, Essential Energy do recognise that there may be opportunities to reduce the average unit rate by combining the work with other planned work. | 4.7.7.3 |
| 169 | In summary, we do not believe Essential Energy has provided compelling evidence that it has derived a prudent and efficient replacement/refurbishment expenditure forecast for its cable programme. | 4.7.6.5 |

# 5 APPENDIX A – Sources

*Table 5-1: CPI and multipliers to $2012/13*

| Years | 2008/09 | 2009/10 | 2010/11 | 2011/12 | 2012/13 | 2013/14 |
|---|---|---|---|---|---|---|
| Actual CPI (as applied to annual prices) | | 4.35% | 1.82% | 2.85% | 3.39% | 1.76% |
| Multiplier | 1.129818 | 1.082719 | 1.063366 | 1.0339 | 1 | 0.982704 |

*Table 5-2: repex ($000 2012/13)*[113]

| Years | 2009 | 2010 | 2011 | 2012 | 2013 | Historical repex (2009 - 2013) |
|---|---|---|---|---|---|---|
| Multiplier | 1.12982 | 1.08272 | 1.06337 | 1.03390 | 1.00000 | |
| Essential Energy repex RIN | $66,587 | $106,364 | $144,427 | $147,749 | $137,293 | |
| Essential Energy repex ($2012/13) | $75,231 | $115,163 | $153,578 | $152,757 | $137,293 | $634,022 |
| AusNet repex RIN | $74,953 | $56,276 | $71,936 | $102,779 | $102,488 | |
| AusNet repex ($2012/13) | $84,683 | $60,931 | $76,495 | $106,263 | $102,488 | $430,860 |
| Powercor repex RIN | $38,583 | $47,913 | $59,941 | $69,992 | $82,068 | |
| Powercor repex ($2012/13) | $43,592 | $51,876 | $63,739 | $72,364 | $82,068 | $313,640 |

*Table 5-3: Asset Numbers*[114]

[113] *Attachment 4 2014 Reset RIN Workbook Consolidated*, Essential Energy, 2014, Template 2.2 REPEX Table 2.2.1 – Replacement Expenditure, Volume and Asset Failures by Asset Category and Table 2.2.2 – Selected Asset Characteristics (Essential Energy's REPEX)
*AusNet (D) 2008-13 – Category Analysis RIN – templates Consolidated*, 2014, Template 2.2 REPEX Table 2.2.1 – Replacement Expenditure, Volume and Asset Failures by Asset Category and Table 2.2.2 – Selected Asset Characteristics (AusNet's REPEX)
*Powercor 2008-13 – Category Analysis RIN – responses Consolidated*, 2 June 2014, Template 2.2 REPEX Table 2.2.1 – Replacement Expenditure, Volume and Asset Failures by Asset Category and Table 2.2.2 – Selected Asset Characteristics (Powercor's REPEX)
[114] *Attachment 4 2014 Reset RIN Workbook Consolidated*, Essential Energy, 2014, Table 5.2 Asset Age Profile (Essential Energy's Age Profile)*AusNet (D) 2008-13 – Category Analysis RIN – templates Consolidated*, 2014, Table 5.2 Asset Age Profile (AusNet's Age Profile)

| Assets at 2013 EOFY | AusNet | Powercor | Essential | SA Power Networks |
|---|---|---|---|---|
| Poles | 339,151 | 466,383 | 1,374,116 | 739,709 |
| OH Line kms | 38,448 | 68,843 | 182,791 | 71,164 |
| UG Cable kms | 6,169 | 6,245 | 7,468 | 16,731 |
| Service line kms | 7,622 | 10,786 | 13,368 | 12,716[115] |
| Transformers | 58,536 | 84,284 | 135,729 | 75,042 |
| Switchgear | 112,469 | 343,055 | 462,447 | 14,045 |
| SCADA/Control/Protection | 10,455 | 7,059 | 884 | 17,147[116] |
| Street Lights | 96,282 | 156,598 | 149,307 | 0 |
| Total | 669,131 | 1,143,253 | 2,326,109 | 946,055 |

*Powercor 2008-13 – Category Analysis RIN – responses Consolidated*, 2 June 2014, Template 2.2 REPEX Table 5.2 Asset Age Profile (Powercor's Age Profile)
*SA Power Networks(D) 2008-13 – Category Analysis RIN – templates Consolidated*, 2014, Table 5.2 Asset Age Profile (SPAusnet's Age Profile)

[115] Calculated at 15m per service times 736,831 services

[116] Not included in total assets normalised

# 6 APPENDIX B – Project Justification Example

Initial Submission

### APPROVED ###

essential energy

**PROJECT APPROVAL REPORT**

| | | | |
|---|---|---|---|
| *Approval ID:* | *79763* | IO Region: | South Eastern |
| **Approval required:** | **$171,483** | Works Area: | SE Eurobodalla Tablelands |
| *with oncosts:* | *$268,094* | FSC: | Moruya Depot |
| **Final Approver:** | **GM Network Planning** | Local Gov't area: | Eurobodalla Shire Council |
| | | State seat: | Bega |

**Project Name:** Replace rusted steel and copper conductor on the Bumbo line spur - Bodalla Fdr.

**Summary:**
Replace rusted steel and copper conductor on the Bumbo line spur - Bodalla Fdr - 1km 3W - 4.8km 2W Total 5.8km

| | | | |
|---|---|---|---|
| Planning Project ID: | 1037801 | WASP ID: | 638078 |
| Primavera No.: | | WASP Program: | NC Dist HV Lines and Cables |
| Urban/Rural: | Rural | Asset type: | 11OHR 11kV dist OH Lines Rural |
| Construct Target: | 30/06/2013 | Primary AER Category: | Asset Renewal / Replacement (REP) |

***Project Analysis and Justification***

**Project Driver contributions:**

| | | |
|---|---|---|
| 40 % | Growth (GRI) | HV reconductoring |
| 60 % | Asset Renewal / Replacement (REP) | HV reconductoring |

**Available Facts**

Primary Driver - Asset Condition

Conductors on the Bumbo spur line are in poor condition and are in need of replacement. The ties at the pins are rusted and the line has a documented history of failure. (Please refer to the photos in the supporting documents for examples of poor asset condition & outage report detailing LCM)

A large proportion of steel conductors installed in the 1950 and 1960s are now experiencing corrosion problems causing conductor failure. The corrosion also causes high resistance joints, reduced current carrying capacity and increases the risk of failure.

Conductor Joints, Connections and Tie failures accounted for 1351884 total lost customer minutes. This was 47% of the overall outage minutes. This Data has been taken over the last 5 Year period during which this feeder has been a Poor Performing feeder.

CEOM7092 distribution planning manual states in 4.1.6 that rusted steel conductors in coastal areas are a safety risk and should be prioritised for replacement.

Secondary Drivers

Radio interference from tracking on insulators due to rust has been an issue in the Bumbo area.

**Alternate Options**

1. Replace rusted steel and copper conductor with 7/3.00AAAC. (Preferred)
2. Replace rusted steel and copper conductor with 7/4.50AAAC.

printed 19/06/2012 3:08:16 PM Planning Project ID 1037801 **Page 1 of 3**

Initial Submission

### APPROVED ###

OptionNo: **1** Replace Rusted Steel and Copper with 7/3.00AAAC **Preferred Option**

Reconductor rusted Steel and Copper consuctors with 7/3.00AAAC along Bumbo Spur in Bodalla.

NPV Result: wacc 8.18% = $ -243434

OptionNo: **2** Replace rusted steel and copper with 7/4.50AAAC

Reconductor rusted steel and copper conductors with 7/4.50AAAC along the Bumbo line spur in Bodalla.

NPV Result: wacc 8.18% = $ -252095

**Demand Management**

15/06/12 Grant Guihot 16582 : DM bypassed; Prime cost is $171,483 includes Deferable costs of $68,593 which are less than the trigger level of $250,000 - Auto generated record.

**Financial Implications**

This project has been included in the 12/13 financial year budget.

**Project benefits**

Primary

The preferred option will improve asset condition & improve reliable by reducing the number of outages caused by the poor asset condition.

It will also reduce the amount of maintenance required on the assets in the immediate future and solve the radio interference issues experienced in the area.

**Recommendation**

Option 1 is the most cost effective solution to solve the ovehead line asset condition constraint and reduce lost customer minutes on this feeder.

The project cost is: $171,483.3 (Prime) - $268,094.18 (Oncosted)

It is recommended that this reconductor project be approved.

**Project Authorisations**

*eApproval processes used*

Planner endorsement by Grant Guihot, Planner 19/06/2012

Recommended for approval by Steve Holm, MPCC 19/06/2012

Approved by Julian Besestri, GM Network Planning 19/06/2012

##### APPROVALS COMPLETE #####

**Notes and Comments**

N/A

**Approval History**

Initial Submission

### APPROVED ###

| APPROVAL: | ID | APPROVAL_LEVEL_REQUIRED | COMPLETED |
|---|---|---|---|
| **Initial** | 79763 | 4 GM Network Planning $250,000.00 | Yes |

| APPROVAL_PRIME | APPROVAL_TOTAL | Variance-Prime | Variance-Total |
|---|---|---|---|
| **$171,483** | **$268,094** | $0 | $0 |

19/06/12 main table updated by Julian Besestri 10714
19/06/12 eAPPROVAL PROCESS COMPLETED by Julian Besestri 10714
19/06/12 Julian Besestri 10714 set L4 approval by 1023 19/06/2012 3:08:14 PM
19/06/12 Steve Holm 11238 set L5 approval by 2398 19/06/2012 2:00:38 PM
19/06/12 Grant Guihot 16582 set L6 approval by 3623 19/06/2012 10:11:41 AM
15/06/12 Grant Guihot 16582 : DM bypassed; Prime cost is $171,483 includes Deferable costs of $68,593 which are less than the trigger level of $250,000 - Auto generated record.
Grant Guihot 16582 set registered by Guihot Grant 16582 15/06/2012 10:13:48 AM
PR check #0/0@L4=False
QR check #0/0@L4=False
15/06/12 Grant Guihot 16582 set primecost to $171,483.30 app. lvl=4 (GM Network Planning $250,000.00)
15/06/12 Grant Guihot 16582 set Total cost to $268,094.18
15/06/12 Grant Guihot 16582 set primecost to $250,000.00 app. lvl=4 (GM Network Planning $250,000.00)

# 7 APPENDIX C – RISK Assessment Methodology

## 7.1 Introduction

In the Essential Energy Draft Decision (November 2014) and associated consultants reports, the Australian Energy Regulator (AER) raised concerns about the veracity of Essential Energy's risk modelling practices and tools in relation to CAPEX.

> *Our consultant, EMCa has found a number of issues with Essential Energy's proposal which we accept. These issues include Essential Energy using overly conservative risk criteria and multiple contingency allowances that systematically overstate its costs, not adequately justifying the timing of its proposal at the project/programme level, relying on network age and condition information that is at times inconsistent and contradictory.*[117]

> *Essential's risk-based repex justifications are a cause for concern, due to Essential's use of a variety of risk assessment tools and an apparently over-conservative application of risk criteria. This reduces our confidence that its risk rankings are internally consistent, in turn reducing the likelihood of selecting the optimal mitigation action(s). Its approach to risk assessment often appears to be overly conservative due to unreasonably high frequency assumptions for major and catastrophic consequences.*[118]

> *Essential uses at least three risk assessment methodologies - this reduces our confidence that Essential's risk rankings are consistent, in turn reducing the likelihood of selection of the optimal risk mitigation activity.*[118]

## 7.2 Background

Essential Energy applies risk assessment practices as detailed in CEOP2111 Operational Procedure Corporate Risk Management (superseded by CEOP0002.21 on the 29/8/2014). This policy stipulates the risk framework and methodology to be applied when developing investment cases and programmes of work.

During the development of the investment cases that underpin Essential Energy's regulatory proposal deficiencies in the vanilla model as detailed in CEOP2111 were identified. The identified deficiency was in regards to likelihood (probability and exposure), which meant there was lower granularity in the risk assessment approach for the investment cases. Application of the vanilla model to the investment cases with this deficiency meant that it was not possible to rank order the investment cases by risk to the level required, or for that matter adequately quantify the risk considering likelihood.

On recognising this deficiency and the potential when it was applied to investment cases for overstating the risk, Essential Energy sought to enhance the existing vanilla model with capabilities increasing the granularity with regards to likelihood. Thereby permitting a probability and consequence level of detail not found within the vanilla corporate model. This approach is consistent with the corporate policy (CEOP2111) where the need to adapt the corporate model to suit the risk and level of information available is documented as follows;

*It may also be necessary to adapt the likelihood and consequence tables (see Step 2) to meet the prevailing circumstances for the analysis.* [119]

Essential Energy implemented a software tool called '*Riskex*' for use in the Investment Cases allowing a higher level of detail for likelihood based on the probability and exposure. Where necessary the consequence table used in the '*Riskex'* tool was expanded to include consequences that were not listed in CEOP2111. In all other respects the *'Riskex'* tool is the same as the corporate tool with the same risk

[117] Draft decision Essential Energy distribution determination 2015-16 to 2018-19 Attachment 6: Capital Expenditure. AER Nov 2014
[118] Review of Proposed Replacement Capex in Essential Energy's Regulatory Proposal 2014 – 2019, EMCa / Strata Energy Consulting, Oct 2014
[119] CEOP2111 Operational Procedure Corporate Risk Management, 22 July 2011 Issue 4

categories. The difference is that the *'Riskex'* approach removed a significant degree of subjectivity from the corporate approach.

## 7.3 Risk Methodology Investment Cases

Essential Energy notes as does SA/SNZ HB 89:2013 (AS/NZ 31010:2009 Risk management – Principles and Guidelines) that there are different risk assessment techniques broadly grouped into Qualitative and Quantitative risk assessment techniques.

SA/SNZ HB 89:2013 states *"The choice of technique is highly dependent on context and the form of assessment and its output should be consistent with the risk criteria developed as part of establishing the context."*

To that end Essential Energy has a developed qualitative (corporate risk model) and quantitative risk management tools. The selection of which tool to use is highly dependent on the level of intelligence or statistical data available for the risk assessment as per SA/SNZ HB 89:2013.

### 7.3.1 Qualitative Risk Assessment

Essential Energy has a risk framework encapsulated in CEOP2111 which provided a risk approach and tool at a corporate level. The policy permits enhancement of the risk model when circumstances provide further information that is material to the risk at hand. Essential Energy is cognisant of the subjectivity that some risk assessment techniques are prone to, so in order to remove subjectivity permits enhancements of the risk model to allow for extra information. With regard to the formulation of the Investment Cases a deficiency in the corporate model with regards to likelihood was identified that may have led to subjective outcomes if employed.

The corporate risk model was enhanced to remove this subjectivity such that the likelihood was calculated via the probability and exposure as follows.

$$Likelihood = Probability * Exposure$$

This approach provided a greater level of granularity when determining likelihood and removed subjectivity as the likelihood score was comprised of:

> **Probability:** The chance of the event occurring
> **Exposure:** The frequency of exposure to the event

For example, when considering the risk of a pole failure causing a public risk (injury or fatality) the likelihood in the corporate model is simplistic with a score of 1 to 5 (Rare to Almost Certain).

However Essential Energy has the second highest pole failure rate in Australia (1:10,000 per annum) due to the serviceability criteria Essential Energy employs which drives higher asset utilisation (but consumes asset life and carries significantly more risk), thus it is highly likely that a pole will fail on the network at any one point in time. Users of the corporate model are cognisant of this fact and may be swayed to consider the likelihood as Certain or Almost Certain.

Separating out the probability and exposure components of the likelihood aspects of risk assessments permits users to select a high probability of pole failure (as is the case on Essential Energy's network) and, couple that with the exposure element which may be low, as Essential Energy has a low customer density. This process arrived at a more considered likelihood outcome rather than the vanilla corporate model and has been detailed in CEOP2011.01 (Jan 2014) Risk Ratings Investment Cases and AMPs.

### 7.3.2 Quantitative Risk Assessment

Essential Energy notes despite best efforts to refine and enhance risk assessment models that any qualitative risk model is exposed to a degree of subjectivity. To that end a quantitative risk assessment methodology has been developed utilising event trees and probabilistic techniques (CEOP 2111.01). By nature this sort of risk assessment is highly dependent on statistical analysis and a high level of informational accuracy which make application of this model in every investment case difficult. Conversely, this approach is highly methodical, repeatable and not as prone to subjectivity. As per SA / SNZ HB 89:2013 the selection of technique to use is subject to the context, and Essential Energy has a strategic intent to transition to this form of risk assessment where possible, and utilised it in one investment case submitted in the regulatory proposal. However it should be noted that a qualitative risk assessment should produce a similar risk outcome, it is however less repeatable than a quantitative approach.

### 7.3.3 Risk Calculation Governance

In conjunction to the above refined risk methodology all risk assessments for the Investment Cases were subject to review by a number of review teams (staged review process) for accuracy and reasonability. During this process some risk assessments were reworked to remove subjectivity or to clarify the risk. Essential Energy contends that the application of enhanced risk models is consistent with internal risk management practices CEOP2111 and the intent of SA/SNZ HB 89:2013 (AS/NZ 31010:2009 Risk management – Principles and Guidelines) where the risk model best suited to the level of available information and the situational context is selected to model the risk. Essential Energy has taken reasonable steps to ensure all the three models referred to are applied with the same categories, risk framework, and are interchangeable albeit dependent on the model with a lower degree of informational content.

## 7.4 Risk Rating

Essential Energy contends that by employing an enhanced risk model for the Investment Cases, there is a significant improvement in rigour associated with the risk assessments. Coupled with the staged review process for each investment case the subjective nature of qualitative risk assessments has been moderated by the number of reviewers whom reviewed the risk assessment. It is Essential Energy's contention that this increases the relativity of the risk assessments and removed overly conservative assessment.

The risk assessment was informed by consequences based on network occurrences derived from asset failure histories, insurance claims or outage data. Thus the risk assessment is based on the service performance of the network Essential Energy manages. Where this information was not available or incomplete Essential Energy obtained information from like utilities or from case law to inform the risk model. Given the pedigree of the source information Essential Energy contends that the risk assessments are reasonable for the number of assets it manages and the risks thereof.

The argument that the risk assessments are overly conservative as forwarded by the AER is difficult for Essential Energy to reconcile with its current operating environment and network risk. This risk assessment or similar models have historically been used in part to develop maintenance and serviceability criteria, given for example that Essential Energy has the second highest pole failure rate in Australia (and is thus significantly higher risk) it is incongruous to the assertion that the risk assessments are conservative.

With regard to repex spend the application of risk assessments, whilst informative, are not the driver of the investment. The driver is the condition of the asset in question, be it a conditional or functional failure, in these cases the veracity of the risk assessment is somewhat of a moot point as the asset is in a state that requires corrective action. Nevertheless the modelling of functional and/or conditional failures was derived from historical performance and defect analysis when performing the risk assessments. To make this point clearer, the most relevant risk is in fact the risk assessment that determines the inspection and condition assessment regimes (serviceability criteria). As noted above, Essential Energy has the second worst pole failure record in Australia and there are similar examples in the other asset categories. This performance is dictated by the risk inherent within the asset management strategies such as the serviceability criteria.

## 7.5 Essential Energy's Current Risk Appetite

Essential Energy applies one of the highest risk based asset management strategies in Australia. In asset classes with the most amount of proposed expenditure (for example poles) Essential Energy's asset management practices is often the highest or second highest risk profile.

The high risk profile of Essential Energy is of concern to NNSW and in turn there has been an assessment of Essential Energy's practices resulting in a step change in the serviceability criteria for pole inspections in order to arrest the high pole failure rate. Essential Energy seeks to clarify that it intends to arrest the pole failure rate using administrative controls in combination with increased funding in later years as a result of the revised serviceability criteria. The revised serviceability criteria will result in more poles being reinforced earlier and an increase over time in the pole condemnation rate[120]. However the proposed reductions in opex / repex places considerable pressure on maintaining the current serviceability criteria and places Essential Energy's strategy of decreasing pole failures via administrative controls at considerable risk.

Essential Energy notes that the risk today and in the future with regard to the built network is a function of a number of factors as follows:

> The type of asset and its inherent failure mode.

> Historical practices in construction and selection of materials.

> Service duty of the asset.

> Historical maintenance and serviceability criteria.

> Environmental conditions.

Shifting the inherent risk profile of the network to a new level requires a step change in the following controllable factors:

> Selection of a different type of asset.

> Change in maintenance or construction including life extension strategies.

> Shift in serviceability criteria.

When examining the highest proposed spend profile (poles) Essential Energy has investigated the lifecycle cost of differing assets and determined that timber poles present the best fiscal outcome assuming static inspection regimes[121].To address the long term risk profile which predicts increased asset failures[122] the changes Essential Energy has investigated require a change in the serviceability criteria and the life extension strategies such that more poles are reinforced earlier in conjunction with a tighter condemnation criteria. In developing this strategy Essential Energy has remained cognisant of the existing build network and the legacy contained within the network. By altering the serviceability and reinforcement criteria essential Energy's modelling suggests a 1:20,000 pole failure rate is achievable and not excessive when compared to peers[123]. Essential Energy contends this target is in the public interest as recent developments in other jurisdictions demonstrate that the tipping point between a managed failure profile and an uncontrolled asset is highly capital intensive, particularly when a regulatory body is required to intervene[124]. Essential Energy's modelling shows that the prior target of 1:10,000 pole failures is on the boarder of instability with the built legacy network and its current service duty. Essential Energy holds concerns that if funding approval is not obtained to improve the risk profile then future regulatory body intervention to address asset performance and ensure the protection of the public interest is inevitable.

[120] POLE System Investment Document ESS_17 and ESS_46 Pole Replacement and Reinforcement, Essential Energy:
[121] Pole Selection Guide for Distribution Applications, Essential Energy, March 2013
[122] Pole SYSTEM INVESTMENT DOCUMENT ESS_17 AND ESS_46 POLE REPLACEMENT AND REINFORCEMENT, ESSENTIAL ENERGY:
[123] A 1:20,000 failure rate would still place Essential Energy in the top quartile for risk when compared to peers, and the second worst utility for pole failures in the NEM.
[124] Western Power pole failure inquiries

### 7.5.1 Risk Relativity and Asset Performance against Peers

Comparatively across all asset classes Essential Energy asset management practices is in the top quartile against its peers with regard to high risk, this is evident when the asset failure rates or management practices across Australia are compared. A comparison against the Victorian utilities with regard to asset failures demonstrates the higher risk taken in Essential Energy's network whereby the assets remain in service longer leading to a higher failure rate[125].

Essential Energy has 6.3 failures per 100 kilometres of line compared with 1.4 in Victoria and 8.3 failures per 1000 poles compared with 1.8 in Victoria.

*Table 7-1: Total Asset Failures 2013*

| Category | Essential Energy[126] | All Victorian DNSPs[127] |
|---|---|---|
| Total Asset Failures | 10,809 | 2269 |
| Normalised Asset Failures (/100km) | 5.9 | 1.4 |
| Normalised Asset Failures (/1000 poles) | 7.9 | 1.8 |

Essential Energy has a higher failure volume than AusNet and Powercor for all reported failure types, as shown in Figure 7-1.

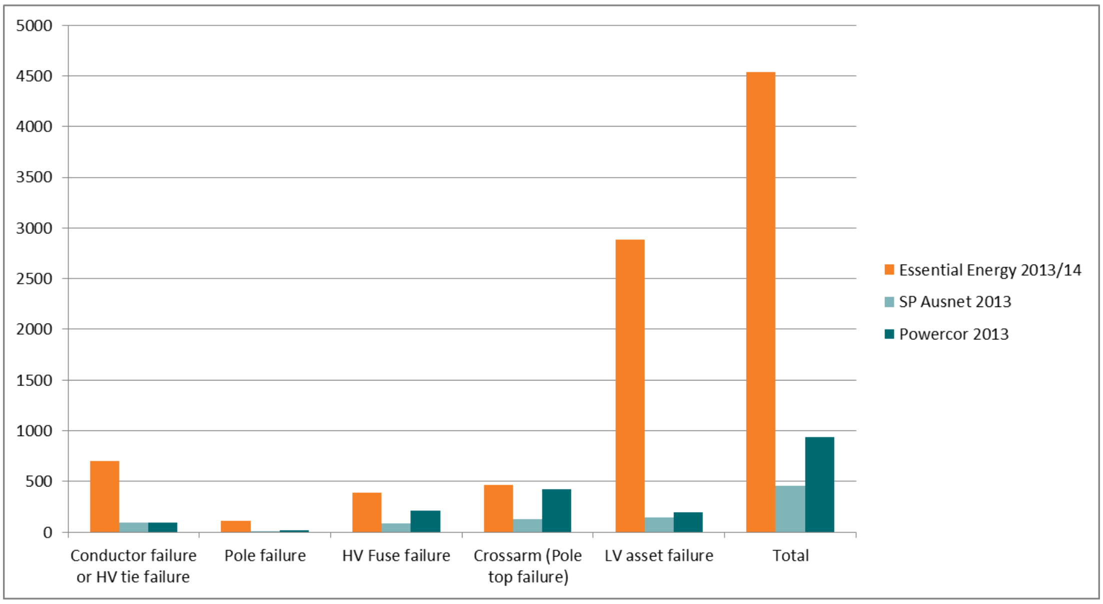



*Figure 7-1: Number of failures[128]*

Figure 7-2 displays the same failure volumes normalised by pole population. Essential Energy's pole failure, conductor failure and LV asset failure are higher per asset than both AusNet and Powercor.

[125] The failure rate is also influenced by the type of asset (eg timber, steel, concrete) and the operating environment. The majority of utilities have serviceability standards that would result in the asset being replaced well before they would in Essential Energy. The difference in the definition of conditional failure across peer utilities means a direct comparison for repex, opex and life extension strategies is not easily achieved.
[126] Excludes fuse operations
[127] Safety Performance Report on Victorian Electricity Networks 2013, Energy Safe Victoria, June 2014, p.7
[128] SP AusNet and Powercor data from *Safety Performance Report on Victorian Electricity Networks 2013*, Energy Safe Victoria, June 2014, Table 20 p. 62, Essential Energy data from Essential Energy *Energy Network Incident* database for 2013/14

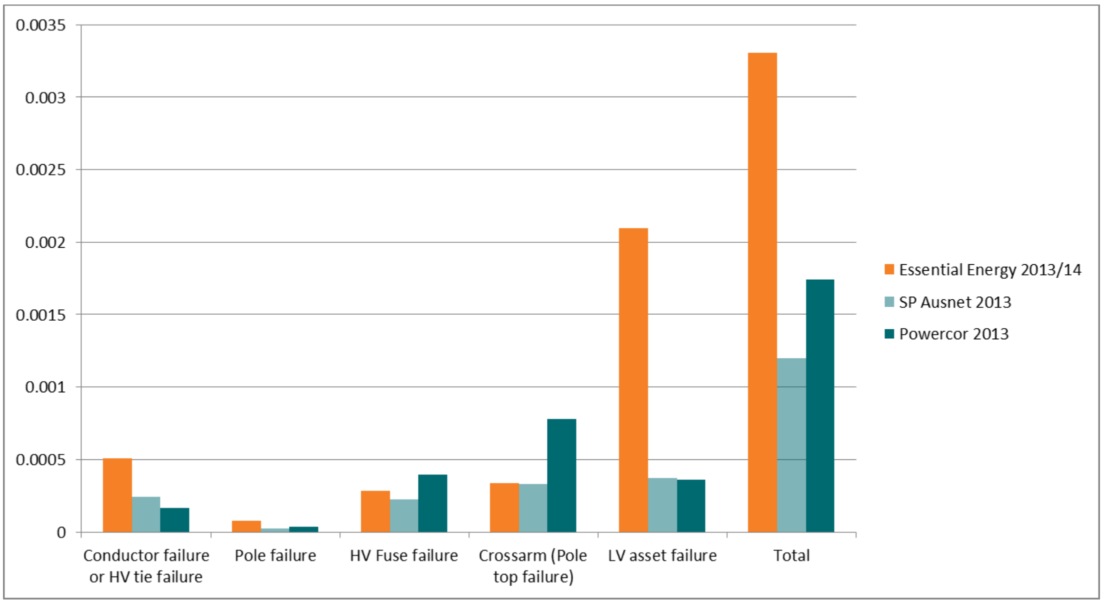



*Figure 7-2: Number of failures normalised by number of poles (failures/1000poles)*[129]

## 7.6 Summary of Arguments

### 7.6.1 Overly Conservative Risk Assessment

This point is addressed in some detail in the preceding. However in summary Essential Energy relies on the governance process, historical data and performance of the assets coupled with the enhancements of the corporate risk model to demonstrate that the risk assessment is not conservative.

### 7.6.2 Numerous Risk Models

Essential Energy notes that an explanation for the use of 'differing' risk models was absent in the submission and seeks to provide the preceding as an explanation for the 'differing' models. Essential Energy contends that the difference amounts to increasing capability and increased confidence in the subsequent risk modelling outcomes.

### 7.6.3 Frequency of events

This is based on Essential Energy's historical experience within the geographical area that it operates in with the assets at its disposal. Coupled with events of a similar nature in other utilities franchise areas that have resulted in legal liabilities.

### 7.6.4 Current Risk Appetite

Essential Energy has a high risk profile based on the current and historical asset management practices and associated serviceability criteria. Essential Energy has historically traded off higher risk for lower capital cost and whilst this strategy has achieved a moderate historical repex spend in some asset classes there has been an over-reach with regard to risk resulting in the average asset service life being consumed at a higher rate than prudent when balancing risk, repex and opex. This over-reach has reached a critical point based on modelling for poles where an intervention is required to avoid uncontrollable future pole failures which will increase opex costs considerably.

[129] SP AusNet and Powercor data from *Safety Performance Report on Victorian Electricity Networks 2013*, Energy Safe Victoria, June 2014, Table 20 p. 62, Essential Energy data from Essential Energy *Energy Network Incident* database for 2013/14

# 8 APPENDIX D – Pole Asset Strategy and Serviceability criteria

Essential Energy instigated a programme in 2012 to investigate the performance and cost effectiveness of its pole selection and management strategies this programme is ongoing. As such there is a depth of documentation and analysis behind the pole replacement and reinforcement investment cases (ESS_17 and ESS_46) submitted in the regulatory proposal. This analysis work has been separated into streams of activity where the outcomes of one stream of work flows through to the analysis work of another stream. By applying this approach, Essential Energy is confident that the appropriate strategy is selected for the most cost effective asset management.

**Stream 1 – Pole Selection**

Essential Energy analysed pole technology options and developed an analysis paper[130], investigating the performance of the pole population within Essential Energy for timber, steel, composite and concrete poles, to determine the correct balance between upfront capital cost and lifecycle performance, including opex trade-offs, in selecting a pole technology. The reduced opex and inferred reduced repex costs for manufactured poles (steel, concrete and composite) do not outweigh the increased capital cost for Essential Energy's network over timber poles. Concrete poles present the least desirable cost outcomes; this pole type has been discontinued in Essential Energy's footprint. Steel poles are cost effective only in a few selected areas.

Factors considered in the NPV:

> Capital cost.

> Electrical, mechanical strength, and environmental performance.

> Cost to install, transport, and maintain.

> Failure and condemnation performance.

Key parameters are that timber poles are condemned on average at 36 years, concrete 40 years and steel 60 years. (Note: early life failures for timber poles should not be taken to indicate long term performance)[131] based on Essential Energy's pole condemnation data or corrosion studies. The average pole life for timber poles is noted as being very conservative for the purposes of the fiscal evaluation. Even so timber poles prove to have the lowest lifecycle cost.

For over 80 per cent of Essential Energy's pole usage timber Chromated Copper Arsenate (CCA) treated poles are the most cost effective, leading to an ongoing capital saving.

**Stream 2 – Pole Performance**

Essential Energy, having determined the most cost effective pole technology (timber) for its operating network, commenced analysis work on timber pole treatment technology and species options and developed an analysis paper[132] considering the option and costs.

The optimal treatment type and species mix considering technical performance based on service life analysis, maintenance, and risk of replacement cost analysis determined in a NPV analysis that:

> PEC treated poles are better performers than CCA treated poles with regard to external decay.

[130] Pole Selection Guide for Distribution Applications, Essential Energy, March 2013
[131] Mortality figures should not be confused to be inferring a survivability figure, condemnation ages are influenced by environment and do not reflect the entire population The NPV hurdle rate for timber poles to remain positive in this analysis was an expected service age of 23 Yrs which is an entirely reasonable expectation for a timber pole in the majority of Essential Energy's footprint.
[132] Trethewey, B, Essential Energy Pole Treatment Performance – Optimising Business Outcomes : Essential Energy 2014

- CCA treated Spotted Gum has a higher probability of external decay than CCA treated Blackbutt poles.

- Generally irrespective of treatment type D1 (durability 1) species poles are better performers than D2 (durability 2) poles.

Financial modelling using the performance probability statistics for the variations on treatment type and species including the maintenance and risk cost of replacement in a 40, 60 and 80 year NPV concluded that despite the better performance outcomes for PEC treated poles or D1 poles that the lowest cost outcome was in fact CCA treated D2 poles; the better performance of PEC treated poles or D1 poles did not justify the increased capital cost premium. Essential Energy will seek to implement this finding at the next pole tender opportunity.

**Stream 3 – Pole Survivability and Inspection Criteria**

To improve the serviceability and inspection criteria for timber poles an investigation[133] into the inspection manual and the asset management practices of Essential Energy when compared to other DNSPs found that:

- There were opportunities for improvements in the inspection manual and the management of identified defects that would materially improve the failure rate. Improvements included temporary struts, further detailed autopsies, changes in the inspection work activity and defect management (Administrative controls).

- The inspection regime was fundamentally the most prudent for Essential Energy's network when the costs for implementation of other peer DNSPs pole management practices were calculated.

- The serviceability criteria was the highest risk lowest cost option on Essential Energy's network.

- The low cost, high risk pole management practice in Essential Energy was predicted to reduce the average pole condition on the network to an unsustainable future.

These findings recommended altering the serviceability criteria such that poles would be reinforced earlier than the prior criteria. They have been implemented in the revised inspection manual in conjunction with the recommendation of the review of pole reinforcement.

**Stream 4 – Pole Reinforcement Technology and Application**

A critical review[134] [135] of pole reinforcement, including technologies, the expected life of reinforced poles, optimum time for reinforcement based on expected decay rates and expected serviceable mechanical strength (safety factor) and the serviceability criteria for reinforcement, recommended improvements in the inspection regime and reinforcement criteria:

- The banded style of reinforcement was more suitable considering failure modes and strength.

- Changing the wall thickness criteria to better delineate between reinforcement and replacement[136].

[133] Bell, G. Timber Poles Overview and Opportunities : Essential Energy April 2014
[134] Spencer, N. Comparison of Pole Reinforcement Types : URI Engineering April 2014
[135] Spencer, N. Hillston Feeder Reinforcement Review : URI Engineering June 2014
[136] It was noted that Essential Energy's reinforcement point was close to the condemnation point in the original serviceability criteria. Given that Essential Energy runs poles very close to failure before replacement the original criteria meant that some poles failed before reinforcement occurred, or that replacement in some areas was favoured over reinforcement.

> The life expectation of the reinforced pole is dictated in part by the life expectation of the reinforcement. The finding concluded that a reinforcement can be expected to last 10 - 20 years depending on environmental conditions (corrosive soils etc).

> The life expectation is considered when selecting a revised wall thickness criterion.

**Stream 5 - Inspection and Serviceability Criteria Comparison**

Essential Energy undertook a cost benefit review of the options considering the technical performance and constraints identified in the review.

The prior serviceability criteria was based on considering poles for reinforcement that had a factor of safety of between 1 and 2. Poles with a factor of safety less than 1 were replaced. This resulted in a timber pole failure rate of one pole per 9,550 in service. The replacement rate will progressively increase from 0.68 per cent in 2014-15 to 0.84 per cent of the population in 2018-19 due to ageing population as presented in ESS_17.

The number of reinforced poles will stay constant during the entire regulatory period at 0.056 per cent of the population with no improvements to the failure rate. This would result in a spend of $271.63M over the 2014-19 regulatory period as shown in Table 8-1.

*Table 8-1: Prior Inspection and Serviceability Criteria*

| | 2014/15 | 2015/16 | 2016/17 | 2017/18 | 2018/19 | Cost over 5 years ($M) |
|---|---|---|---|---|---|---|
| Pole Replacement | 8151 | 8623 | 9106 | 9601 | 10105 | 268.638 |
| Reinforcement Current (5 Year Average from 2014/15) | 680 | 680 | 680 | 680 | 680 | 2.988 |
| Total | 8831 | 9303 | 9786 | 10281 | 10785 | 271.626 |

## 8.1 Revised Inspection and Serviceability Criteria

The revised serviceability criteria is based on considering poles for reinforcement that have a detailed factor of safety between 1 and 3 but not less than 1. Poles with a factor of safety less than 1 are replaced. This is different to the prior serviceability criteria in that poles with factor of safety between 2 and 3 are considered for reinforcement.

**Target Aspirational Failure Rate:** Timber pole failure rate of one pole per 20,000 in service. Transition to this target to be achieved by administrative controls, a moderate change in serviceability criteria, and a step increase in pole reinforcement rates.

**Forecast Cost:** The replacement rate will be the same as current strategy and progressively increase from 0.68 per cent in 2014-15 to 0.84 per cent of the population in 2018-19 due to ageing population. The number of reinforced poles will increase however to bring Essential Energy's failure rate of 1 in 20,000 poles closer to reasonable industry practice. This will mean more poles (between safety factors of 2 and 3) will be considered for reinforcement. Therefore the number of reinforced poles will be 0.11 per cent of the population. This results in a spend profile of $274.26M over the 2014-19 regulatory period as shown in Table 8-2. The difference in spend from the prior strategy to revised strategy is marginal at $2.63M as the spend on additional reinforced poles is the only significant difference between the two strategies. What is significant is the anticipated improvement in pole failures.

*Table 8-2: Proposed strategy*

| | 2014/15 | 2015/16 | 2016/17 | 2017/18 | 2018/19 | Cost over 5 years ($M)[137] |
|---|---|---|---|---|---|---|
| Pole Replacement | 8,151 | 8,623 | 9,106 | 9,601 | 10,105 | 268.638 |
| Reinforcement Current (5 Year Average from 2014/15) | 1,280 | 1,280 | 1,280 | 1,280 | 1,280 | 5.625 |
| Total | 9,431 | 9,903 | 10,386 | 10,881 | 11,385 | 274.263 |

## 8.2 Review of Peer DNSP Serviceability and Inspection Criteria

In determining the revised criteria, Essential Energy examined the inspection criteria of other DNSPs and concluded that the cost increases for implementation could not be justified. The EMCa Technical Review suggests adoption of Ausgrid's 40 (47 per cent for LV poles) per cent pole reinforcement outcomes.[138] The cost impost for adoption of Ausgrid's approach to pole management is significant. It is to be noted that the pole inspection, serviceability, condemning criteria are a total asset management strategy. Thus reinforcement and replacement rates go hand in hand with the serviceability criteria. In other words, if Essential Energy was to increase the number the poles reinforced in line with Ausgrid's strategy, it would also have to adopt Ausgrid's pole inspection, serviceability and condemning criteria.

As noted in the 2013 Timber Poles Overview and Opportunities[139] paper section 4.1 Serviceability Criteria, Ausgrid utilise a wall thickness minimum of 70mm as the assessment criteria for pole reinforcement Essential Energy utilises a number of minimum wall thickness depending on the load present on the pole ranging from 20mm through to 50mm. Thus adoption of Ausgrid's management practices[140] in Essential Energy results in higher costs as shown in Table 8-3.

*Table 8-3: Summary of strategy cost against NSW peers[141]*

| Over 5 years excl inspection cost | Essential | Essential (Scaled to Ausgrid reinforcement strategy) per year | Essential (Scaled to Endeavour reinforcement strategy) per year |
|---|---|---|---|
| $M | 303.45 | 607.79 | 495.15 |
| Number of poles | 48,986 | 157,771 | 81,100 |

It is impractical to lift the outcomes of one DNSPs reinforcement regime and apply it to another DNSP without considering the serviceability criteria that lead to the reinforcement rate and the impact on overall cost of the strategy. To do so would be contrary to well-founded asset management philosophy, as mixing and matching the lowest common denominator from multiple DNSPs leads to a disjointed asset management approach and ultimately adverse outcomes with regard to functional failures. The calculation basis for Table 8-3 is shown in Table 8-4.

If Essential Energy was to adopt Ausgrid's serviceability criteria it would reinforce and replace 5.01 per cent and 5.6 per cent of poles inspected respectively. This will result in a strategy cost of $607.79M which is over twice Essential Energy's proposed strategy cost over the regulatory period.

[137] Essential Energy – Pole replacement and reinforcement investment case ESS_17 unit rates
[138] Review of Proposed Replacement Capex in Essential Energy's Regulatory Proposal 2014 – 2019, EMCa / Strata Energy Consulting, *Oct 2014, Item 113* footnote 34.
[139] Bell, G. Timber Poles Overview and Opportunities : Essential Energy April 2014
[140] Essential Energy is not criticising Ausgrid or any other DNSP's serviceability criteria. The selection of serviceability criteria is a complex activity intrinsically linked to risk and consequence. Essential Energy operates a geographically disperse network with low customer density. The risk / consequence for pole failure in Essential Energy is thus different to a CBD DNSP with high customer density and proximity to assets.
[141] Utilises forecast RIN unit rates (CA RIN Table 2.2.1)

Essential Energy's revised serviceability criteria results in a reinforcement rate of 0.43 per cent for poles inspected to achieve a target pole failure rate of 1 in 20,000. The replacement rate progressively increases from 2.7 per cent of poles inspected in the first year to 3.4 per cent in the fifth year.

This strategy is based on Essential Energy keeping in service poles of a lower wall thickness than Ausgrid before considering reinforcement or replacement. Almost all distributors use the nominal safety factor of the poles capacity as an indicator of an unserviceable pole while Essential Energy takes a position of determining the safety factor of the actual pole with the actual loads that the pole will be required to support. This has the effect of running the pole down to a very low wall thickness and/or material external reduction before the pole is deemed unserviceable. It brings with it a prudent fiscal management of the asset but at higher inherent risk due to the variability's in timber poles and their assessment. This approach also has an added consequence in that when relatively small loads are added to a pole that is at the limit of serviceability the risk can be higher for Essential Energy than that of other DNSPs.

## 8.3 Pole Reinforcement

Reinforcement regimes cannot be separated from the serviceability criteria that assess the timber pole; a DNSP's reinforcement rates cannot be lifted and applied to another DNSPs without the associated serviceability criteria. Pole reinforcements generally require some form of residual strength to be retained in the timber pole. Consequently all DNSPs have condemnation criteria for reinforced poles that are not dissimilar to the criteria they use for a pole that is not reinforced. Thus the primary function of reinforcement is failure avoidance due to random events such as wind. The life extension properties of the reinforcement is due to the support offered by the reinforcement to the timber in the pole, this retards the fibre strength reduction and shifts the critical zone further up the pole. The serviceability criteria determine the timber wall thickness for reinforcement or replacement.

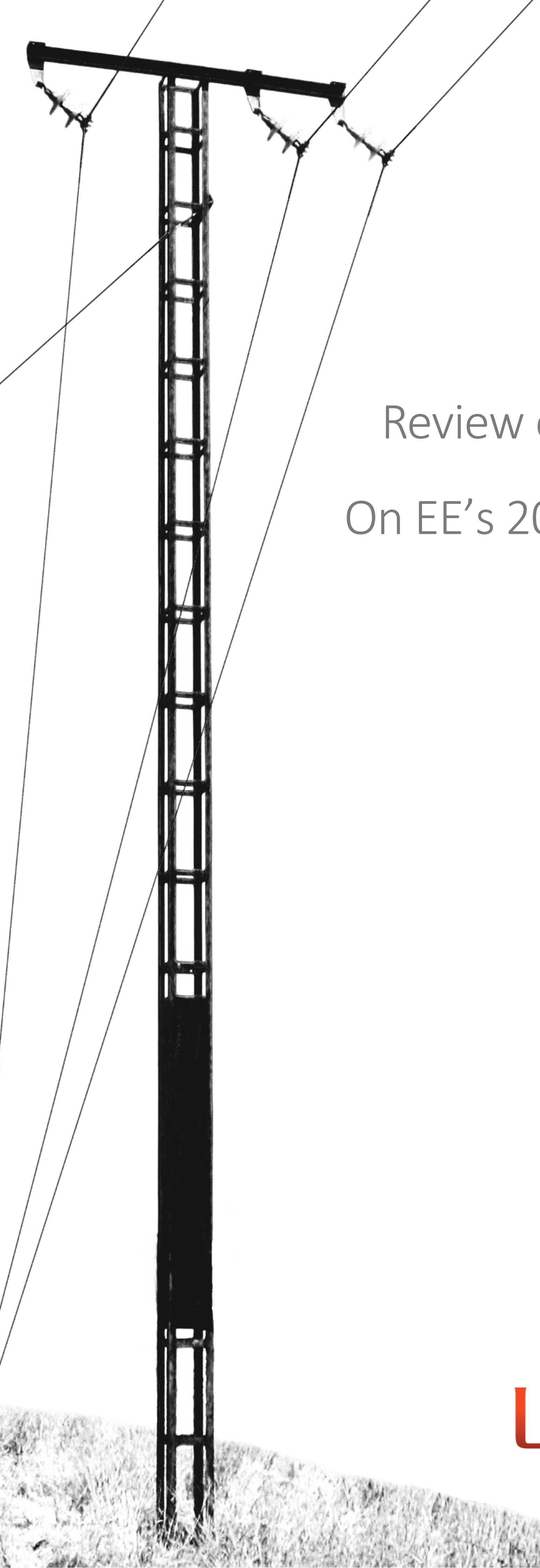
*Table 8-4: Details of Strategy cost against NSW peers[142] ($2013/14)*

| Overall Performance (Estimate) | Essential | | | | | Essential (Scaled to Ausgrid reinforcement ) per year | Essential (Scaled to Endeavour reinforcement) per year | Ausgrid per year | Endeavour per year |
|---|---|---|---|---|---|---|---|---|---|
| | 2014-15 | 2015-16 | 2016-17 | 2017-18 | 2018-19 | | | | |
| Conditional Failures | 8705 | 9177 | 9660 | 10155 | 10659 | 31533 | 16206 | 9108 | 3463 |
| Functional Failures | 125.6 | 125.6 | 125.6 | 125.6 | 125.6 | 21.3 | 13.4 | 7.7 | 3 |
| Timber Pole Population | 1.19M | 1.19M | 1.19M | 1.19M | 1.19M | 1.19M | 1.19M | 430864 | 266466 |
| 1 failure in n poles | 9500 | 9500 | 9500 | 9500 | 9500 | 56497 | 112947 | 56497 | 112947 |
| Pole Inspection Cycle (years) | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 4.5 |
| Poles Inspected per year | 298279 | 298279 | 298279 | 298279 | 298279 | 298279 | 298279 | 86173 | 59215 |
| Ground Line Inspection cost | $36 | $36 | $36 | $36 | $36 | $36 | $36 | $76 | $88 |
| OH Pole Inspection cost | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 56 | 0 |
| Annual Inspection cost | $10.7M | $10.7M | $10.7M | $10.7M | $10.7M | $10.7M | $10.7M | $11.4M | $5.2M |
| Reinforcement (% of poles inspected) | 0.23% | 0.23% | 0.23% | 0.23% | 0.23% | 5.01% | 0.46% | 5.01% | 0.46% |
| Annual Reinforcements | 680 | 680 | 680 | 680 | 680 | 14939 | 1375 | 4316 | 273 |

[142] Utilises forecast RIN asset data (CA RIN Table 2.2.1) and unit rate, no unit rate was available for Endeavour from the RIN data so Ausgrid's rate was utilised

| Overall Performance (Estimate) | Essential | | | | | Essential (Scaled to Ausgrid reinforcement ) per year | Essential (Scaled to Endeavour reinforcement) per year | Ausgrid per year | Endeavour per year |
|---|---|---|---|---|---|---|---|---|---|
| | 2014-15 | 2015-16 | 2016-17 | 2017-18 | 2018-19 | | | | |
| Reinforcement cost | $800 | $800 | $800 | $800 | $800 | $800 | $800 | $967 | $967 |
| Annual Reinforcement cost | $0.5M | $0.5M | $0.5M | $0.5M | $0.5M | $12.0M | $1.1M | $4.2M | $0.264M |
| Replacement (% of poles inspected) | 2.7% | 2.9% | 3.1% | 3.2% | 3.4% | 5.6% | 5.0% | 5.6% | 5.0% |
| Annual Replacements | 8,151 | 8,623 | 9,106 | 9,601 | 10,105 | 16,615 | 14,845 | 4,800 | 2,947 |
| Replacement cost | $6,597 | $6,597 | $6,597 | $6,597 | $6,597 | $6,597 | $6,597 | $12,789 | $11,120 |
| Annual Replacement cost | $53.8M | $56.9M | $60.1M | $63.3M | $66.7M | $109.6M | $97.9M | $61.4M | $32.8M |
| **Annual Strategy Cost excl inspection cost** | **$54.3M** | **$57.4M** | **$60.6M** | **$63.9M** | **$67.2M** | **$121.6M** | **$99.0M** | **$65.6M** | **$33.0M** |

# 9 APPENDIX E – Review of AER's Draft Decision on EE's 2015 – 2019 Pole REPEX: URI Engineering, Jan 2015



# Review of AER's Draft Decision On EE's 2015-2019 Poles REPEX.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CLIENT REFERENCE

Not Applicable

URIE JOB NUMBER

01267

DATE

6 January 2015

VERSION

Rev 2

URI ENGINEERING

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# 1 EXECUTIVE SUMMARY

URI Engineering (URIE) were engaged by Essential Energy (EE) to review the Australian Energy Regulator's (AER) draft decision on EE's Capex budget for 2014/15 to 2018/19 (1), and the associated Energy Market Consulting Associates (EMCa) high level 'engineering review' (2). This engagement was initiated out of concern that EE had their pole replacement, reinforcement and inspection budgets significantly reduced compared to their proposals, and EE were concerned that such reductions would significantly hamper their ability to provide the levels of supply reliability and safety that customers expect, let alone improve their current failure rates.

The results of our review are summarised as follows;

1. The AER used inappropriate reasons for reducing the Repex budget by seemingly basing the decision on an incorrect assumption that EE should be able to reinforce (a.k.a. stake/nail) 47% of their defective wooden poles like Ausgrid do with their low voltage poles only, and that Ausgrid's staking rate would be economically and socially responsible for the entire EE population. They also reference deficiencies identified by EMCa as part of the reason why the overall reduction is justified, however we could not find any substantiation or explanation from EMCa that supports their opinions, specifically in relation to the pole replacement/reinforcement portion of the proposed Repex. In our review of the EE proposal for poles (3) despite having some minor deficiencies, these were not significant enough to suggest that the overall budget was not prudently considered.
2. Benchmarking to other utilities and to average 'long-term' Repex expenditure is not considered an appropriate review technique. Other utilities have different network makeups due to different historical and current design and inspection criteria, and different pole materials. If those utilities have also been under-investing in their network in the past, it will just hold everyone at an unsustainable level until the point where the problem is too large to handle efficiently. In addition, we would not consider average Repex to be a good benchmark given it only appears to be based on data from 2001 onwards, and the true trend in the Repex spend is a continual increase. In this respect, EE's proposed budget is below the observed trend.
3. Ausgrid's reinforcement rate and criteria is inappropriate for EE's network, and in our opinion it is a waste of money and inappropriate for any network, as a large portion of the poles will still be replaced before the reinforcement takes any significant load. Any significant reinforcement program that is not accompanied by an appropriate level of replacement volumes is likely to just push back and build up the required replacement expenditure to a point in the near future when the required replacement rate will far exceed the current rate, and will cause an unnecessary financial and risk burden on the customers.
4. EE use a risk based inspection and replacement/reinforcement selection criteria that is in line with industry best practice. EE's system is however less risk-averse than other network providers, and hence reduction of the planned program will undoubtedly lead to an increase in failure rate in the short term, and a backlog of required Repex expenditure in the short to mid-term.
5. Reinforcement should not be used solely as a cost deferral mechanism, as it will only push back and make worse the replacement requirements in the future.
6. Based on simple projections of EE's required Repex to 2050, it is clear that the level of pole replacements proposed by EE is too low to adequately lower the average age of the network and hence risk of failure. In fact, replacement rates should be in the order of 2-3 times the current rates, and need to be maintained at that level in the long term to adequately maintain the network.

7. Failure to significantly increase pole replacements will lead to a situation similar to that of Western Power, but hopefully not as drastic. At this point in time, Western Power are replacing around 24,000 poles per year on a network with less than half the number of poles of EE. They are also reinforcing in the order of 68,000 poles per year just to reduce the risk of failure of the worst poles that they cannot get to for replacement due to deliverability and cost constraints. This is a significant part of why electricity prices have increased by more than 76% for residential customers and more than 180% for large business over 2009 prices, with more on the way in the coming years (4) (5).
8. We are aware that the Opex for pole inspections has also been significantly cut by the AER in their draft decision. EE suggest that this cut will likely require a reduction in pole inspections per annum. The effects of this need to be carefully considered, and based on our knowledge of the relationship between inspection interval, failure rate and pole replacement requirements, increasing the inspection interval can be offset by changing the condemnation criteria to give the same or improved failure rates, but it increases the number of pole replacements required at an overall increased cost. Hence, we would warn that failure rates are likely to increase if the inspection interval was increased whilst keeping the inspection criteria the same.

Based on these results, we recommend that a year-on-year increase in pole replacement of 11% per annum is the preferred option to be able to gradually increase the number of replacements to a sustainable level, in the most cost effective and deliverable way. Some minor adjustment of this may be required to adequately deliver the first few years increases, but the more sustainable replacement rate of approximately 1.7% of the pole population per annum should be reached within 10-15 years to avoid a significant increase in network age and failure rate, and limit the amount of additional expense that would be incurred to be able to repair the effects of under-investment in the meantime if a BAU approach is adopted.

Further analysis and study of the EE network data will allow for better modelling of the requirements in the future, but the 1.7% level is an appropriate minimum target at this stage.

At the very least, the AER should approve EE's budget for pole Repex and inspection Opex, but in our opinion it should actually be increased, with a long term plan to reach 1.7% per annum replacements.

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# TABLE OF CONTENTS



# REVISIONS

| Revision Number | Date | Comments | Approved By |
|---|---|---|---|
| **0** | 5/1/2015 | Completed report submitted to client | NS |
| **1** | 6/1/2015 | Clarification of 47% reinforcing rate applied to entire population in AER models. | NS |
| **2** | 6/1/2015 | Updated Western Power replacement & reinforcement dates with more current data. | NS |
| | | | |

# DISCLAIMER

# 2 INTRODUCTION

## 2.1 SCOPE

URI Engineering (URIE) was engaged by Essential Energy (EE) to undertake an expert review of the Australian Energy Regulator's (AER) *Draft decision, Essential Energy distribution determination 2015-2016 to 2018-2019, Attachment 6: Capital expenditure* (1). In particular, we were asked to comment on the decision relating to the pole replacement and reinforcement replacement capital expenditure included by the AER, which was a 35% reduction of the figure proposed by Essential Energy.

## 2.2 AUTHOR

URI Engineering was formed in 2013 by Nathan Spencer after he could see a need for independent, expert advice in relation to the structural design, durability and performance of different utility pole materials, but particularly timber. Nathan is a Chartered Structural Engineer with more than 14 years experience in a range of design and asset management disciplines, and has been focussed on the electrical distribution industry since 2007. He has completed full-scale destructive testing on more than 500 new and old utility poles, help utilities get their pole asset management systems back on track, has provided advice to Australian Standards committees on timber pole design and testing, and has helped a number of Australian and New Zealand utilities revise their pole design and inspection policies to bring them into line with 'best practice' in the most efficient manner.

Nathan's experience and knowledge of pole inspection, replacement and reinforcement practices is the basis on which we are qualified to provide the opinions contained herein.

Nathan Spencer

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# 3 BACKGROUND TO THE DECISION

In Section A.3.1 of the AER's draft decision, they note that EE proposed $857 million for Repex. However, the AER only included $676 million in their estimate. This equates to a reduction of 21%. Despite an overall reduction of 21% in proposed Repex, the AER have actually reduced the allowance for pole replacement and reinforcement specifically from $312M to $204M, a reduction of 35%.

The main reasons for the reduction in allowance appears to be based on high level economic modelling, comparison to long term averages, an 'engineering review' of EE's proposal by Energy Market Consulting Associates (EMCa) (2), and comparisons to other utilities such as Ausgrid, Endeavour Energy, Ergon, SP Ausnet and Powercor.

For pole replacement however, the only reason that can be directly linked to the reduced allowance is the assumption that Essential Energy should reinforce 47% of their poles that are at the end of their service life, rather than the 18% proposed. This is based solely on the assumption that Ausgrids asset management systems and pole serviceability criteria are directly applicable to Essential Energy's network.

# 4 SUMMARY OF AER FINDINGS REVIEW

Based on our review of the AER draft decision (1), the EMCa *Review of Proposed Replacement Capex in Essential Energy's Regulatory Proposal 2014-2019* (2) and Essential Energy's *System Investment Document ESS_17 and ESS_46 Pole Replacement and Reinforcement* (3), we submit that the decision to reduce the Repex for pole replacements and reinforcements is unjustified.

Whilst we agree with many aspects of the EMCa report, we also understand the history behind Essential Energy's current position in relation to pole asset management and forecasting pole replacement/reinforcement rates. As such we note that current techniques are prudent at this stage of the company's development, and in many cases exceeds that of comparable networks. Any lack of rigor does not in this case justify the use of broad assumptions and simplistic economic models used in place of EE's analysis.

The application of Ausgrid's pole reinforcement percentage to Essential Energy's network is the only material method used to reduce the Repex allowance. In our opinion this is grossly reckless from a risk and long term financial perspective and lacks appropriate understanding of the different asset management conditions – and in particular the differences in the pole serviceability criteria – between the two companies.

Although the AER draft decision (1) and EMCa's report (2) note a number of deficiencies in EE's Repex proposal, in our opinion they are broad generalisations lacking in substantiation and do not in our opinion apply to the pole replacement and reinforcement component to the extent that they would be a basis for reduction of Repex allowance.

These findings are explained further in Section 5.

# 5 DETAILED DISCUSSION

## 5.1 POLE REINFORCEMENT ASSUMPTIONS

A detailed commentary on the AER's considerations in reducing the Repex allowance for Essential Energy is shown in Appendix A.1. In our opinion the reasons given do not appear to apply to the pole reinforcement/replacement program of Essential Energy. However, the main method used to reduce Essential Energy's Repex allowance is to assume the reinforcement/replacement ratio of Ausgrid can be applied to EE's network. This assumption is flawed in a number of ways;

1. Utility poles of any material have finite lives. Whilst reinforcing is a cost effective way of extending the life of **some** poles, it is not preferred for critical assets (transformer poles, termination poles, etc.), steel or concrete poles. In addition it should not be used where the pole has other issues such as deterioration at or above the top of the nail, or pole top assemblies that require replacement. Reinforcement only ever delays the pole replacement, pushing the investment back 5-20 years in most cases (6).
2. The only ways that reinforcing can be economically beneficial in the medium term are;
    a. If there is a definite spike in aged poles that are nearing the end of their life, with a large gap in age back to the next significant age group of poles. This could be a case for deferment of replacement to save money in the short term or average out capital expenditure if it is not going to significantly add to future replacement requirements.
    b. If pole replacements are still at a level that will prevent the pole population from ageing beyond a sustainable level. As a simple example, if the average life expectancy of the poles is 50 years, then a replacement rate of 2% per year for an evenly age-distributed population is required to prevent the development of a backlog. We have not looked in depth at the other utilities submissions to the AER, but based on our

knowledge of the Australian utility industry, we highly doubt that anyone with any significant reinforcement program is replacing enough poles to prevent the backlog from building up.

3. Pole reinforcement is only just starting to really be understood in terms of how it works structurally. Even though reinforcement testing has been done in limited quantities in the past, the methods used included a few well-meaning but misguided assumptions and in reality the reinforcement systems do not perform as well as expected. In particular, there have been unconservative uses of plastic design theories to determine the design capacity, and assumptions that the timber and steel will work as one (composite action) to resist the design loads. In reality, these assumptions are not supported by sound structural theories, nor by experiences with failures in the field or during realistic testing.
   In short, the timber takes almost all the load up until the point that it begins to fail because the timber section has a higher EI ("stiffness") than the steel, and the connection between the two has too much play before transferring shear loads. Once the timber fails the steel has to take over. By the time the steel takes over, the lean on the pole is significant and the weight of the pole together with the lean and the external loads will almost always buckle the steel reinforcement and the pole will fall to the ground. In other cases the timber will actually fail at the top of the reinforcement through one of a number of mechanisms and definitely fall to the ground. The number of instances where the timber fails and the steel continues to hold the pole off the ground and out of immediate danger is considered very rare. Understanding this should significantly alter perceptions of risk reduction offered by reinforcement.

4. Ausgrid and EE have very different asset management standards for their timber poles. The main reason why Ausgrid has a lower failure rate than EE is the overconservative inspection criteria that it uses. According to NS145 (7) Ausgrid classifies a pole defective if it has a "good wood" wall thickness of less than 70mm for any size pole, or 50% of its original capacity. Strangely, even the largest 20m long pole will still have at least 73% of its section capacity when its wall thickness reaches 70mm, so the 50% mark is unlikely to be reached. Although we do understand that Ausgrid are one of the few utilities to have considered the previously unknown loss of good wood fibre strength in their design criteria for new poles, it is uncertain from the documentation we could find whether this is also considered in the inspection criteria. If it is considered, the inspection criteria needs amendment.
   Ausgrids inspection criteria calls for a condemned pole to always be considered for reinforcement, with the only criteria as to whether it can be reinforced or not being wall thickness values above ground that are less than the 70mm minimum wall thickness that they call for at ground line. In other words, unless a pole deteriorates extremely quickly between inspections, or is damaged above the reinforcement zone, every condemned pole on Ausgrids network should be reinforced rather than replaced (barring any other significant issues that may require replacement regardless, such as mechanical damage). This in turn is extremely wasteful given that;

   a. The timber can still take the design loads and the reinforcement is unlikely to take anything substantial until the timber wall thickness reduces considerably, which will depend on the decay rate for the pole, which has a coefficient of variation of around 92% (8).

   b. In most cases, based on reinforcing a pole at 70mm and expected decay rates of around 1-2mm per year (8), we would expect the reinforcement to do very little work within its life expectancy of 5-20 years.

5. If EE were to take on the same reinforcement criteria as Ausgrid, the reinforcement rate would require a significant increase. In most cases using a wall thickness of 70mm or 50% residual strength as the main criteria would mean that for the more common 11m to 14m pole length range, EE would be reinforcing before the residual Factor of Safety[1] (based on the assumption that the FoS was 4 to start with) was down to 3.2, and more commonly around 3.5. In addition, EE currently use a detailed calculation of residual FoS that compares the actual design load to the residual capacity. If EE were to just go off residual strength alone, most poles would have started with an actual FoS of 6 or more, and hence if they are at or around a detailed FoS of 3 at the moment, the poles would already be at or close to replacement stage based on Ausgrid's criteria, let alone reinforcement stage. How this would affect overall required replacement/reinforcement numbers has not been investigated in detail for the purposes of this review, but it is expected to significantly increase them beyond the levels proposed by EE in their submission. At this stage EE only consider reinforcing below a detailed FoS of 3 (9), and even this is verging on being too early to be structurally and economically efficient, but it allows for some risk reduction of poles that are close to their limit, to try and reduce overall failure rates.
   In short, increasing reinforcements to Ausgrid levels is unlikely to significantly reduce the number of replacements required, it will just add to the overall cost of a responsible Repex program by requiring more poles to be reinforced in addition to the replacements.
   We are not sure of the justification behind Ausgrids reinforcement strategy, but from the information available to us it is not considered responsible.
6. We have been witness to pole failures at the top of reinforcement in Ausgrids network that we know were not recorded as a pole failure, let alone a reinforced pole failure, so we would question the use of Ausgrids data regarding reinforced pole failures in making any assumptions about performance of reinforced poles, regardless of the fact that the timber itself is unlikely to fail.
7. In our experience, reinforcement should only be an option as a risk reduction technique until a more permanent replacement can be arranged. If it is to be used as a cost deferral technique whilst maintaining an acceptable risk profile, a plan needs to be put in place for the management of increased pole replacements in the future.
8. A reinforced pole does not automatically have a lower risk of failure or consequence of failure compared with an unreinforced pole because it does not reinforce the entire length of the pole and does not support significant compressive loads. It is an additional safety measure in case the pole is one of the lower percentile poles that has a combination of low fibre strength, high load, and the inspection was unconservative.
9. Whilst EE have put a lot of thought into their reinforcement vs. replacement targets, it is hard to predict actual numbers of each, because the system is by necessity reactionary in that decisions are made following inspections. The most efficient decision is also not made

[1] The Factor of Safety (FoS) referred to is based on the working stress design methodologies that were used up until the implementation of Limit States Design rules in the industry. Factor of safety is a measure of capacity divided by load, where the load was significantly less (or more likely to be exceeded per year) than that used in Limit States Design, but the capacity used in Limit States Design is generally much higher. In general, any variability in design variables for working stress design were taken up by a large safety margin (FoS) on the capacity calculation, while Limit States Design addresses the variability of different load and material variables individually. Ultimately, for timber poles, a FoS of 2 is considered as having the highest allowable level of risk of failure based on EE's design and inspection criteria and current knowledge of timber pole residual capacity, and the pole should be replaced. In other words, a pole with a FoS of 3 cannot afford to lose two thirds of its capacity before replacement.

on a pole-by-pole basis. Rather, depending on the inspection results in a particular area/line, efficiency can be gained by replacing all poles that require action, or even reinforcing some poles that might otherwise be replaced, but the latter needs to be carefully considered as there is normally a good reason as to why a pole has been tagged for replacement.

Despite the structural deficiencies and risks associated with pole reinforcement, these can be relatively well managed, and in our review of EE's procedures (6) and in subsequent discussions and assistance provided in relation to EE's reinforcement/replacement trigger points; EE's systems have been adjusted to increase the structural relevancy of pole reinforcement practices, whilst increasing the number of poles that can be reinforced rather than replaced. This approach gives a reasonable balance between cost and risk, with the main aim of bringing the failure rate closer to those of the other NSW distributors by increasing the number of poles that can be improved without significant cost increases.

## 5.2 RISK & LONG TERM FISCAL ISSUES

Whilst increasing the reinforcement rate of defective timber poles to 47% is illogical, we are also concerned that the AER's draft decision to reduce EE's Repex budget appears to ignore or at least significantly downplay the backlog of replacements that is highly likely to build up in the next 10-20 years unless EE's pole replacement numbers are increased in real terms. The submission from EE (3) alludes to such an issue, and proposes relatively modest pole replacement increases to start to address this long term issue. However, even these numbers are still unlikely to be enough to maintain the current risk profile of the network in the long term, which is related to the average residual FoS of the poles across the network.

After World War II, there was a significant expansion of the electricity network in NSW that is now Essential Energy (See Figure 2). This is recognised by the AER, but only specifically in relation to the significant amount of overhead conductor that is on the network from that period. What doesn't seem to be recognised is that a large portion of the poles that were installed to support the conductor are still original. This is evidenced by the significant number of poles from 45-59 years old that are still on the network. Indeed, there is in the order of 160,000 poles that are in the age group of 45-49 years old currently, which suggests an installation rate of more than 32,000 poles per year from 1965-1969. In fact, Figure 1 suggests that the current installation rate for poles is at the lowest it has been since the installation of most of the oldest poles on the network (the 'Current' curve). If that continues, it is obvious that there is going to be a point where pole replacements will need to drastically increase, or failures will drastically increase.

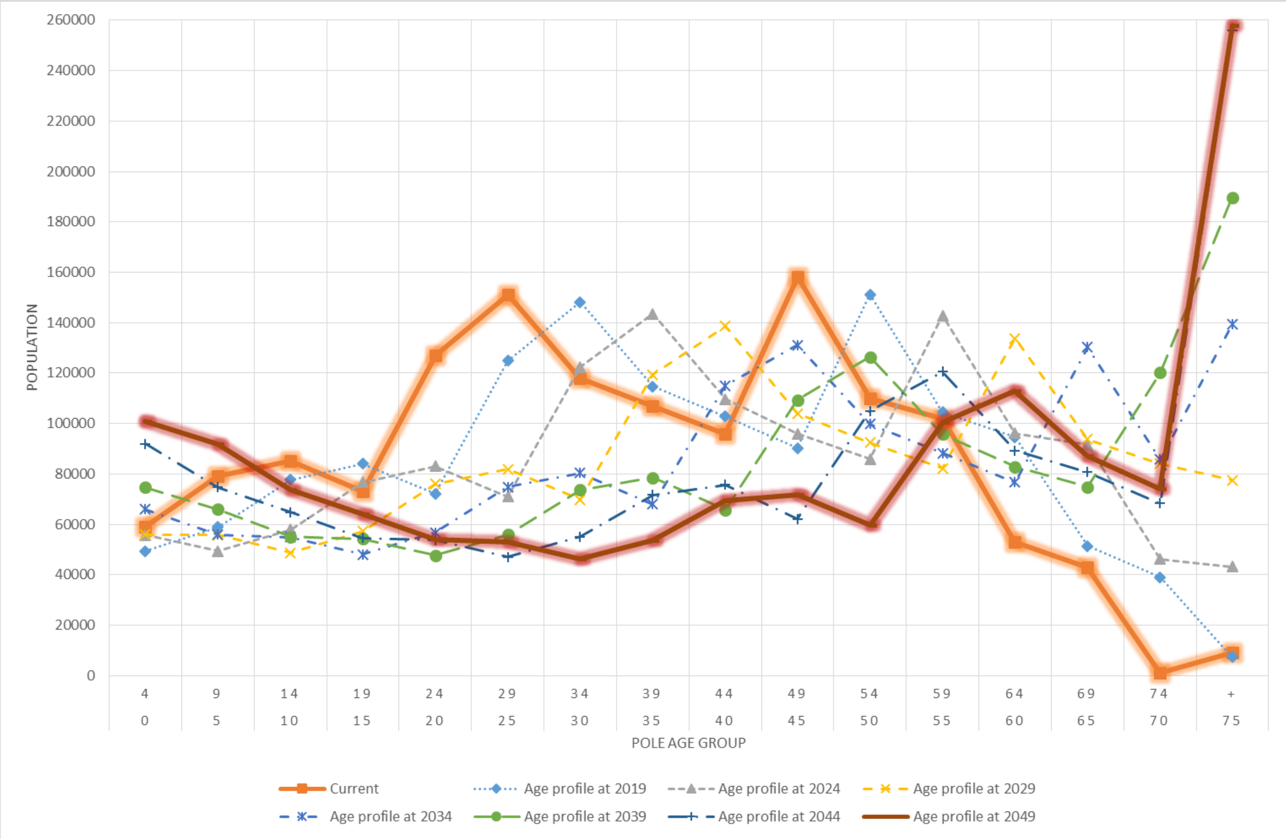


***Figure 1: Projected Pole Age Profile at Current Replacement Rates***

Figure 1 shows the long-term effects of what is effectively a Business As Usual (BAU) scenario. This is a simple 5 yearly projection model based on the percent of all poles across the EE network that are replaced in each 5 year age group. The percentages may not be current as they are taken from a 2009 study (10) and the accuracy of the information available to EE is now understood to be greatly improved, however it is sufficient for the purposes of this argument. It is assumed that no poles less than 5 years old are replaced, and that 80% of poles older than 75 are replaced rather than 100%, and the numbers are normalised back to the maximum rate of approximately 0.7% of the population being replaced per annum (based on the 10,105 replacements proposed in 2018/19 in the EE submission (3) to the AER). There is some increase (5-20% between each 5 year period) in pole replacements in each period due to the increase in pole numbers older than 75 years and the way the model is set up, if this increase is not realised in reality, then it will just make the long term issues worse.

For the BAU case, the percentage of poles older than 50 years will go from 23% currently, to more than 50% by the end of 2039. The number of poles in the >70 age bracket would go from 0.7% to more than 22% in the same period. Clearly, this will be unacceptable from a risk perspective as risk of failure is strongly related to network average age versus life expectancy, and the number of failures and condemned poles will have to increase before this point is reached, most likely due to public concerns.

In addition, the use of average 'long-term' Repex for benchmarking against EE's proposal is considered inappropriate given the average only goes back to 2001 when EE was formed by amalgamating numerous smaller networks. Since that time, the AER's graph of Repex consistently increases, and if anything, EE's proposal is below the real trend, and is still potentially inadequate for the projected condition of the network.

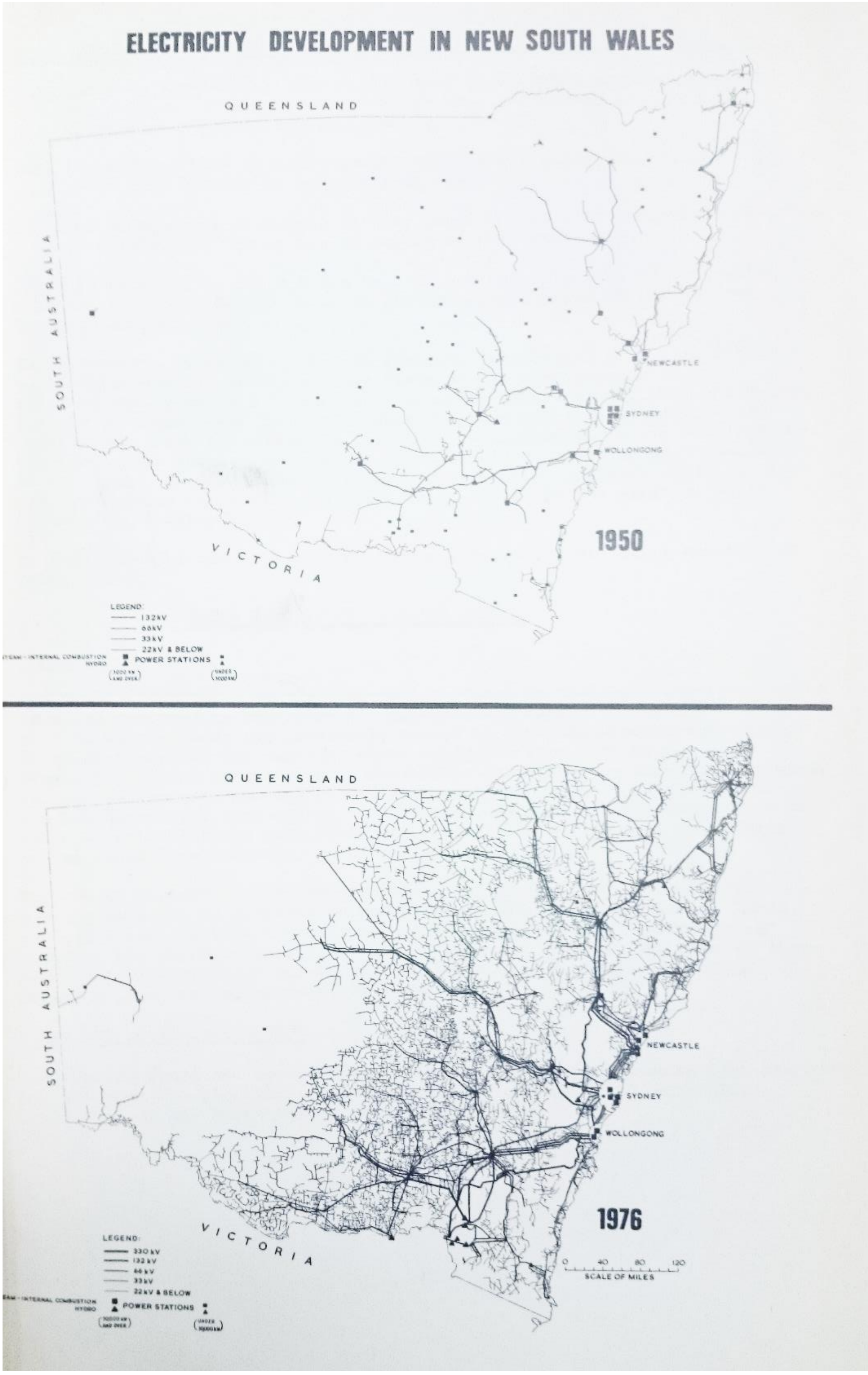


***Figure 2: NSW Electricity Expansion Between 1950 and 1976.[2]***

[2] Reference is being sought but was unavailable at the time of publishing due to illness of the person that provided the image.

### 5.2.1 Lessons to be considered

An obvious example of what could happen if EE and other east coast utilities do not plan for increased replacements in the short to medium term is given by Western Power. Western Power only have a pole population in the order of 700,000 poles, and they are now replacing more than 24,000 per annum **and** reinforcing in the order of 68,000 per annum (as a risk reduction more than capital deferment exercise) to make up for a period of almost 20 years at the end of last century when there were practically no pole replacements conducted.

Not only has Western Power needed to significantly increase their Repex for the next 15-20 years to overcome previous deficiencies, they have spent tens of millions of dollars on R&D projects to better understand and improve inspection accuracy and efficiency, projections and work programming so that they can best prioritise the replacements and reinforcements. At this stage, this level of investment does not seem necessary for EE, but it is an extra hidden expense that needs to be considered if the backlog is allowed to build to a level that requires more intervention than can be physically or economically achieved.

To relate EE's projected backlog situation to an economic effect on customers, based on information from the WA Department of Finance (4) and Infinite Energy (5) power prices in WA have increased by more than 76% for residential customers and more than 180% for large business over 2009 prices. There is an additional 7% increase for households and up to 28% increase for business earmarked for 2015. This did follow a period of 11 years of no increases for households and no increases for large business between 1993 and 2007, but the increases are well above a Consumer Price Index "catchup" increase to try and cover required spending to make up for years of significant underinvestment in the network.

## 5.3 OTHER ISSUES

### 5.3.1 Deliverability

The main problem with a sudden increase in required replacements is the delivery of the work. Not only does material availability come into consideration, getting the personnel to be able to do the work becomes an issue, regardless of how many external providers are engaged to assist. Both material and personnel constraints are the main reason for the abnormally high reinforcement rate for Western Power (around half their network needs some form of intervention as quickly as possible, and around half of those poles are reinforced timber[3]). An increase of 20% over a 5 year period is not considered difficult for EE to reach based on what we have witnessed in Western Australia. However, an increase of 300% will require a significant ramp-up period.

### 5.3.2 Undetectable strength loss

As EE pointed out in their submission (3), the industry is only now coming to terms with an apparent loss of strength in the wood that is currently considered as 'good wood' with all its original strength (some still ignore it completely). Fortunately, conservativeness in previous design and inspection rules compensates somewhat for this, but at this stage Limit States Design rules do not properly account for this loss of strength, and more work is required before EE could comfortably move to a Limit States Design inspection criteria. In reality, there is no need to rush into this change as it does not provide significant benefits or changes to the overall asset management outcomes.

### 5.3.3 Data

Ideally, EE and other utilities would all have enough historical inspection data to project the loss of strength of individual poles, and hence project out replacement requirements with great accuracy. The

[3] Based on our knowledge of their issues gained from work done to assist them.

reality is that the database systems required to do this accurately have only just started to be developed and used in earnest in the last 10-15 years, and most in the industry have had issues with data quality, not to mention recording the required types of data. EE have improved their data quality significantly in the last 4-5 years, but it would take another 2 or more inspection cycles to be able to confidently project replacement requirements. For steel and concrete poles this is almost impossible because there are currently no methods available to accurately or efficiently detect/estimate residual strength, let alone differentiate it with sufficient accuracy between inspection cycles. All assessments for materials other than timber are currently based on visual assessments and unreliable simplistic measurements, which makes projection of residual capacity impractical.

### 5.3.4 Desired replacement increases

The presumption of BAU until more information is available by say 2025, and then replacing everything over 75 years old, plus everything else at a rate that assumes an average service life of approximately 61 years gives the pole age profile projections in Figure 3. This shows that the pole replacement rate will need to jump by approximately three times its current rate to be able to maintain a reasonable level of risk in the EE network. Replacement rates in Figure 3 are in the order of 0.7% and 0.78% per annum between 2014/15 and 2024/25 respectively, then 2.4% to 2.7% per annum after that. When comparing Figure 1 and Figure 3, it is obvious that one regulatory period of slightly increased replacements is not enough to significantly improve the condition of the pole network, and the scenario that includes significant increases in pole replacements is much preferred from a risk perspective as it significantly reduces the number of poles older than 75 years.

A more economically acceptable and deliverable approach would be to increase pole replacement rates by 11% year on year for the next 15 years. This would allow the replacement rate to increase to 2.59% per year by 2028/29, or at least 1.7% by 2024/25, at which point the year on year increase may be able to be reduced. 11% per annum may not be achievable in the first few years so even this rate may need to be increased gradually, but it is considered much more achievable than a sudden 300% increase.

Another issue that is hidden in the information is that the majority of poles that are more than 50 years old will be untreated 'Natural Round' or 'Desapped Durable' hardwood poles. Many will be highly durable species of timber, but at more than 50 years old the mortality rate is expected to increase significantly. The typical service life for these poles from the "Timber service life design guide" (11) is 40-60 years on average depending on environment and diameter, but we would expect a significant increase in mortality rate beyond this. Currently there is more than 18% (~244,000) of the network that is in this age bracket, and another 112,000 in the 40-50 year age bracket (12). At the same time, many of the treated poles should last longer than currently assumed, and even some of the untreated hardwoods will last many more years, which will balance out some of the replacement requirements. However, this effect is unlikely to significantly alter the observation that at some stage in the near future, EE will have to increase its replacement rate by two to three times or pole failure rates will increase significantly. Reinforcement will only delay that point in time by a relatively inconsequential amount.

Further analysis of EE's network data will be able to provide more information about the amount of poles at different safety factor levels, which could also be used to project the amount of replacements required, however the accuracy of this would be similar to that of the above projections.

Realistically, although EE has a risk based inspection and replacement asset management approach, it needs to be combined with an appropriate overall level of replacement. The exact level needs to be based on a cost benefit options analysis that projects out at least 40 years, then an appropriate plan put in place to achieve the goal.

### 5.3.5 Increase in unit costs

Any significant increase in replacements is likely going to increase the unit costs due to the need to use more expensive pole materials to supplement timber pole supply. This effect will be worse if the rate of replacements has to increase more suddenly in the future. Also, other materials such as steel and concrete are more prone to corrosive soil and atmospheric conditions than timber, and cannot just be assumed to last longer than timber in most locations, and networks have continued to push into more marginal areas in terms of durability. This is likely to also negatively impact the unit costs due to corrosion protection allowances required, otherwise it may increase the number of replacements required in the future due to a potentially shorter life expectancy. However, EE have done and are continuing to do some good work in this regard (from what we have witnessed), in an attempt to only place timber-alternative pole materials in conditions that will likely allow for acceptable asset lives.

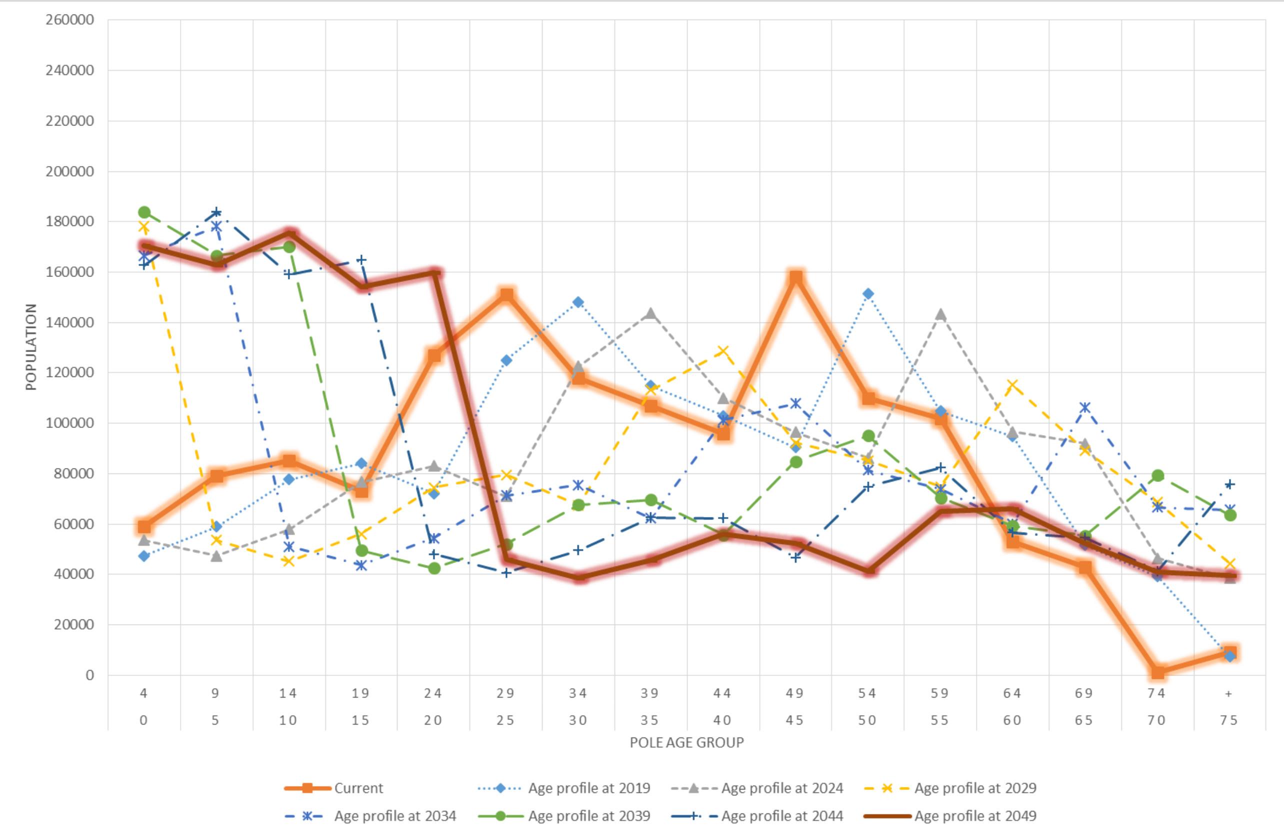


***Figure 3: BAU until 2025 then replacement rate based on an average life expectancy of 61 years.***

### 5.3.6 Climate change considerations

Recent studies that we have been involved in suggests that there will be fairly minimal impact on the performance of poles in Sydney and Canberra due to predicted climate changes to 2070, however this may or may not apply to EE's network. More work would be required to assess this in detail, but it is considered of low importance as it is unlikely to significantly change the magnitude of the projected issues of required replacements.

### 5.3.7 Opex reductions

We also understand that EE's Opex has been significantly cut at the same time as the Repex. As a result we understand EE are considering options to reduce cost based on extending the inspection interval for their poles. This would only serve to exacerbate any failure rate increase due to lack of replacements, unless the inspection criteria is changed to counteract the increased risk of failure between inspections. As shown in previous studies (8), increasing inspection intervals can be achieved with minimal failure rate increase, but it comes at a cost of increasing the replacement rate at nearly the same rate as the number of inspections are decreased (as a percentage). Given that pole replacements are significantly more costly than pole inspections, it is hard to see how this can be an effective overall cost reduction mechanism.

# 6 CONCLUSIONS

In our opinion, the draft decision by the AER to significantly reduce the pole replacement and reinforcement Repex, at the same time as reducing the Opex for pole inspections shows inappropriate disregard for the performance issues, long term financial effects and current state of the network that Essential Energy is constrained by. In reality, to avoid issues that Western Power are now facing, Essential Energy's Opex should at least be maintained with any minimal savings coming from efficiency improvements. On the other hand, Repex should be gradually increased such that within the next 10-15 years the replacement rate should be in the order of 1.9-2.5% per annum, compared to the EE proposed 0.7% in 2018/19. Increasing the reinforcement rate will not significantly change the level of increase required, it will only delay it by maybe 5-10 years given the peak in age profile in the 45-59 years age brackets, which are mostly untreated 'durable' hardwood poles.

If Essential Energy were to assume Ausgrid's relative pole replacement/reinforcement figures it would be considered grossly inappropriate given the current levels of overall replacement, condition of the network, and the observation that Ausgrid's reinforcement assessment appears wasteful due to reinforcement of poles that are not weak enough to substantially utilise the reinforcement.

We found the EMCa report touched on some good points, but it lacked in substantiation and specificity in its findings and based on our review of EE's proposal for pole replacement and reinforcement Repex, we do not understand how the majority of the negative findings can relate to the proposal for pole replacement/reinforcement of poles given the depth of explanation provided in their proposal, which is considered prudent for a network of EE's size and complexity.

Based on our assessment, we recommend that Essential Energy increases its Repex for pole replacement, whilst maintaining the proposed level of reinforcements. A responsible level of increase is likely to be in the order of an 11% increase in the replacement rate compounded year-on-year. Failure to increase at some substantial level would be directly ignoring the lessons to be learnt from Western Power's current situation. The only reason Western Power are in that situation now and 'east-coast' utilities are not is because Western Power's hardwood poles are almost all untreated, and they have a life expectancy of less than 40 years, compared to the higher life expectancy of the east-coast hardwoods.

Any delay in replacement increases will put further financial pressure on EE and the end customer not only due to the jump in replacement levels that will be required, but due to the increased cost of other materials that are likely to be required to supplement the availability of timber in the event of a sudden, significant spike in required replacements.

# 7 REFERENCES


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3. **Chessells, Mal and Walkerden, John.** *System Investment Document ESS_17 and ESS_46 Pole Replacement and Reinforcement.* Port Macquarie : Essential Energy, 2014.

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10. **Spencer, Nathan and Elder, Leith.** *Pole Service Life - An Analysis of Country Energy Data.* Sydney : s.n., 2009.

11. **MacKenzie, C. E., et al.** *Timber service life design guide.* Melbourne : Forest and Wood Products Australia, 2007. PN07.1052.

12. **Bell, Greg.** *Timber Poles Overview and Opportunities.* Port Macquarie : Essential Energy, 2014.

# DETAILED REVIEWS

## A.1 SUMMARY OF AER & EMCA REVIEWS

Table 1 summarises the main AER and EMCa considerations used in the decision to reduce Essential Energy's Repex allowance, as well as providing our opinion of the applicability of these considerations to pole replacement and reinforcement allowances.

***Table 1: Comments on AER & EMCa reasoning for draft decision.***

| | AER / EMCa Consideration | Comments on Applicability |
|---|---|---|
| 1 | EE's proposal is around 59% higher than the long-term average. | The long term average is not in our opinion a true measure as Repex has been steadily increasing since the formation of Country Energy in 2001. This is representative of under-investment before and after amalgamation and an ageing profile. If anything EE's proposal plateaus the true trend. |
| 2 | Controlling for network scale characteristics, Essential Energy does not compare favourably to that of other service providers in the NEM. | Repex vs. customer density and capacity density do not show the true picture in relation to poles. Even Repex vs. number of poles or network length would not be a fair comparison except maybe when comparing with Endeavour and possibly Ausgrid, because everyone else in the country had historically very different network risk profiles due to different design and inspection policies (i.e. Factor of Safety of 4 in NSW vs. 2.5 in QLD and Vic, different environmental design requirements, and different performance expectations). We know that some utilities in the comparison will need to increase their own Repex in the near future to manage their own deteriorating asset profile. EE's serviceability criteria are also less risk averse than other asset owners that are used in the comparisons, which changes the age profile and hence risk profile of their network, making it difficult to draw direct comparisons. |
| 3 | A substantial increase in spare network capacity during the 2009-14 period should reduce the rate of deterioration of EE's assets over the 2014-19 period. | This may apply to some assets, but it does not apply to poles. Pole life expectancy is governed by the environment in which it is placed, not by the electrical load on the system. In fact lower temperatures in conductors due to lower electrical loads may increase pole loads under some conditions. |

| | AER / EMCa Consideration | Comments on Applicability |
|---|---|---|
| 4 | EE applies its risk criteria overly conservatively, and this causes overly conservative investment decision making. | This may be true for some assets, and without detailed analysis to prove otherwise it may be true for poles. However, this is likely to be less important for poles given that EE's performance in regards to this asset is commonly measured in unassisted failures per year. Given there is a long-standing asset management system in place, it is considered more appropriate to predict requirements against past performance of the existing system, adjusted as required to give the desired failure rate. The risk profile will become more important for poles as EE's asset management system evolves. Even so, EE allows its poles to degrade to a lower factor of safety compared with other distributors, which is much less conservative than suggested by this comment from EMCa, and can be witnessed by their relatively high failure rate. |
| 5 | It was unclear, at a detailed level, how EE estimated its proposed Repex program. | In general this might be the case, however the method used by Essential Energy was quite clear in the ESS_17 and ESS_46 document (3). It may not have looked at every pole in the network and predicted which ones were going to need replacing/reinforcing in the next period, but there is no system currently used by any utility in the world that will do so with more accuracy than the methods employed by Essential Energy. |
| 6 | EE's Repex strategies were not informed by robust options analysis or adequate cost-benefit analysis. | This is considered a reasonable statement for the proposed Repex for poles, as there was some discussion of the effects of lower spend on replacement/reinforcement, but it was not clearly portrayed as an options analysis. However, it is noted that the simplistic model used by Essential Energy is in our experience best practice for EE's current network and age profile, and the reasoning for the proposed increase was robust. |
| 7 | EE has enough asset information to determine which assets need attention, but data quality shortcomings compromise its decision making. | EE have done a lot of work in the past 5 or more years cleaning up the asset information for their network, and poles in particular. This is recognised in the first part of this statement but it is unclear what the data shortcomings are that would significantly compromise the decision making in relation to pole replacements/reinforcements. |
| 8 | It was not always clear how EE derived its proposed replacement volumes. | See comments for No. 5 |
| 9 | EE's cost benefit analysis was not robust and was often characterised by qualitative rather than quantitative assessment. | There were a number of cost-benefit analyses that EE mentioned in their submission (3) relating to the selection of pole materials. Admittedly, the submission itself was somewhat lacking in regards to details about reinforcement volumes, but based on our understanding of their submission reinforcement levels are predicted based on a desire to add an extra element of safety to poles that are nearing the end of their life and hence try and reduce the pole failure rate. Hence, it is more of an aspiration than a projection. |

| | AER / EMCa Consideration | Comments on Applicability |
|---|---|---|
| 10 | EMCa were unconvinced that EE's cost estimation approach was sufficiently robust to support efficient outcomes. | Whilst our review is considered more from a structural performance/risk perspective, our knowledge of EE's unit costs is that they compare favourably with other east-coast utilities, and the cost predictions for pole replacements are relatively well known and easy to predict within the industry on a network wide basis. |
| 11 | EMCa noted potential deficiencies in the capital governance and ability to deliver the proposed repex. | We don't see any issues with EE being able to reach their targeted pole replacement and reinforcement increases given the current industry-wide slow down. However, our proposed increases for poles would require further consideration and planning. The point is more that regardless of whether EE have fully finished delivery plans, it does not detract from the actual need to increase pole replacements. |

# 10 APPENDIX F – Essential Energy's Response to AER Initial Comments on Replacement Expenditure

# BRIEFING

# RESPONSE TO AER INITIAL COMMENTS ON REPLACEMENT EXPENDITURE

## TABLE OF CONTENTS

## 1 PURPOSE

The purpose of this paper is to present to the Australian Energy Regulator (AER) Essential Energy's response to the issues raised by the AER regarding Essential Energy's Replacement Expenditure (Repex) submitted as part of the 2015 – 2019 regulatory proposal.

## 2 BACKGROUND

Under the National Electricity Rules Essential Energy, as a Distribution Network Service Provider (DNSP), is required to submit a regulatory proposal to the AER every five years to set appropriate network tariffs. As part of the regulatory proposal Essential Energy has submitted a proposed Repex[1] to the AER in respect of regulatory period 1 July 2014 to 30 June 2019.

The AER has raised concern over the lack of a formalised risk mitigation model applied to Essential Energy's replacement programs, and hence the efficiency of the programs. The AER have noted that the framework utilised by SP Ausnet satisfies them that appropriate risk analysis has been completed on the SP Ausnet Repex[2], and are holding it out as a benchmark approach.

Given the preliminary feedback from the AER to the business on Essential Energy's Repex, this report seeks to discuss in more detail the approach and methodology used by Essential Energy and its comparability to SP Ausnet's Repex and Powercor's Repex[3].

## 3 DISCUSSION

Each month a meeting is held between the AER, ActewAGL and New South Wales DNSPs. In the meeting held 2 October 2014 the AER provided current thinking on the Draft Determination in relation to each of the present businesses. The AER raised concerns about Essential Energy's Repex and the application of a formal risk management framework to Essential Energy's Repex. This response looks to address the following:

> the application of risk management
> the appropriateness of Essential Energy's Repex quantum
> the efficiency of Essential Energy's Repex
> the outcomes of Essential Energy's Repex and the impacts of the determination on the network
> the appropriateness of Essential Energy's overall Operating Expenditure (Opex) quantum

Essential Energy's Repex is reflective of a replacement strategy that is a lower cost, higher risk strategy than some of its peers. Essential Energy has used risk based prioritisation and optimisation within its asset management strategy to ensure that its Repex is best utilised to mitigate its risk. The application of a formal risk management plan, such as that used by SP Ausnet, is unlikely to reduce (and likely to increase) the quantum of Essential Energy's Repex. In determining its Repex Essential Energy makes extensive use of the information obtained from routine asset inspections and condition monitoring. This process allows for the actual condition of the network to underpin the Repex program and determine the risk (safety, operational and performance) mitigated by the Repex program to be quantified. Rather, a holistic risk analysis model will

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[1] *Attachment 4 2014 Reset RIN Workbook Consolidated*, Essential Energy, 2014, Template 2.2 Repex Table 2.2.1 – Replacement Expenditure, Volume and Asset Failures by Asset Category and Table 2.2.2 – Selected Asset Characteristics (Essential Energy's Repex)

[2] *SP Ausnet (D) 2008-13 – Category Analysis RIN – templates Consolidated*, 2014, Template 2.2 Repex Table 2.2.1 – Replacement Expenditure, Volume and Asset Failures by Asset Category and Table 2.2.2 – Selected Asset Characteristics (SPAusnet's Repex)

[3] *Powercor 2008-13 – Category Analysis RIN – responses Consolidated*, 2 June 2014, Template 2.2 Repex Table 2.2.1 – Replacement Expenditure, Volume and Asset Failures by Asset Category and Table 2.2.2 – Selected Asset Characteristics (Powercor's Repex)

create synergies between asset strategies, to further refine the prioritisation of the replacement programs, and hence provide a greater return on investment through reduced risk and improved service levels (refer to section 3.1.1). In summary, all Repex is as a consequence of conditional or functional failure, uneconomic to maintain in service or due to unacceptable risk.

Comparing Essential Energy to SP Ausnet is not necessarily appropriate because of the physical differences between the networks (refer to section 3.2.1) and the age profile of the assets on the network (refer to section 3.2.2):

- Essential Energy's customer density is 87% lower than SP Ausnet's customer density
- Essential Energy's proportion of overhead network is 9% higher than SP Ausnet's
- Essential Energy's asset age profile is older than SP Ausnet's

The number of assets on the network that require replacement is a more appropriate driver of Repex than customers, consumption or demand. Essential Energy has a greater number of assets than SP Ausnet and the normalised failure rates of assets on Essential Energy's network are greater than those seen on SP Ausnet's network. Use of a Weibull function to predict a future replacement rate of Essential Energy poles displays an increasing failure rate into the regulatory control period though to 2050 (refer to section 3.2.3.2).

Comparison between Essential Energy's Repex and SP Ausnet's Repex on this basis shows:

- The quantum of Essential Energy's Repex is significantly lower per asset (refer to section 3.2.4).
- Essential Energy's replacement unit rates are lower than SP Ausnet, by 62%, i.e. Essential Energy's unit costs are 38% of SP Ausnet costs. Essential Energy's proposed Repex is being utilised to replace more assets per dollar than SP Ausnet's Repex.

Essential Energy's replacement strategy has historically been focused on replacing assets that have conditionally or functionally failed thereby managing the inherent safety risks of asset failures to a certain level. This has resulted in a lower cost strategy than some of its peers, with a higher risk profile emerging in other outcome areas (refer to section 3.4):

- Essential Energy's total number of escaped fire starts is greater than all other DNSPs,
- Essential Energy's shock incidents were 340% higher than SP Ausnet
- Essential Energy's pole failure rates are higher than the industry average and statistical analysis predicts them to increase until 2050

Further risks have recently become evident on the network, which are likely to increase the need for both investments in replacements and Opex (refer to section 3.4.5).

Essential Energy considers the trade-off between Opex and Repex to reduce Repex through increased focus on maintenance activities is not in the best interests of customers, because:

- The cost of maintaining assets on an older asset age profile is not efficient and many assets in any case once conditionally failed must be replaced and cannot be further maintained.
- The increased need for Opex (from LiDAR data, refer section 3.4.5 will already place pressure on deliverability.
- Essential Energy's Opex is comparable to its peers (normalised by both poles and length of network for Fault and Emergency, Maintenance and Vegetation Management it is of a similar magnitude to both SP Ausnet and Powercor).

As Essential Energy's replacement strategy is already lower cost and higher risk than many of its peers, a reduction in Essential Energy's Repex would only serve to increase the risks on the network and reduce service levels. Additionally a reduction in Repex ultimately results in a time delayed Opex increase for future years. This leads to increased Opex unit rates and reactionary business practices in an attempt to manage the risk, causing cost escalations.

### 3.1 Application of risk management

In developing Essential Energy's Repex proposal, consideration was given to the risks and outcomes of the proposed level of work. The cost and volumes were considered for each asset class in the context of the service levels required and asset age profiles. In particular, the optimisation and prioritisation of the replacement programs are considered by asset class in the individual Asset Management Plans (AMPs) prepared by Essential Energy:

- Distribution Overhead Feeders (CEOM8018.01)
- Customer Connections (CEOM8018.03)
- Distribution Substations (CEOM8018.04)
- Network Underground Systems (CEOM8018.05)
- Subtransmission Overhead Feeders (CEOM8018.06)
- Load Control Equipment (CEOM8018.08)
- SCADA & DSA Equipment (CEOM8018.09)
- Generation (Regulated Assets) (CEOM8018.10)
- Subtransmission Transformers (CEOM8018.11)
- Subtransmission Equipment (CEOM8018.12)
- Vegetation Management (CEOM8018.15)

The AMPs outline the key risks and mitigation strategies, including replacement and prioritisation of assets that are in the worst condition (determined through inspection or performance history), that supply critical customers or that are in bushfire or safety critical areas. Asset class based decisions are made with consideration of the whole of life management of each asset class to ensure that the overall expenditure on an asset is efficient.

In regard to Repex, the AMPs are underpinned by 55 detailed Investment Cases (IC) for asset sub classes. These IC's explain in detail the required replacement rates and estimated unit costs.

#### 3.1.1 Application of a formal risk management framework

Further to this report, Essential Energy seeks to undertake a comparison of the assumptions made within the SP Ausnet risk management model to the assumptions made about the Essential Energy network and the current condition assessment framework operated by Essential Energy. Consideration of these assumptions and their impacts on the cost, service levels and asset age profiles will likely be undertaken in the next 6 months to determine the difference in cost and risk between the two approaches to inform the long term risk management framework for Essential Energy's Repex over the next 1 – 2 years.

Essential Energy accepts that refined risk prioritisation of any replacement program should bring with it increased benefit by targeting the highest risk exposure and thereby improving service levels, reducing high risk failures and maintaining an appropriate asset age/condition profile. In this regard Essential Energy is intending to review the SP Ausnet risk management model, if it can be made available. Application of an improved risk management plan is unlikely to reduce Essential Energy's Repex quantum as Essential Energy holds that Repex should be based on asset condition rather than theoretical modelling, however it is accepted that modelling can assist in understanding the underlying risks and their cost to mitigate.

As the current Repex spend is already significantly below industry peers (including SP Ausnet and Powercor) a reduction in Repex spend will not be possible without a material increase in risk which is already higher than industry peers as evident in the failure rates shown in 3.4.3.

### 3.2 Essential Energy's Repex Quantum

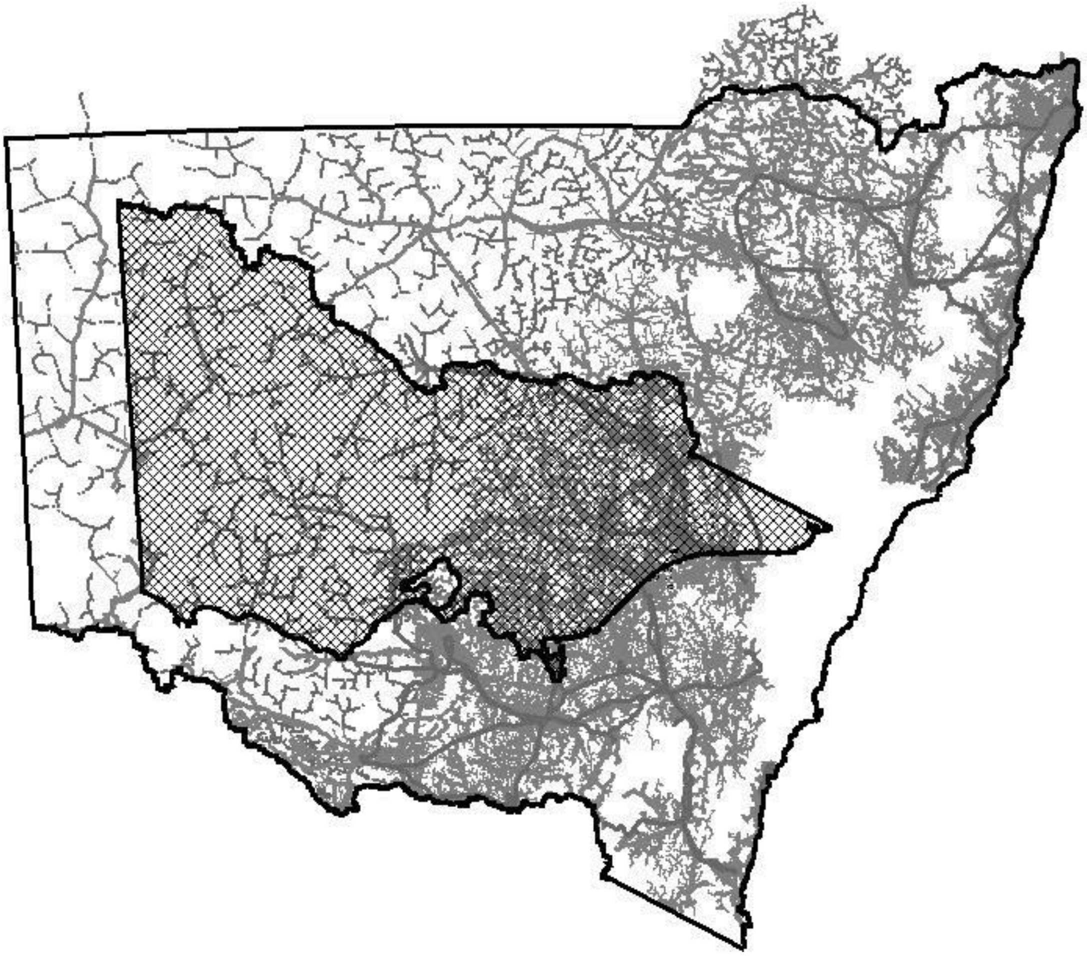
The replacements that constitute Essential Energy's Repex are dependent on the number of assets on the network and the assessed condition of those assets. The replacement volumes do not correlate with the demand on the network, including the number of customers and electrical demand in MVA or kWhs. It is therefore inappropriate to benchmark Repex against these metrics.

Essential Energy has a large asset base, with a high normalised failure rate and age profile that is older than many of its peers. Despite this, the quantum of Repex that Essential Energy is proposing is lower, by asset, than both SP Ausnet and Powercor, resulting in a comparatively higher risk on the network.

#### 3.2.1 Essential Energy Network

Essential Energy is the largest regionally based network service provider in Australia.

**Figure 1: Comparative Network Size**



Essential Energy's franchise area covers approximately 737,000 km², or 95% of New South Wales, with over 800,000 network customers. Essential Energy's network covers more than three times the area of all of the Victorian DNSPs combined (including SP Ausnet and Powercor), as shown in Figure 1 which displays Victoria superimposed on the footprint of Essential Energy's high voltage network. The number of customers connected to the Essential Energy network is comparable to both SP Ausnet and Powercor, although marginally higher, as shown in Table 1.

Essential Energy's network consists of approximately 200,000 kilometres of subtransmission, high voltage distribution, low voltage distribution power lines, and around 1.4 million poles. Essential Energy's network length is greater than all of the Victorian DNSPs combined and contains more poles, as shown in Table 1.

Almost 98% of the network is of an overhead construction type. Essential Energy's network has a higher proportion of overhead assets than both SP Ausnet (90%) and Powercor (89%). The overhead system is exposed to environmental conditions and with a relatively high average number of lightning days (30 per annum); the impact of lightning and wind from storms on the network assets is significant.

Over 95% of the distribution substation population are pole-mounted due to the predominantly rural nature of the supply area, and the economics of predominantly rural networks. However, this type of distribution substation is inherently more susceptible to failure than ground mounted distribution substations.

The network topology of Essential Energy is also significantly different to SP Ausnet and Powercor. The Victorian utilities operate in the main a 66kV to 22kV network with legacy constructions built by SEC Vic. Essential Energy on the other hand operates a network that has 132kV, 110kV, 66kV, 33kV, 22kV, 11kV and 6.6kV with legacy constructions from over 26 County Councils. As a result the built network in Essential Energy which is represented in the Repex is largely non-homogeneous and has regional differences due to prior standards and practices that influence the condition and service life of the assets and their management.

**Table 1: Comparison of Network Characteristics**

| Item | Essential Energy[4] | SP Ausnet[5] | Powercor[6] | All Victorian DNSPs |
|---|---|---|---|---|
| Area (km2) | 737,000 | 80,000 | 150,000 | 227,010 |
| Customers | 804,410 | 665,000 | 748,000 | 2,714,595 |
| Customers density (customers/ km2) | 1.1 | 8.3 | 5.0 | 12.0 |
| Overhead Network Length (km) | 192,150 | 44,010 | 74,760 | 137,929 |
| Underground Network Length (km) | 10,810 | 4,890 | 9,240 | 21,305 |
| Network Length (km) | 202,960 | 48,900 | 84,000 | 159,236 |
| Poles | 1,379,900 | 380,000 | 540,000 | 1,295,200 |

Essential Energy's customer density (1.1 customers/km$^2$) is lower than SP Ausnet (8.3 customers/km$^2$). Essential Energy's proportion of overhead network at (98%) is higher than SP Ausnet's at (90%).

### 3.2.2 Asset age profile

The average age of assets on Essential Energy's network is greater than SP Ausnet and Powercor for all three major asset types, as shown in Table 2.

**Table 2: Current average asset age (years)**

| Item | Essential Energy | SP Ausnet | Powercor |
|---|---|---|---|
| Poles | 33 | 30 | 29 |
| Overhead Conductors | 43 | 37 | 35 |
| Transformers | 27 | 26 | 26 |

Essential Energy replaces assets based on a combination of condition assessment and failure analysis. Modelling of replacement rates for timber poles suggests an unacceptably high risk of failure if Repex is not

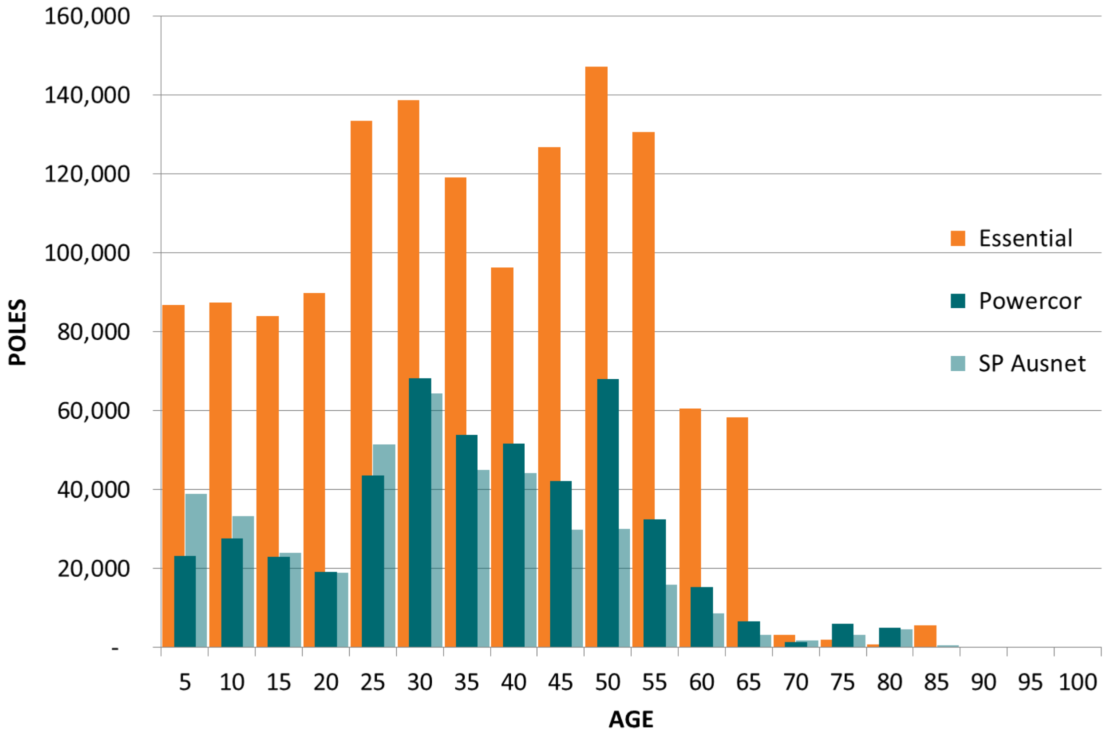
[4] *Attachment 4 2014 Reset RIN Workbook Consolidated*, Essential Energy, 2014, Template 2.8 Maintenance, Table 2.8.1 – Descriptor Metrics for Routine and Non-Routine Maintenance

[5] Safety Performance Report on Victorian Electricity Networks 2013, Energy Safe Victoria, June 2014, Table 1 p. 20

[6] Safety Performance Report on Victorian Electricity Networks 2013, Energy Safe Victoria, June 2014, Table 1 p. 20

increased to alleviate risk[7]. As a guide, Industry Standards (AS/NZS 4676 and AS 2209) suggest a design life for timber poles of 50 years. Essential Energy's network contains 19% of poles greater than 50 years old, by comparison to 10% and 14% on SP Ausnet and Powercor's networks, respectively, as shown in Figure 2.

**Figure 2: Pole Age Profile[8]**




On average, Essential Energy's pole age is 10% older than SP Ausnet's and 14% older than Powercor's. This statistic needs to be considered in light of the fact that Essential Energy has a network consisting mostly of timber poles (87% of poles are timber) compared to SP Ausnet (49% timber) and Powercor (75% timber), as shown in Figure 3. Conventional wisdom asserts that a timber pole will not last as long as a concrete or steel pole. Whilst the environmental conditions vary between the networks, Essential Energy believes that the practical timber pole service life on all three networks is likely to be similar, and that the increased age of Essential Energy's timber poles represents an increased risk of failure, which is mitigated by targeted pole replacement.

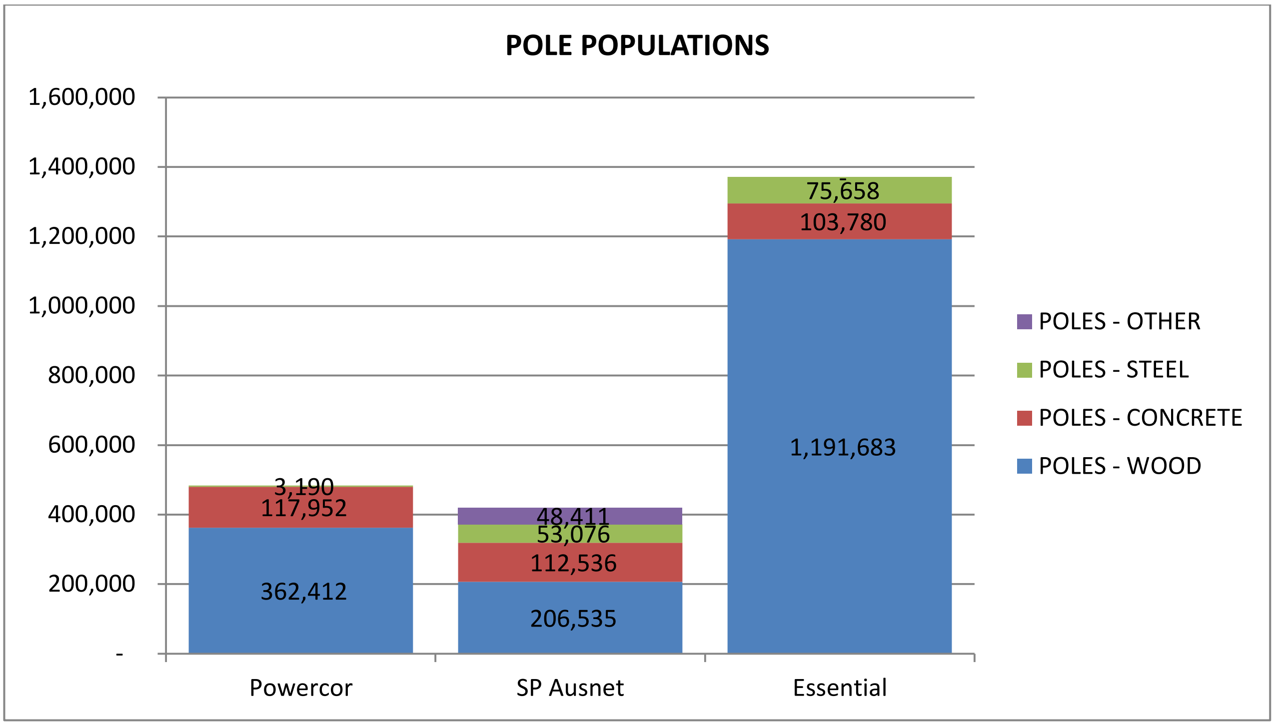
[7] For details of planned pole replacement and reinforcement refer to the System Investment Document ESS_17 and ESS_46 Pole Replacement and Reinforcement

[8] *Attachment 4 2014 Reset RIN Workbook Consolidated*, Essential Energy, 2014, Table 5.2 Asset Age Profile (Essential Energy's Age Profile)

*SP Ausnet (D) 2008-13 – Category Analysis RIN – templates Consolidated*, 2014, Table 5.2 Asset Age Profile (SPAusnet's Age Profile)

*Powercor 2008-13 – Category Analysis RIN – responses Consolidated*, 2 June 2014, Template 2.2 Repex Table 5.2 Asset Age Profile (Powercor's Age Profile)

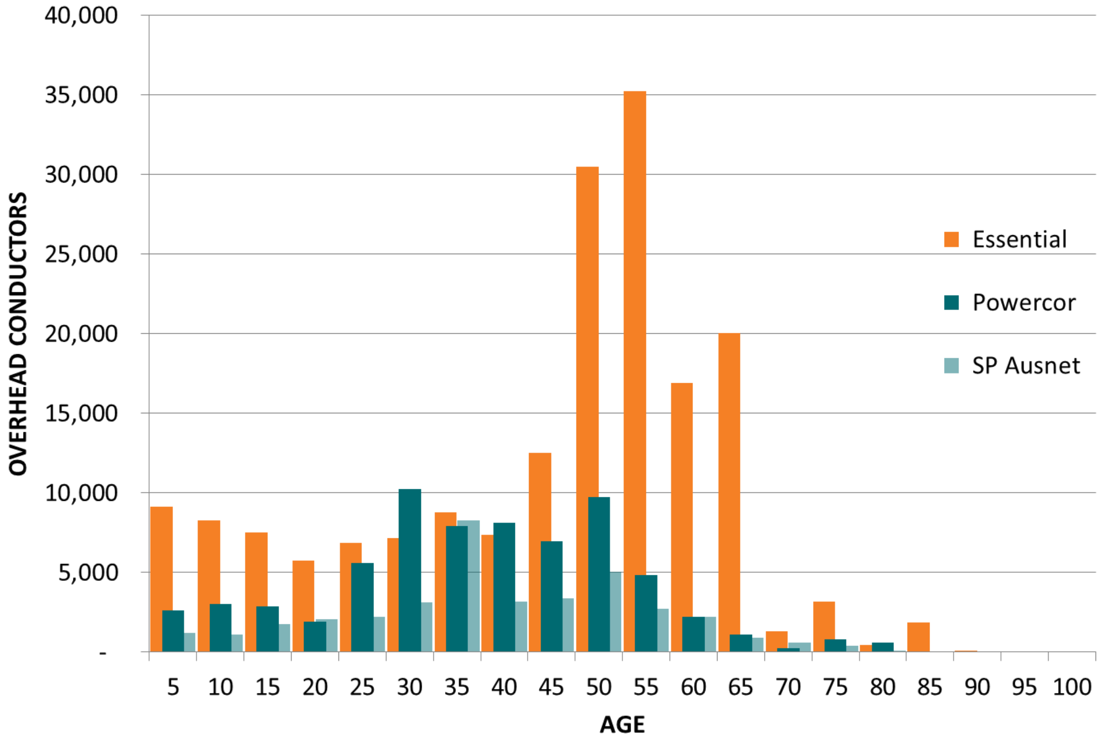
**Figure 3: Pole Population by Material**




Essential Energy's network contains a large volume of conductors toward the latter half of the age profile, as shown in Figure 4. Essential Energy conductors have an average age 16% older than SP Ausnet and 23% older than Powercor. Whilst the environmental conditions vary between the networks, Essential Energy believes that the practical conductor life on all three networks is likely to be similar, and that the increased age of Essential Energy's conductors represents an increased risk of failure, which is mitigated by targeted conductor replacement where assessed condition and failure history shows that replacement is warranted and the only reasonable approach.

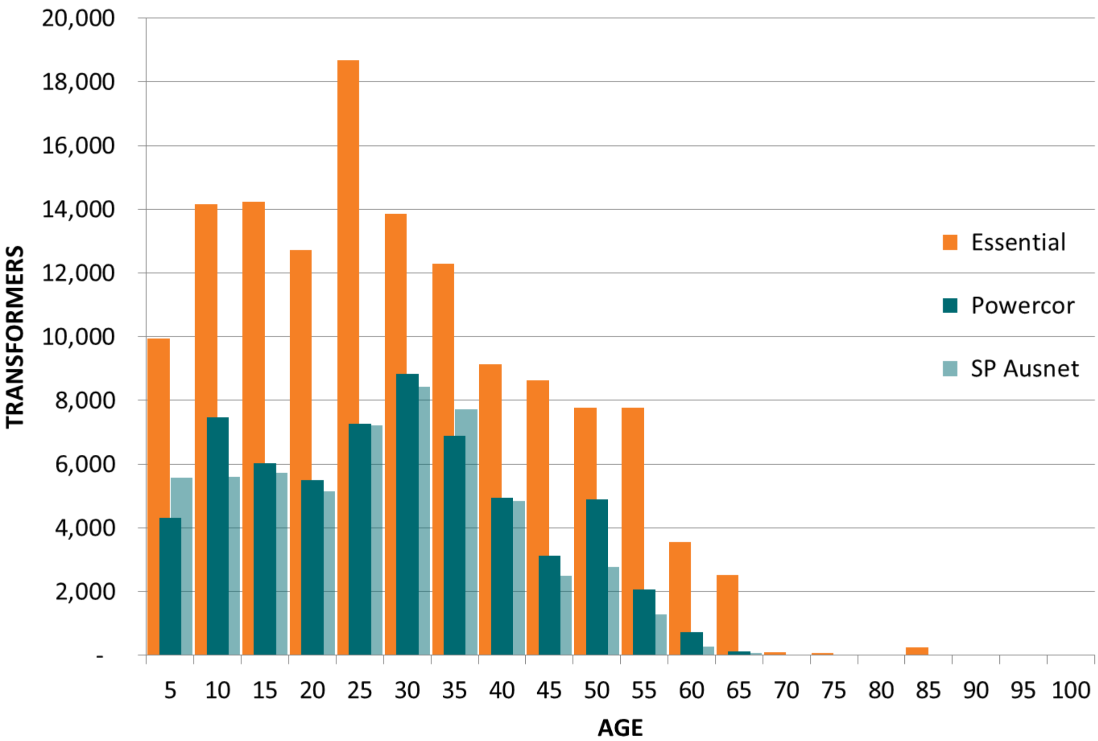
Due to the very low density of customers on the Essential Energy network small gauge conductor is dominant. Essential Energy Repex targets 'small gauge' conductor which comprises by far the largest percentage of 'wires down' reports. These conductors represent a public risk with regards to bushfires and or electric shocks. It is noted that the Victorian utilities have a similar approach as a result of the royal commission into the Victorian bushfires. Of the 182,791 route km's of overhead conductor approximately 110,000 km's are of small gauge that are identified as at risk including approximately 75,000 km of steel conductor which is predominately 3/12 and 3/14 gauge.

**Figure 4: Overhead Conductor Age Profile**




Essential Energy's transformer population is similar in age to both SP AusNet and Powercor as shown in Figure 5. On average Essential Energy's transformers are 4% older than those of both SP Ausnet and Powercor.

**Figure 5: Transformer Age Profile**



### 3.2.3 Asset Failures

Essential Energy is experiencing high failure rates and predictions suggest that the rate of pole failures will continue to rise until 2050, refer to detailed analysis in section 3.2.3.2.

#### 3.2.3.1 Current Asset Failures

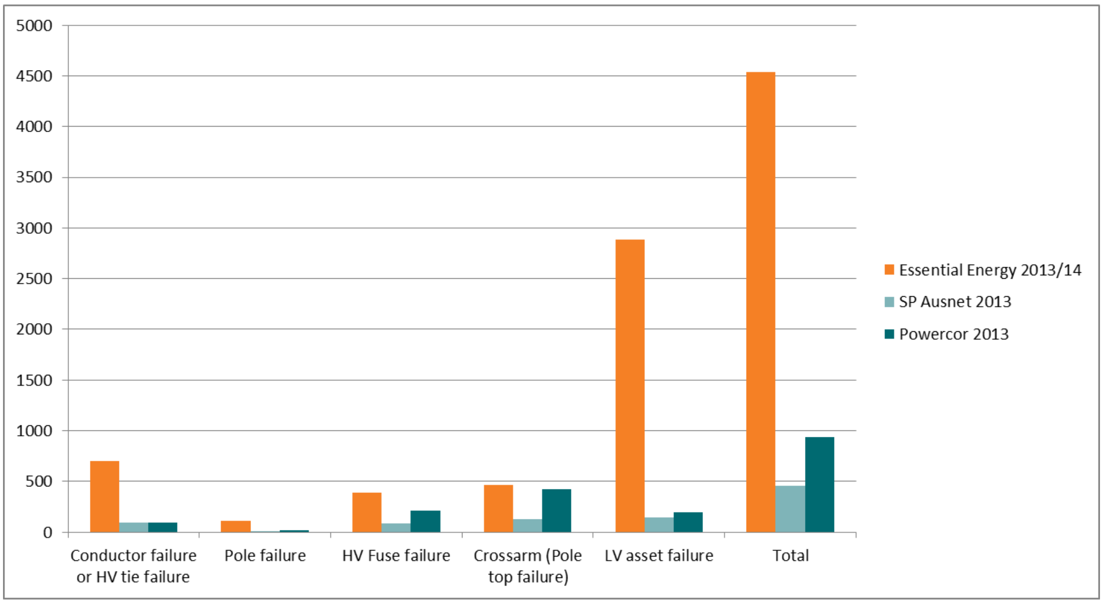
Essential Energy is experiencing high rates of failure compared to the Victorian DNSPs, as shown in Table 3. Essential Energy has 6.3 failures per 100km's of line compared with 1.4 in Victoria and 8.3 failures per 1000 poles compared with 1.8 in Victoria.

**Table 3: Total Asset Failures 2013**

| Category | Essential Energy[9] | All Victorian DNSPs[10] |
|---|---|---|
| Total Asset Failures | 11,457 | 2269 |
| Normalised Asset Failures (/100km) | 6.3 | 1.4 |
| Normalised Asset Failures (/1000 poles) | 8.3 | 1.8 |

Essential Energy has a higher failure volume than SP Ausnet and Powercor for all reported failure types, as shown in Figure 6.

**Figure 6: Number of failures[11]**



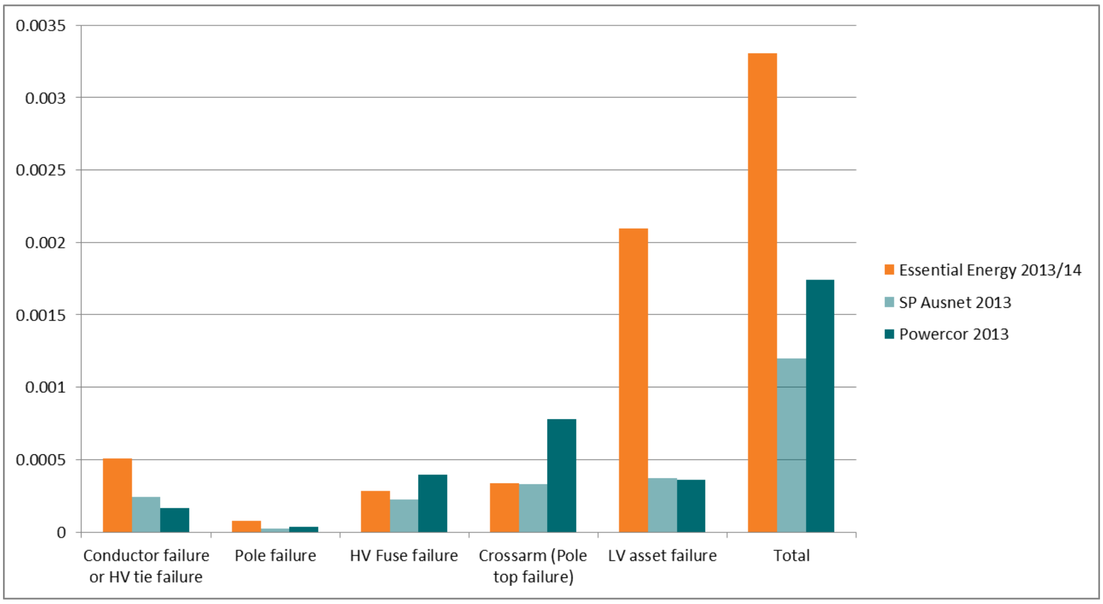

[9] Excludes fuse operations

[10] Safety Performance Report on Victorian Electricity Networks 2013, Energy Safe Victoria, June 2014, p.7

[11] SP Ausnet and Powercor data from *Safety Performance Report on Victorian Electricity Networks 2013*, Energy Safe Victoria, June 2014, Table 20 p. 62, Essential Energy data from Essential Energy *Energy Network Incident* database for 2013/14

Figure 7 displays the same failure volumes normalised by pole population. Essential Energy's pole failure, conductor failure and LV asset failure are higher per asset than both SP Ausnet and Powercor.

**Figure 7: Number of failures normalised by number of poles (failures/1000poles)**[12]

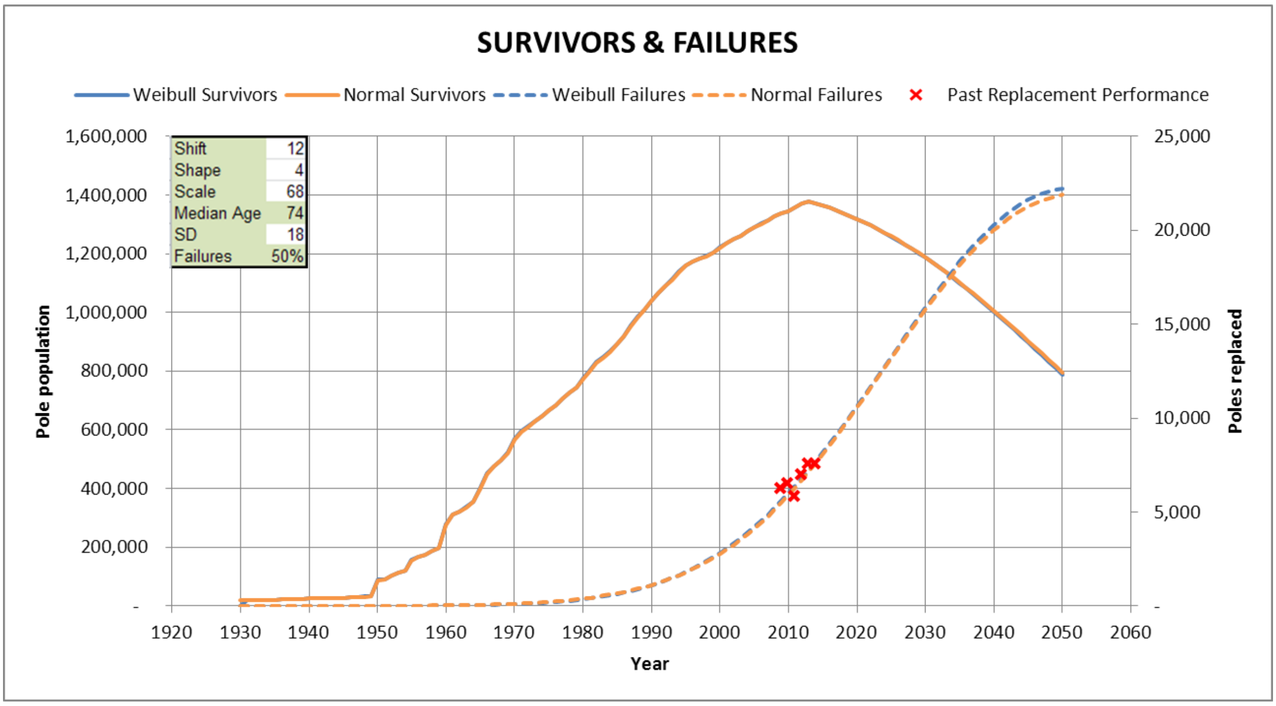



[12] SP Ausnet and Powercor data from *Safety Performance Report on Victorian Electricity Networks 2013*, Energy Safe Victoria, June 2014, Table 20 p. 62, Essential Energy data from Essential Energy *Energy Network Incident* database for 2013/14

### 3.2.3.2 Predicted Future Asset Failures

Essential Energy has utilised a Weibull function to predict a future replacement rate of poles, as shown in Figure 8, which displays an increasing conditional failure rate into the regulatory control period and beyond. The Weibull function has been calibrated to the known age of the poles and the replacements for the five years 2009/10 to 2013/14. The Weibull curve after calibration uses the same mean estimated life expectancy as the normal distribution of 74 years and can be seen to track closely to the normal distribution curve with a standard deviation of 18 years.

**Figure 8: Conditional Pole Failures - Weibull Prediction**[13]




The Weibull curve with parameters of Shift (12), Shape (4) and Scale (68) also approximates to the last 5 years of data and indicates a future replacement rate of what appears reasonable, approximating to almost the same annual increase in replacement rates between 2014 and 2034 of 4.3% per annum compounding. This is a range of 0.55% of poles condemned by population per annum to 1.27% over a 20 year period. For the 5 years of the regulatory period the condemning rates increases from 0.55% to 0.68% in 2018/19. Given the aging population this seems a reasonable prediction at least for the coming 5 year period of the likely pole condemning rate.

Conditional failures peak in the year 2050 at which time the condemning rate by population is 1.59% per annum. This increasing pole condemning rate given the age profile of the existing poles, current replacement rate and with a mean life expectancy of 74[14] years is considered a conservative prediction as the 74 year mean life expectancy is likely to be an optimistic prediction. The Asset life may need to be re-assessed as

[13] System Investment Document ESS_17 and ESS_46 Pole Replacement and Reinforcement

[14] Whilst it could be argued that the mean life expectancy of 74 years is an optimistic prediction of the pole population it will return a reasonable result for the coming 5 year period which is likely to be within the band of an acceptable prediction given the vagaries of the life of a very diverse pole population. Should the prediction prove incorrect any error will be at the margins given that the 2013/14 result has been forecast with 8 months of actual data and with 5 years of accurate pole condemning statistics coupled with 99% known pole installation dates across the network. It is argued that with a nominal mean life expectancy of 74 years for the asset a 5 year forward prediction can be achieved with reasonable confidence and without material error. The forward predicted condemning trend will need to be re-evaluated annually to detect any material error that may become evident over time and can be reset at the next regulatory determination.

the current 74 year expectancy is based on the current serviceability criteria and is resulting in high failure rates compared to industry peers.

### 3.2.4 Comparison of Repex Quantum

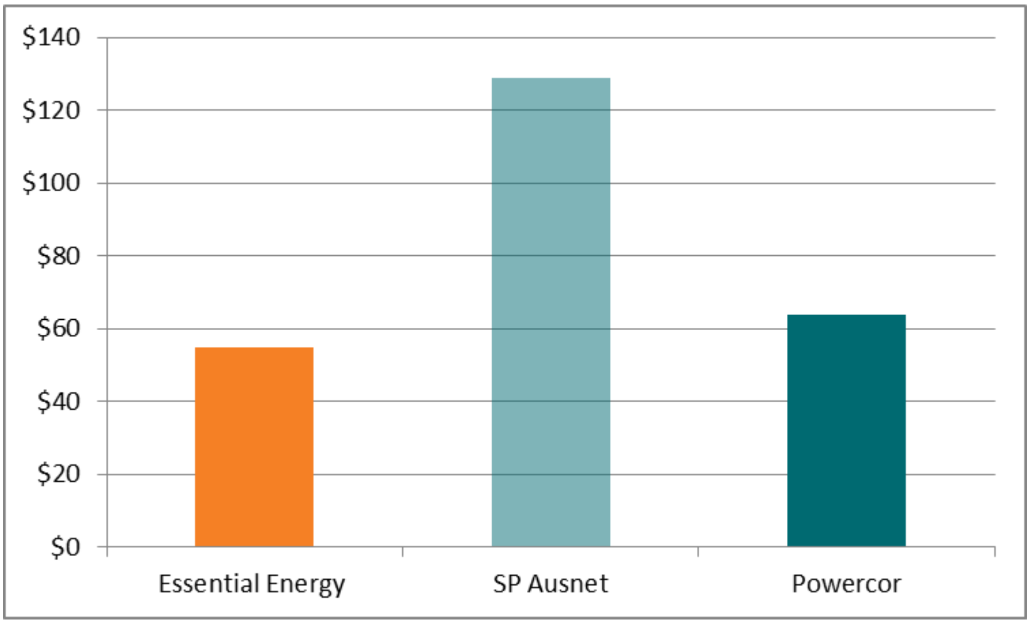
The quantum of Essential Energy's Repex for the 2015-19 regulatory control period is comparatively less than its peers to undertake replacement of a large asset base. Given the large network of aging assets and high failure rates, this suggests that Essential Energy's replacement strategy is a lower cost higher risk strategy than some of its peers.

Essential Energy's Repex for 2009-13 was less than half SP Ausnet's Repex and 14% lower than Powercor's Repex for the same period when normalised by the number of assets, as shown in Table 4 and Figure 9.

**Table 4: Comparison of Repex Quantum Historical average (2009-13) ($2012/13)**[15]

| Item | Essential Energy | SP Ausnet | Powercor |
|---|---|---|---|
| Total Assets | 2,326,109 | 669,131 | 1,143,253 |
| Repex ($M) | $634 | $431 | $364 |
| Repex ($/asset/year) | $55 | $129 | $64 |

**Figure 9: Comparison of Repex Quantum Historical average (2009-13) ($2012/13/asset/year)**



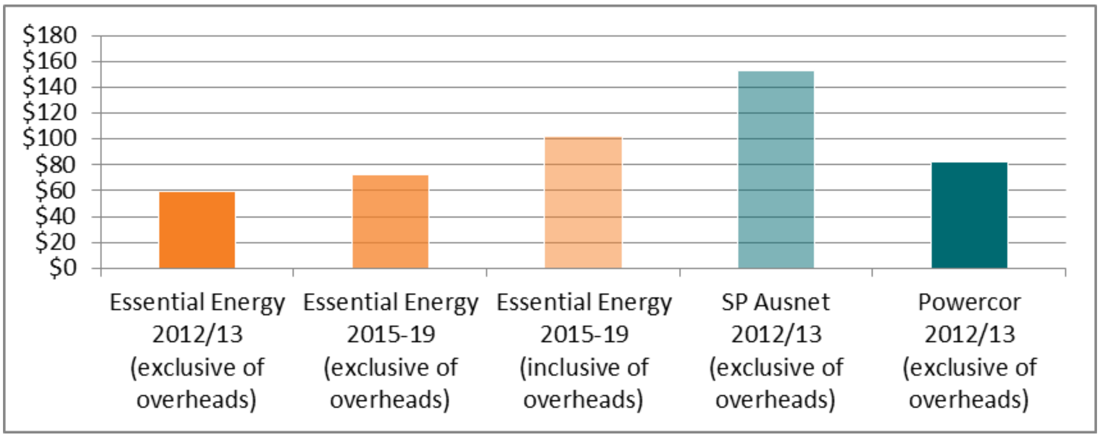

Essential Energy's Repex for 2012/13 was 61% lower than SP Ausnet's Repex and 18% lower than Powercor's Repex for the same period when normalised by the number of assets, as shown in Table 5 and Figure 10. Further, Essential Energy's Repex for 2015-19 is less than half SP Ausnet's Repex and 12% lower than Powercor's Repex for the 2012/13 period when normalised by the number of assets. Even when loaded with overheads, Essential Energy's Repex is 43% lower than the direct component of SP Ausnet's Repex, although 24% higher than Powercor's direct Repex for 2012/13 when normalised by the number of assets.

[15] *Attachment 4 2014 Reset RIN Workbook Consolidated*, Essential Energy, 2014, Template 2.2 Repex Table 2.2.1 – Replacement Expenditure, Volume and Asset Failures by Asset Category with escalation applied, refer to Attachment 1 Table 15 and Table 16

**Table 5: Comparison of annual Repex Quantum ($2012/13)**

| Item | Essential Energy 2012/13 (exclusive of overheads) | Essential Energy 2015-19 (exclusive of overheads) | Essential Energy 2015-19 (inclusive of overheads) | SP Ausnet 2012/13 (exclusive of overheads) | Powercor 2012/13 (exclusive of overheads) |
|---|---|---|---|---|---|
| Total Assets[16] | 2,326,109 | 2,326,109 | 2,326,109 | 669,131 | 1,143,253 |
| Repex ($M) | $137 | $840 | $1,187 | $102 | $94 |
| Repex ($/per asset/year) | $59 | $72 | $102 | $153 | $82 |

**Figure 10: Comparison of annual Repex Quantum ($2012/13)**




### 3.2.5 Limitations of comparisons

Each of the DNSPs around Australia is a unique business so it is reasonable to also expect their cost structures to be different. Hence, the costs of two businesses are not always comparable and should not necessarily be used as the sole method to assess efficiency, and the underlying reasons for any deviations must also be considered in order to draw informed conclusions from the results.

#### 3.2.5.1 Total Cost Benchmarking

In the summer of 2012 Frontier Economics Limited of London was commissioned by a group of Distribution Network Operators (DNOs), led by UK Power Networks (UKPN), to undertake an assignment to demonstrate the feasibility of TOTEX benchmarking for the electricity distribution companies regulated by the UK Energy Regulator, Ofgem.

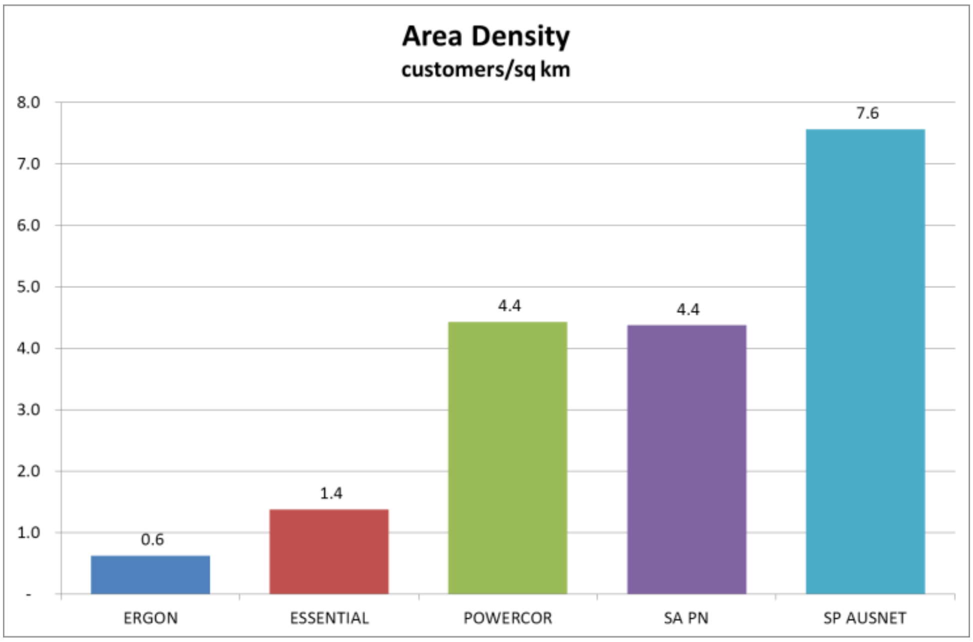
During Phase 1 of that study Frontier Economics analysed two simple measures of density, i.e. customers per unit of service area and customers per network length. Using these very simple measures, the Phase 1 analysis found evidence of “increased density decreasing costs”.

During Phase 2 of the study they revisited the issue of connection density in more detail. They concluded that, “The meter variable is a direct measurement of our variable of interest, and therefore we prefer it over indirect approximations like population and the number of households.” They also used energy consumption variable to construct a comparator density measure.

[16] *Attachment 4 2014 Reset RIN Workbook Consolidated*, Essential Energy, 2014, Template 2.2 Repex Table 2.2.1 – Replacement Expenditure, Volume and Asset Failures by Asset Category with escalation applied, refer to Attachment 1 Table 15

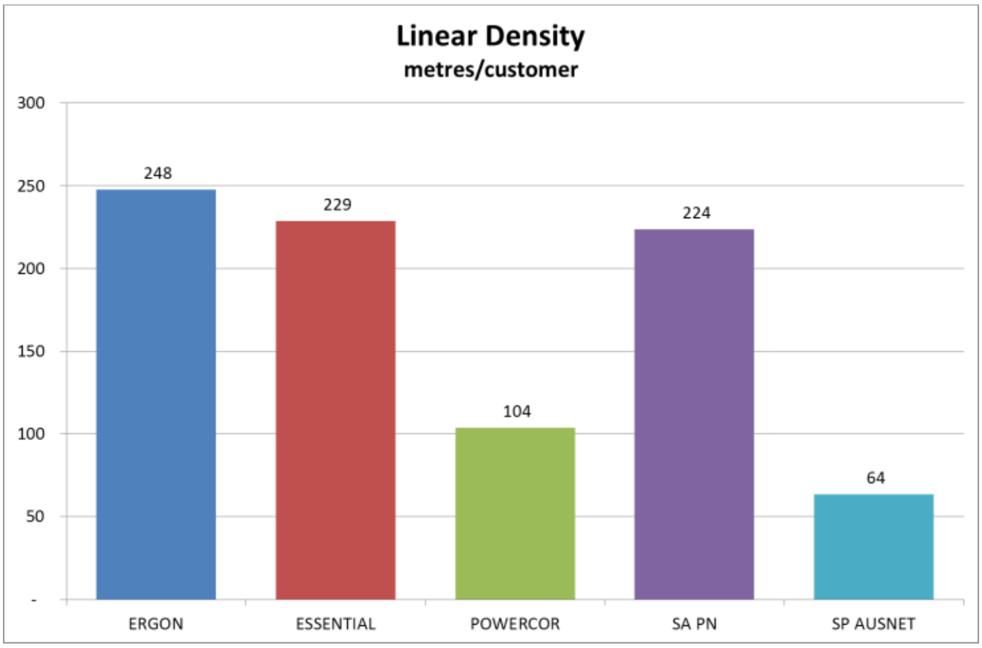
Frontier's first preference, meter density, cannot be applied in Australia because of the various differing metering practices between and within the states. Customers per unit service area is also problematic on account of the vast unpopulated areas in Queensland and South Australia and significant low populated areas in NSW which give extreme differences as shown in Figure 11 below .

**Figure 11: Customer Density by Area**




More appropriate for Australian conditions is Linear Density, customers per km of line, which is most easily grasped as its inverse, metres of line per customer as shown in Figure 12 below:

**Figure 12: Customer Density - Linear**



Essential Energy has only two direct comparators, Ergon and South Australia Power Networks with 248 and 224 metres of line per customer respectively compared with 229 metres for Essential. Powercor at 100m per customer has less than half these figures and SP Ausnet at 64 meters per customer just over a quarter. In real terms this means that the cost burden of operating, maintaining, refurbishing and replacing this many metres of line plus its associated financial charges of depreciation and return on assets must be borne by each and every customer.

It follows that costs, including Repex costs can only be compared between distributors by normalising the networks population of assets allowing comparisons of Repex cost by asset.

### 3.3 Essential Energy's Repex Efficiency

The efficiency of Essential Energy's Repex is reflected in the unit rates for replacement activities. Essential Energy's unit rates are on average 62% lower than SP Ausnet, i.e. only 38% of SP Ausnet's rates. Essential Energy is replacing assets at a lower normalised rate than SP Ausnet and Powercor, demonstrating that replacements are undertaken efficiently in accordance with internal processes.

#### 3.3.1 Unit Rates

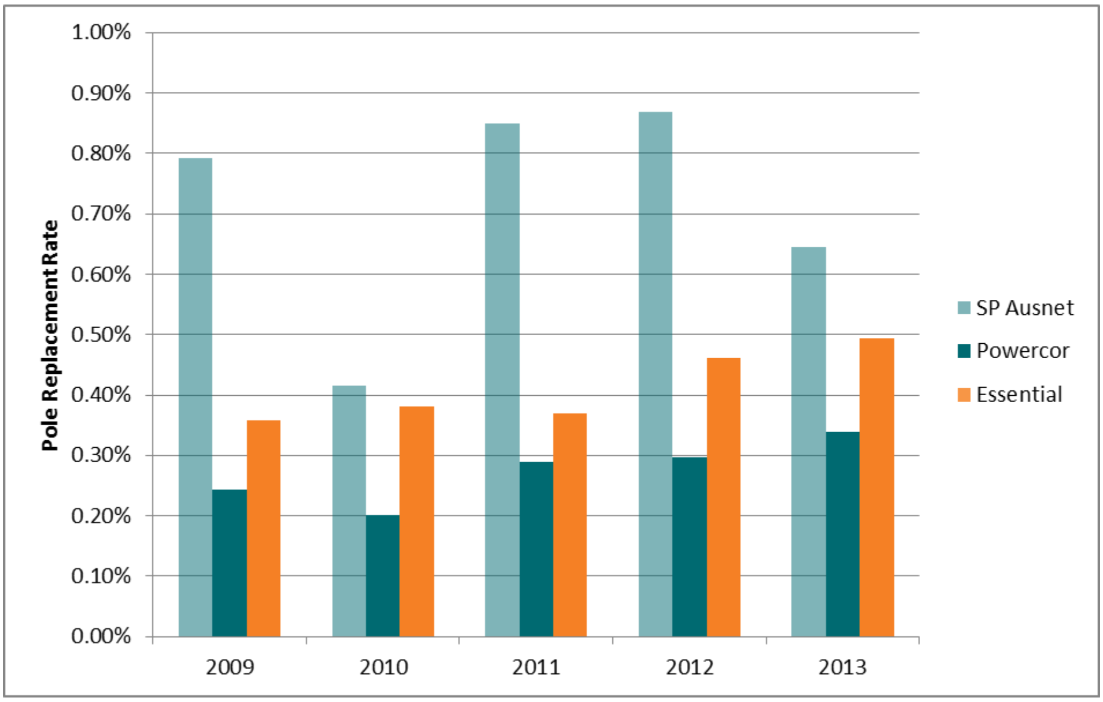
Unit rates for replacement activity are shown in Table 6. The analysis includes only items which all three DNSPs have recorded during 2009 – 2014. There are some variations across the unit rates, as to be expected given that each business programs and replaces their assets in a different way. On a weighted average, Essential Energy's unit rates are 38% of SP Ausnet's and 75% of Powercor's. Whilst line by line there are variances in the data between the businesses, possibly due to different interpretations and systems it is clear that on average the Essential Energy unit rates are significantly lower than its Victorian Peers.

**Table 6: Unit Rates 5 year average (exclusive of overheads) (real $2012/13)**

| Asset Replacement | Essential Energy qty | Essential Energy Unit Rate | SP Ausnet qty | SP Ausnet Unit Rate | Powercor qty | Powercor Unit Rate |
|---|---|---|---|---|---|---|
| Poles: Staking of a Wooden Pole | 281 | $711.49 | 1587 | $1,605.36 | 4630 | $869.84 |
| Poles: < = 1 KV; Wood | 6275 | $6,576.36 | 346 | $5,901.49 | 1172 | $9,646.41 |
| Poles: > 1 KV & < = 11 KV; Wood | 7062 | $6,716.87 | 16 | $4,544.72 | 7 | $10,042.70 |
| Poles: > 11 KV & < = 22 KV; Wood | 3858 | $6,590.87 | 1026 | $10,972.40 | 4254 | $9,677.04 |
| Poles: > 22 KV & < = 66 KV; Wood | 773 | $12,891.26 | 126 | $17,362.74 | 220 | $12,558.92 |
| Poles: < = 1 KV; Concrete | 810 | $8,020.85 | 518 | $6,902.96 | 82 | $15,627.33 |
| Poles: > 11 KV & < = 22 KV; Concrete | 1061 | $7,866.72 | 2713 | $11,645.05 | 473 | $15,497.08 |
| Poles: > 22 KV & < = 66 KV; Concrete | 176 | $13,582.10 | 494 | $20,534.31 | 78 | $18,884.80 |
| Poles: < = 1 KV; STEEL | 286 | $7,982.44 | 4584 | $5,997.19 | 26 | $9,484.84 |
| Pole Top Structures: < = 1 kV | 734 | $1,920.03 | 7762 | $2,860.29 | 9442 | $2,881.92 |
| Pole Top Structures: > 1 kV & < = 11 kV | 3274 | $5,335.28 | 253 | $2,824.26 | 16 | $2,376.76 |
| Pole Top Structures: > 11 kV & < = 22 kV | 2065 | $3,011.47 | 31688 | $3,679.71 | 20240 | $2,748.27 |
| Pole Top Structures: > 22 kV & < = 66 kV | 296 | $9,463.16 | 3481 | $4,315.67 | 985 | $3,474.39 |
| Overhead Conductors: < = 1 kV | 87.5 | $53,287.60 | 92 | $7,993.86 | 27.063 | $60,514.20 |
| Overhead Conductors: > 11 kV & < = 22 kV ; SWER | 12.4 | $52,006.57 | 65 | $52,538.68 | 20.507 | $13,754.43 |
| Overhead Conductors: > 11 kV & < = 22 kV ; Multiple-Phase | 162 | $53,493.20 | 362 | $52,328.60 | 83.418 | $50,581.56 |
| Overhead Conductors: > 22 kV & < = 66 kV | 6.5 | $86,800.11 | 30 | $47,150.73 | 0.387 | $1,374,258.81 |
| Underground Cables: < = 1 kV | 4.4 | $3,266,917.04 | 303 | $29,251.54 | 53.034 | $130,826.13 |
| Underground Cables: > 11 kV & < = 22 kV | 0.7 | $3,211,841.12 | 140 | $30,990.30 | 8.366 | $608,637.11 |
| Transformers: Pole Mounted ; < = 22kV ; < = 60 kVA ; Single Phase | 745 | $2,304.73 | 858 | $4,592.51 | 2670 | $5,340.27 |
| Transformers: Pole Mounted ; < = 22kV ; > 60 kVA AND < = 600 kVA ; Single Phase | 7 | $6,330.97 | 35 | $4,791.11 | 77 | $26,726.70 |
| Transformers: Pole Mounted ; < = 22kV ; < = 60 kVA ; Multiple Phase | 155 | $4,663.45 | 106 | $5,052.24 | 155 | $10,830.26 |
| Transformers: Pole Mounted ; < = 22kV ; > 60 kVA AND < = 600 kVA ; Multiple Phase | 376 | $11,187.47 | 1057 | $8,326.82 | 461 | $16,422.95 |
| Transformers: Pole Mounted ; < = 22kV ; > 600 kVA ; Multiple Phase | 2 | $16,942.98 | 66 | $8,597.07 | 4 | $114,602.92 |
| Transformers: Kiosk Mounted ; < = 22kV ; > 60 kVA and < = 600 kVA ; Multiple Phase | 143 | $47,627.01 | 308 | $24,254.43 | 36 | $101,721.45 |
| Transformers: Kiosk Mounted ; < = 22kV ; > 600 kVA ; Multiple Phase | 8 | $92,482.11 | 19 | $49,325.05 | 5 | $113,142.24 |
| Transformers: Ground Outdoor/Chamber Indoor; > 33 kV & < = 66 kV ; > 15 MVA and < = 40 MVA | 22 | $905,637.24 | 2 | $17,289.13 | 5 | $1,145,527.69 |
| Switchgear: < = 11 KV ; Switch | 571 | $13,954.71 | 8 | $2,024.59 | 1 | $32,870.00 |
| Switchgear: > 11 KV & < = 22 KV ; Switch | 120 | $16,410.12 | 817 | $14,295.29 | 388 | $15,836.02 |
| Switchgear: > 11 KV & < = 22 KV ; CB | 200 | $167,399.60 | 45 | $43,549.34 | 192 | $77,322.49 |
| Switchgear: > 33 KV & < = 66 KV ; Switch | 219 | $50,711.21 | 104 | $45,812.57 | 20 | $34,638.49 |
| Switchgear: > 33 KV & < = 66 KV ; CB | 128 | $125,679.38 | 11 | $37,225.01 | 8 | $129,440.55 |
| **Weighted average** | | **$27,042.64** | | **$71,000.65** | | **$35,900.70** |

Essential Energy is replacing its assets at a slower rate than SP Ausnet, as shown in Figure 13, Figure 14 and Figure 15. The lower normalised replacement rate aligns with the lower overall spend, as discussed in section 3.2.4

**Figure 13: Pole Replacement Rate**[17]




[17] *Attachment 4 2014 Reset RIN Workbook Consolidated*, Essential Energy, 2014, Template 2.2 Repex Table 2.2.1 – Replacement Expenditure, Volume and Asset Failures by Asset Category and Table 2.2.2 – Selected Asset Characteristics (Essential Energy's Repex)

**Figure 14: Conductor Replacement Rate**[18]

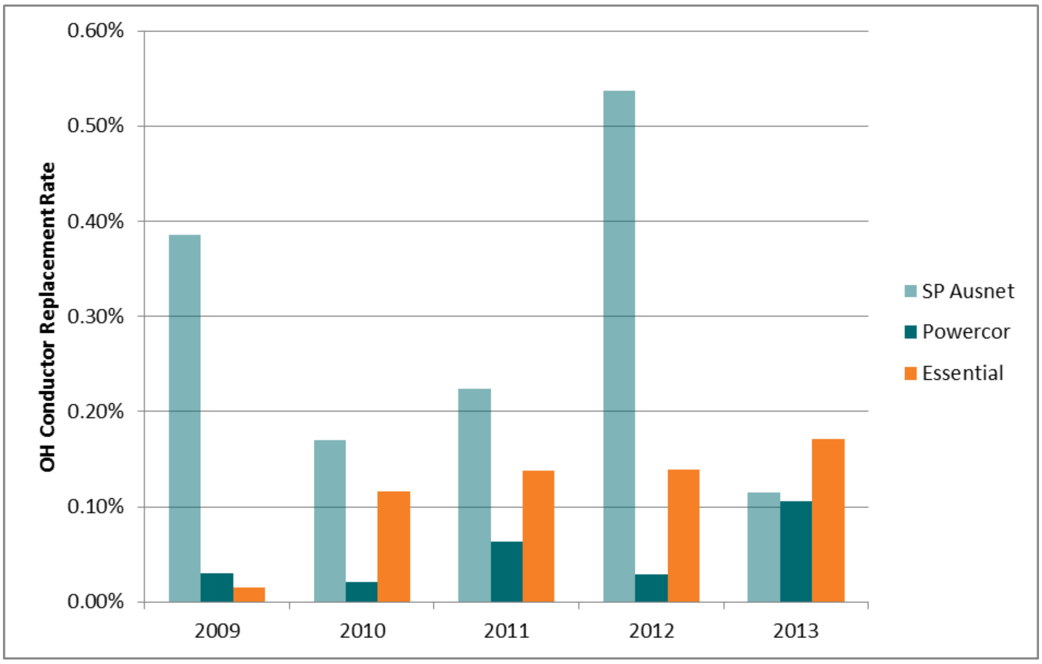
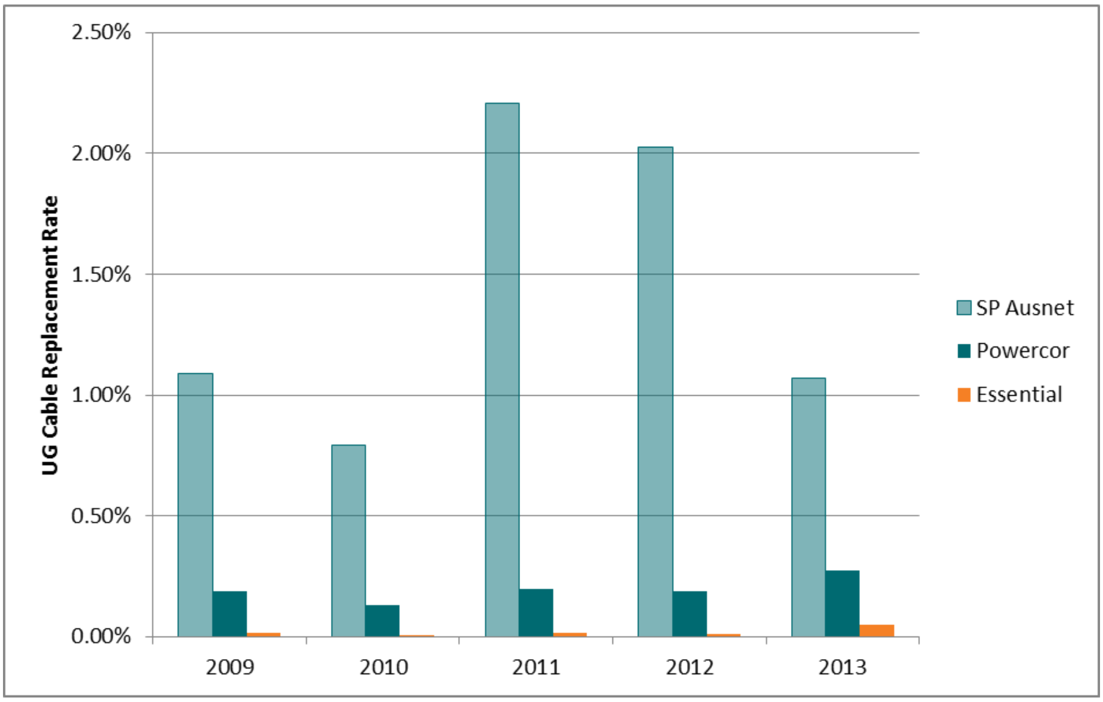



**Figure 15: Underground Cable Replacement Rate**[19]




[18] *Attachment 4 2014 Reset RIN Workbook Consolidated*, Essential Energy, 2014, Template 2.2 Repex Table 2.2.1 – Replacement Expenditure, Volume and Asset Failures by Asset Category and Table 2.2.2 – Selected Asset Characteristics (Essential Energy's Repex)

[19] *Attachment 4 2014 Reset RIN Workbook Consolidated*, Essential Energy, 2014, Template 2.2 Repex Table 2.2.1 – Replacement Expenditure, Volume and Asset Failures by Asset Category and Table 2.2.2 – Selected Asset Characteristics (Essential Energy's Repex)

### 3.4 Repex Outcomes

The investment in Essential Energy's Repex replaces degraded assets, reducing risk and hence impacting on the network's service levels. Essential Energy's replacement strategy aims to balance the reduction of risk from this investment, against the increase in risk brought about by degradation of assets to ensure that service levels are met and the outcomes are maintained at reasonable levels. At this point in time Essential Energy's overall outcomes are below those of their peers, reflective of the lower cost higher risk strategy engaged:

- Escaped Asset Failure Fire starts are greater than all other DNSPs
- Public shocks are higher than both SP Ausnet and Powercor
- Normalised failure rates are higher than both SP Ausnet and Powercor

The strategy of most Repex being applied on conditional or functional failure rather than more expensive pre-emptive replacement programs results in lesser levels of public safety and higher failure rates since the average condition of the assets and asset components is of a lower standard.

#### 3.4.1 Escaped Fire starts

The Royal Commission into the Victorian Black Saturday Bushfires in February of 2009 (VBRC) heard evidence that suggested that at least two of the fatal fires experienced at that time could be attributed to Electricity Distribution Networks. The Royal Commission also heard evidence that would suggest that the rural networks of the Victorian Distribution Network Providers (DNSPs) was of a similar age and construction to that of Essential Energy and both networks are experiencing similar condition issues.

The VBRC recommended that Single Wire Earth Return (SWER) lines be replaced over a 10 year period. Recommendations from the VBRC have been considered in the development of the replacement programmes put forward to replace those poles considered to be at the highest risk of failure due to age, fatigue or degradation. The bulk replacement of the network is not considered practical or economically affordable and as such Essential Energy continues to apply a risk based condition assessment approach to asset replacement.

Essential Energy's network has more escaped fire starts than both SP Ausnet and Powercor, as shown in Table 7. Essential Energy's number of fire starts normalised by both network length and poles are less than SP Ausnet, but greater than Powercor, as displayed in Figure 16 and Figure 17.

**Table 7: Escaped Asset Failure Fire Starts**[20]

| Escaped Fire | Essential Energy | SP Ausnet | Powercor |
|---|---|---|---|
| Number | 154 | 34 | 93 |
| Normalised by length (/km) | 0.0008 | 0.0007 | 0.00117 |
| Normalised by poles (/1000 poles) | 0.1121 | 0.0895 | 0.1722 |

[20] [20] Safety Performance Report on Victorian Electricity Networks 2013, Energy Safe Victoria, June 2014 and Totalsafe

**Figure 16: Escaped asset failure fire starts normalised by network length(/km)**

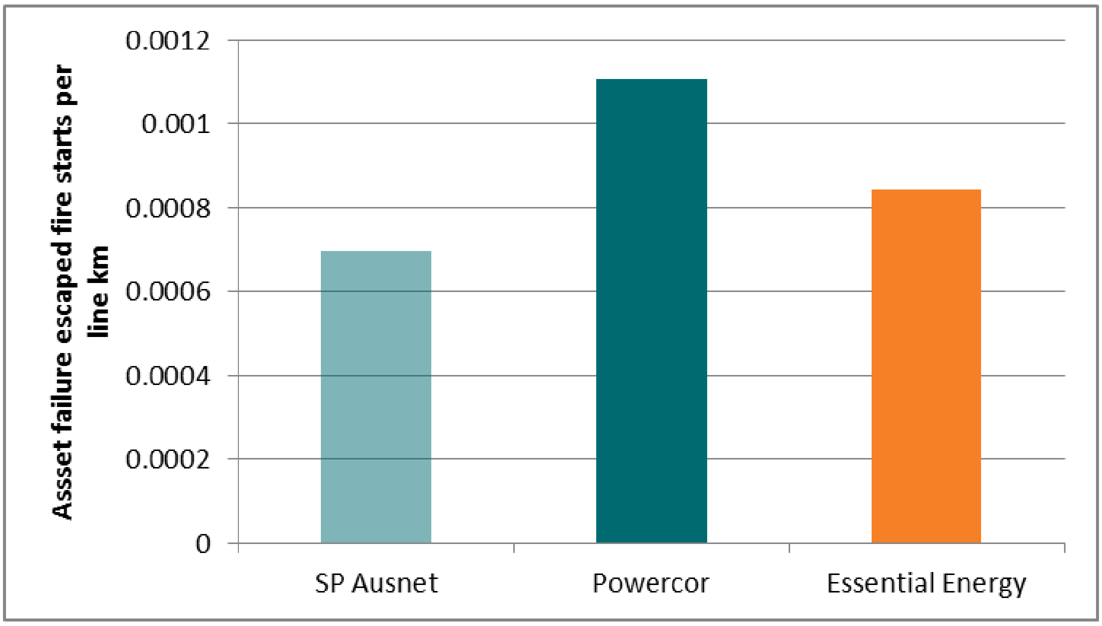
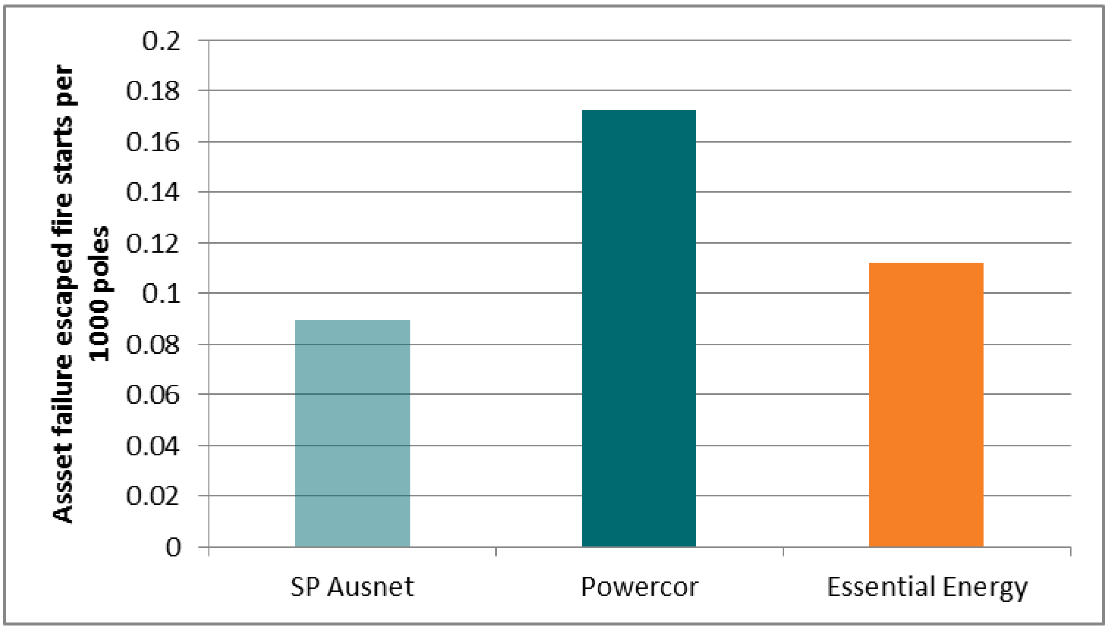
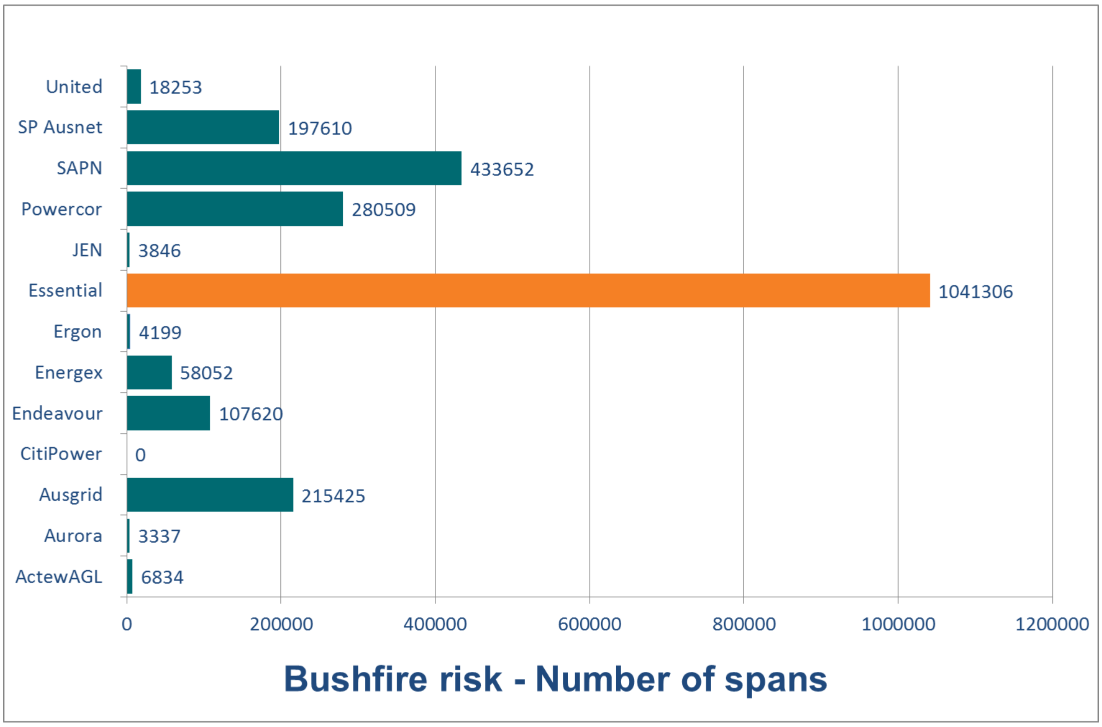



**Figure 17: Escaped asset failure fire starts normalised by number of poles(/1000 poles)**




Essential Energy's total number of bushfire risk spans is significantly higher than all other DNSPs, as shown in Figure 18.

**Figure 18: Comparison of Economic Benchmarking RIN Bushfire risks**[21]




### 3.4.2 Public Shocks

Essential Energy has a much higher rate of public shock incidents due to network components than other DNSPs, as shown in Table 8.

**Table 8: Comparison Public Shock Incidents**[22]

| | Essential Energy 2013/14 | SP Ausnet 2013 | Powercor 2013 | All Victorian DNSPs |
|---|---|---|---|---|
| Overhead related | 161 | 14 | 29 | 102 |
| Service line related | 23 | 40 | 78 | 228 |
| Number of incidents | 184 | 54 | 107 | 330 |

Essential Energy had 184 public shock incidents in 2013/14, as shown in Table 9. The majority of incidents were caused by faulty or degraded network equipment. The rate of public shocks attributable to network components is likely to rise in trend with any Repex reductions. For example the overhead service replacement program is targeted at preventing the existing level of shocks from worsening.

[21] *Economic Benchmarking RIN*, All DNSPs, 2014, Template 8, Table 8.2

[22] Energy Safe Victoria communication October 2014

**Table 9: Public Shock Incidents 2013/14 from TotalSafe**

| Cause | Essential Energy 2013/14 |
|---|---|
| Contact with network mains - Faulty mains | 1 |
| Contact with network mains - Human error | 1 |
| Contact with OH service mains - Faulty mains | 2 |
| Contact with OH service mains - Human error | 3 |
| Faulty OH mains joint | 45 |
| Faulty OH network splice | 5 |
| Faulty OH open service | 2 |
| Faulty OH service joint | 58 |
| Faulty OH twisted service | 12 |
| Faulty UG distribution mains | 1 |
| Faulty UG distribution mains joint | 5 |
| Faulty UG service | 4 |
| Faulty UG service joint | 19 |
| Long LV Run | 15 |
| Other - Network related | 10 |
| Poor Network earthing | 1 |
| **Grand Total** | **184** |

Figure 19 shows that per customer Essential Energy have a much higher rate of shocks than SP Ausnet and Powercor. However, Figure 20 and Figure 21 show that the number of shock incidents normalised either by poles or network length is lower than both SP Ausnet and Powercor. Essential Energy customers are already at greater risk of shock than customers of SP Ausnet and Powercor. Any reduction in Essential Energy's Repex will increase the rate of shocks per customer. Essential Energy's submission is aimed at maintaining the existing level and preventing it from getting worse.

**Figure 19: Public Shock Incidents 2013/14 normalised by number of customers**

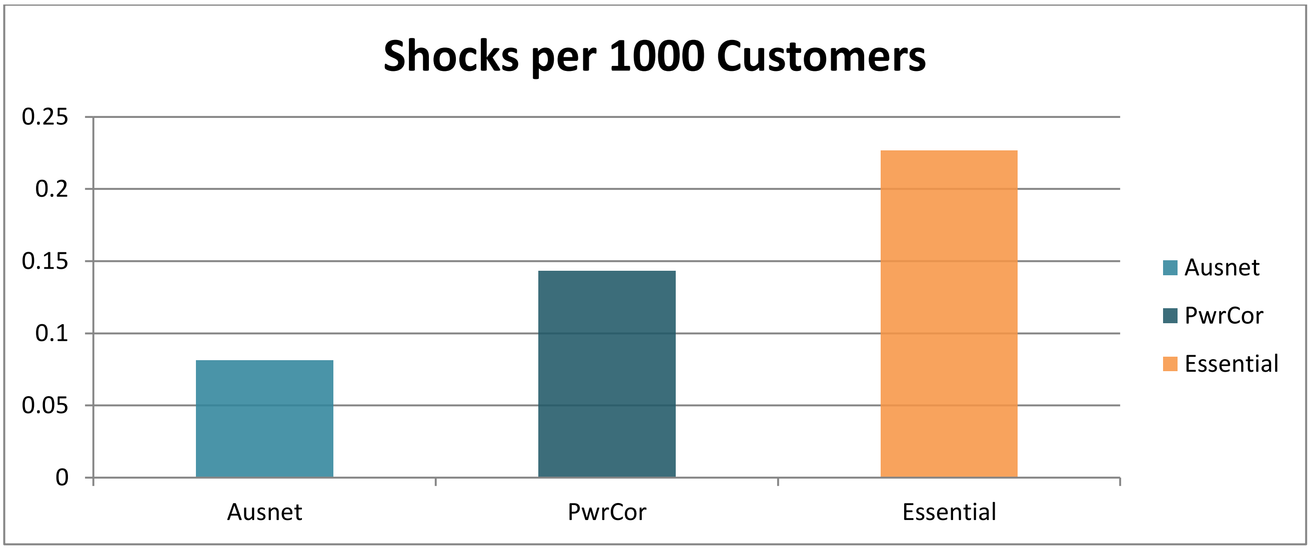


**Figure 20: Public Shock Incidents 2013/14 normalised by number of poles**

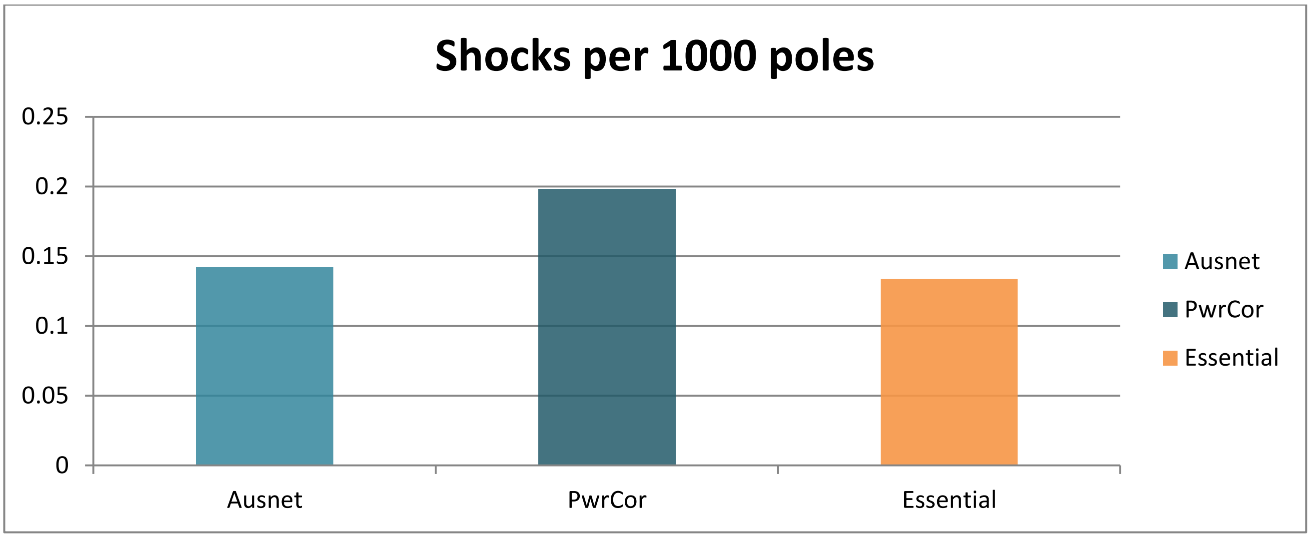
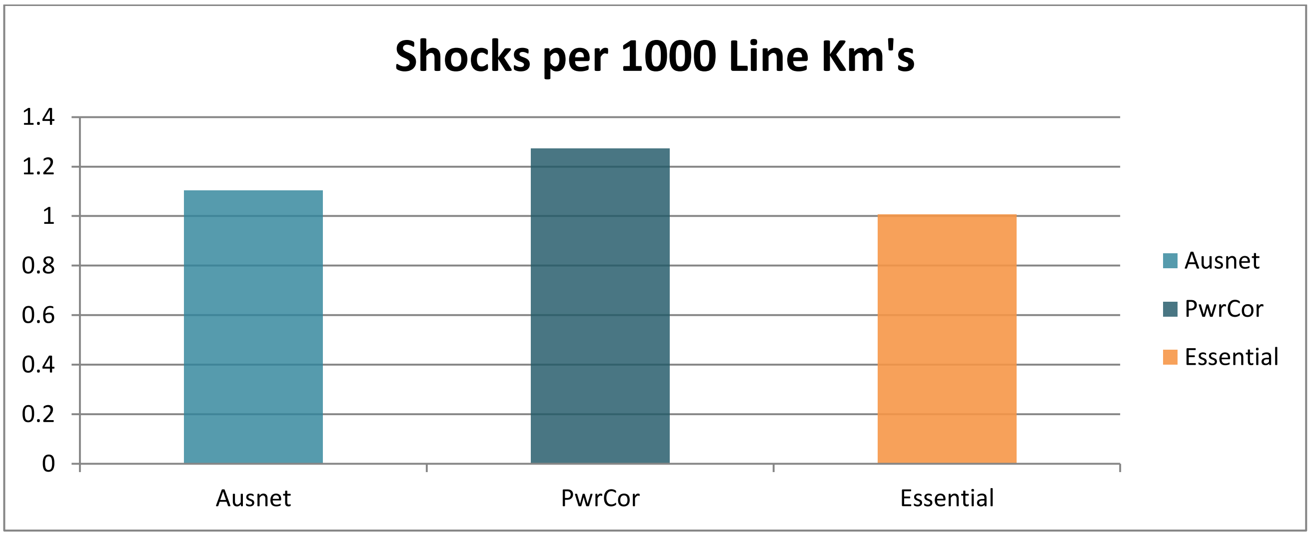


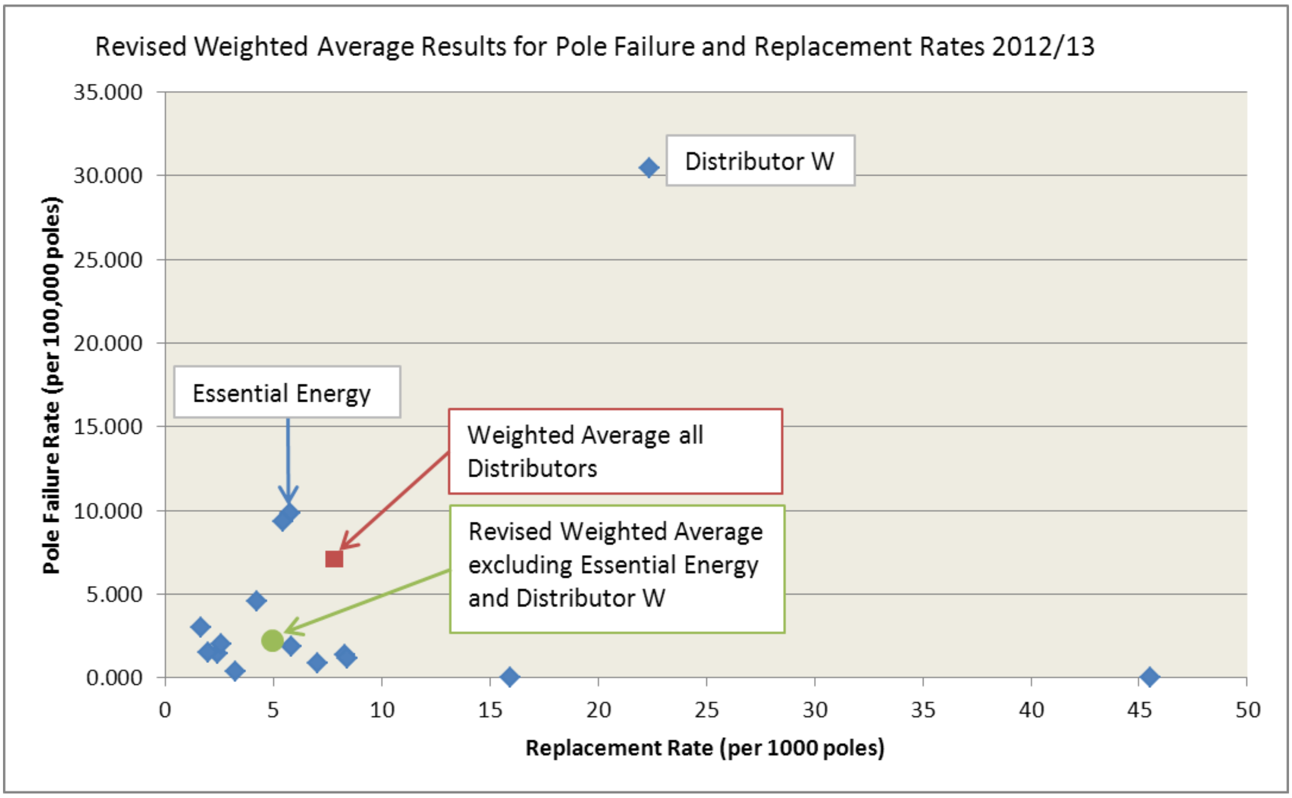

**Figure 21: Public Shock Incidents 2013/14 normalised by network length (km)**




### 3.4.3 Failure rates

As discussed in section 3.2.3, Essential Energy is experiencing high functional pole failure rates and predicting an increase in conditional pole failure rates. This is reflective of the comparatively low proposed magnitude of Essential Energy's Repex. A decrease in replacement activity would cause an escalation in the failure rates of Essential Energy assets. Figure 22 presents the results of a pole failure survey conducted by the Energy Networks Association concerning pole failures across Australia and New Zealand and compares the pole failure rate and pole replacement rate for the participating organisations.

**Figure 22: ENA Power Poles and Crossarms Forum, Pole Failure Survey**




Essential Energy's replacement rate of 5.77 per 1000 poles per annum is lower than the industry average of 7.82; and Essential Energy's functional failure rate of 10.94 per 100,000 poles per annum is higher than the industry average of 7.08.

Essential Energy's current timber pole failure rate is stated at one failure per 9550 poles. This rate is higher than the current industry average rate of one failure per 18,824[23] poles. If one outlier[24] and Essential Energy are excluded the industry annual failure rate is one pole per 41,349 poles[25].

Essential Energy currently has a higher failure rate than Industry peers and a lower replacement rate indicating a lower cost higher risk strategy. In conjunction with the obvious implications of Essential Energy's approach to pole management, Essential Energy must address the management of the pole population such that there is a gradual realignment to the industry average failure rate or as a minimum increase expenditure on pole Repex to maintain the current failure rate or otherwise accept a high and likely increasing failure rate that will result in a significant increase in safety risk.

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[23] Based on the ENA industry average for the 10 years 2003/13

[24] The outlier Distributor W has been identified by their industry regulator as having an unsustainable rate of pole failures, poor inspection practices and an unsustainable pole replacement programme that has resulted in an accelerating failure rate. This distributor has been the subject of two inquiries and regulatory intervention to address failure rates and significantly increase replacement rates. Distributor W has been forced into a very high replacement rate and is still experiencing excessive failures by industry standards.

[25] Figure 17 should be viewed in context as the current failure and replacement rates. Caution is advised in interpreting this graph as it is affected by historical practices in prior decades particularly in relation to prior replacement rates. In this regard now for over two decades the Essential Energy pole serviceability criteria has been applied based on a safety factor of actual loads not the higher criteria used by most distributors of the safety factor using the nominal pole dimensions ignoring the actual loads. This nominal pole capacity technique used by other distributors is a risk adverse approach that results in higher replacement volumes and a high capital expenditure. Whilst these other utilities have a higher replacement rate Essential Energy's approach has resulted in pole capacity being consumed such that as the population ages the replacement rate in Essential Energy will increase naturally.

### 3.4.4 Reliability Service Levels

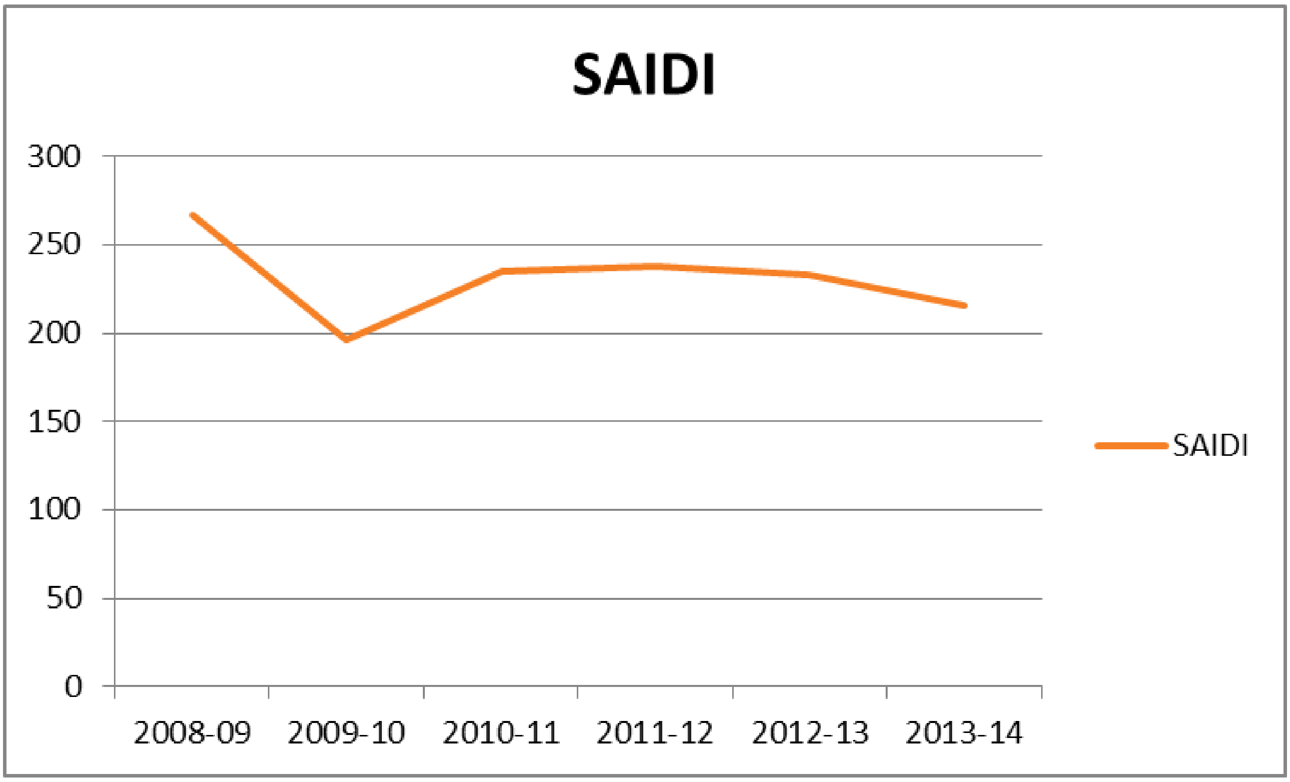
Investment in Repex is not aimed at reducing outages or improving reliability, but rather based on conditional or functional failure; It is important to note that Repex spend does not translate directly into reliability outcomes. Essential Energy reliability service levels are performing within tolerable limits at present, however this is primarily due to investment in network segmentation during 2009 - 2014. Figure 24 shows that Essential Energy has invested significantly in segmentation, but segmentation does not address the underlying cause of an outage or public risk due to asset failure.

The increased segmentation of the network effectively limits the outage results of asset failure and has a positive effect on reliability metrics. Whilst the effects of failures with regards to reliability are contained by segmentation, the failure rate on the network is increasing. This increasing failure rate has adverse safety outcomes with regards to public safety and bushfire risks and is not compliant with reasonable expectations of the Safety Regulator.

**Table 10: Essential Energy SAIDI performance**[26]

| Service Level | 2008-09 | 2009-10 | 2010-11 | 2011-12 | 2012-13 | 2013-14 |
|---|---|---|---|---|---|---|
| SAIDI | 267.1 | 196.5 | 235.1 | 237.5 | 232.5 | 215.8 |

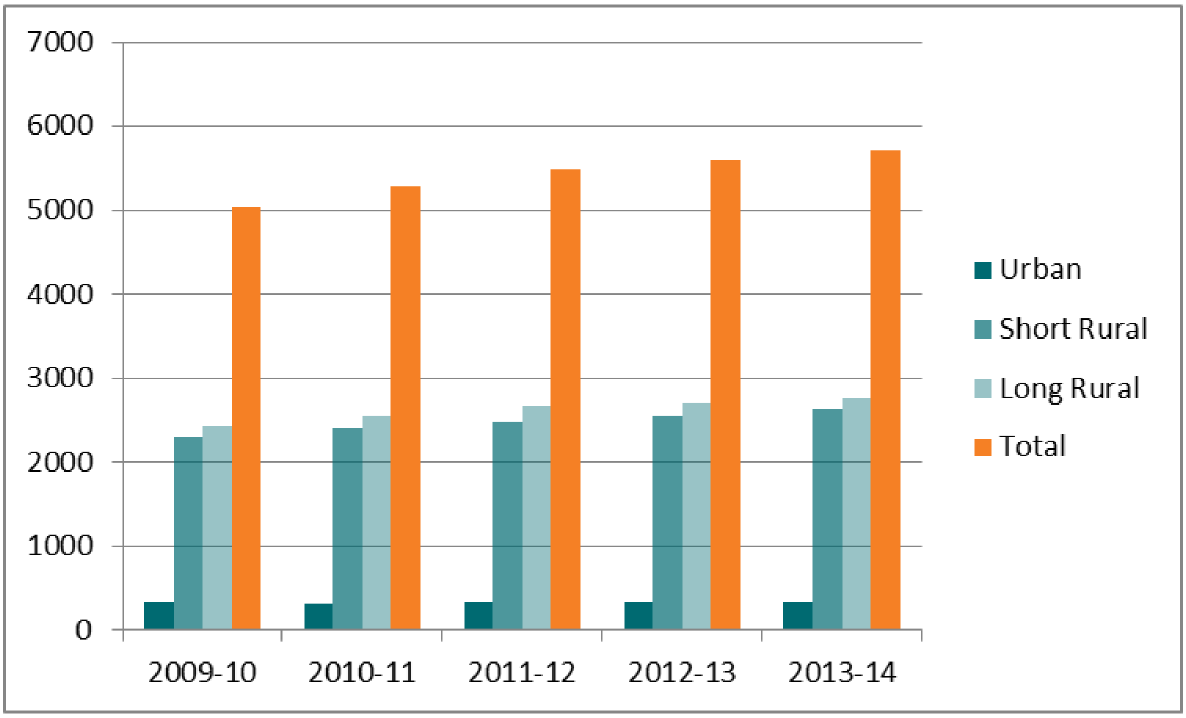
**Figure 23: Essential Energy SAIDI performance**




Individual failures are climbing, but an increase in segmentation as shown in Figure 24, is driving the improvement in SAIDI.

[26] *Attachment 4 2014 Reset RIN Workbook Consolidated*, Essential Energy, 2014, Template 6.2 Reliability and Customer Srvice Maintenance, Table 6.2.1 - Unplanned minutes off supply (SAIDI) - Actual, target and proposed reliability and Table 6.2.2 - Unplanned interruptions to supply (SAIFI) - Actual, target and proposed reliability

**Figure 24: Essential Energy number of feeder segments**




### 3.4.5 Further improvement required

Until 2014 Essential Energy conducted pre summer visual Aerial Patrols of high voltage rural electricity mains. These visual patrols are relatively low cost and rely on a trained observer sighting hardware defects and vegetation encroachments. These visual patrols are limited to sighting very serious defects and very serious vegetation encroachments, low spans being virtually undetectable.

With the limitations of the visual aerial patrol understood in 2014 Essential Energy initiated a new inspection methodology on state-wide contracts with other NSW DNSP's utilising Hi Definition photography of pole top assemblies and LiDAR technology to establish conductor clearances to vegetation, ground and other circuits by aircraft. This is referred to as Aerial Patrol and Analysis (AP&A) including LiDAR survey.

This new method is significantly more expensive than the traditional visual aerial patrol, so much so that with the vast network to be inspected it can only be afforded over a 4 year cycle rather than annually as carried out by some other industry peers. These additional inspections will cover 74% of the Essential Energy network over a 4 year period. Table 11 details the length and percentage of the network inspected and intended to be inspected by the new AP&A methodology.

**Table 11: Kilometres of Distribution network for AP&A – proposed schedule**

| | 2014 | | 2015 | | 2016 | | 2017 | | TOTAL | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Km's | % | Km's | % | Km's | % | Km's | % | **Km's** | **%** |
| Target Km's & network % | 44,000 | 22% | 42,000 | 21% | 41,000 | 21% | 21,000 | 11% | **148,000** | **74%** |

The 2014 inspections when completed, found relatively high volumes of Opex related maintenance tasks of an urgent risk, risk and general maintenance severity which typically require actioning within 14 days, 6 months, and 2-4 years respectively. The costs for this work were not included in the 2015 – 2019 investment submissions to the AER as inspections were still in progress and the results unknown at the time of submission.

Many of the tasks found by photographing and analysing pole top component conditions are considered potential bushfire and public safety risks. This adds pressure to Essential Energy opex and repex investment associated with managing a safe network in accordance with the Electricity Supply Act.

Tasks are grouped into three main categories:

- Pole & Line asset condition tasks
- Low Span tasks
- Vegetation tasks

Table 12 below highlights the additional units of work identified by the AP&A inspection process over the traditional visual aerial inspection for the 44,000Km's (29% of the rural network) flown to date. This volume will increase as the inspection regime is spread across other portions of the network in coming years.

**Table 12: Aerial Patrol – Additional Work**

| Task Type | Volume Visual Patrol | Volume AP&A | Variance | % Variance |
|---|---|---|---|---|
| Pole & Line Assets Tasks[27] | 921 | 3,210 | 2,289 | 348% |
| Low Spans[28] | 2,528 | 16,571 | 14,043 | 655% |
| Vegetation | 8,217 | 59,518 | 51,301 | 724% |

The new AP&A methodology has resulted in the following increases in work task find rates:

- Asset Pole & Line tasks – An increase of 748% in urgent risk defects, 325% of risk defects (348% total increase), equating to approximately $6M additional spend when extrapolated over all areas. This is predominantly Opex, but any reduction in the proposed Repex (expenditure for work that would normally renew these assets) will result in a growing reactive Opex workload in the future and a rising public safety risk profile.
- Non-Compliant Conductor Clearances (Low Spans) - An increase of 655% in the identification of spans lower than regulatory compliance compared to current practice of identification by pole and line inspectors. Applying the current AP&A find rate for non-compliant spans across all depot areas results in an estimated 107,300 spans with an estimated rectification cost of $268M[29].
- Vegetation Management tasks - an increase in cutting of trees close (encroaching minimum safety clearances by more than 50%) to conductors of 112% plus another 40,000 tasks (giving a total 724% increase) of lower risk tasks (encroached clearances by less than 50%) included in Opex

Essential Energy has identified via the new AP&A process an elevated level of risk on the network that will require the replacement and maintenance of more assets, the correction of many more low spans of conductor and a very material increase in vegetation encroachment issues.

A significant proportion of the low spans will likely require pole replacements to correct which will put further pressure on Repex expenditure.

### 3.5 Overall Opex

Essential Energy considers the trade-off between Opex and Repex to reduce Repex through increased focus on maintenance activities is not viable. The cost of maintaining assets on an older asset age profile is not efficient; where the cost-benefit analysis shows that replacement is a more viable option this is undertaken as Repex. The increased need for Opex (refer to section 3.2.3.2 and section 3.4.5) will already place pressure on deliverability of defect maintenance. Many assets and components do not lend themselves to any form of maintenance regime but rather are more suited to condition inspection assessments and run to conditional failure at which time they are replaced under Repex.

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[27] Pole, line and vegetation urgent risk and risk tasks only, sampled from 31 depots.

[28] This data has been sourced from ground based asset inspection. The number of low spans is from a sample of 14 depots only.

[29] Using an estimated unit rate to fix of $2,500.00

Essential Energy's Opex normalised by both poles and length of network is lower than SP Ausnet for Fault and Emergency, Maintenance and Vegetation Management, as shown in Figure 25 and Figure 26. The normalised expenditure is of a similar magnitude to both SP Ausnet and Powercor, suggesting that the proposed levels of Opex are reasonable and unlikely to be a causal factor for the lower values proposed for Essential Energy Repex, compared to SP Ausnet and Powercor.

Table 11 shows that Essential Energy's spend on OPEX per asset is similar to its peers confirming that the material lower spend in Repex is not made possible by an over spend in Opex but rather is made possible by accepting a higher risk asset strategy as confirmed by the materially higher failure rates at section 3.2.3 and older age profiles in section 3.2.2. This higher risk asset strategy is as a consequence of the lower customer density resulting in an affordability issue where with many assets per customer compared to its peers Essential Energy cannot afford to spend at the same level of Repex. However whilst Essential Energy operates a higher risk strategy than its industry peers it must be acknowledged as such and that any further reduction in Repex expenditure will further increase operating risk likely to an unacceptable community standard.

**Table 13: Opex expenditure 2012/13 (real $2013/14)**

| Category | Cost | Essential Energy | SP Ausnet[30] | Powercor[31] |
|---|---|---|---|---|
| Fault and Emergency | Expenditure ($m) | $50.00 | $14.80 | $21.20 |
| | Normalised (/km) | $273.54 | $302.66 | $252.38 |
| | Normalised (/pole) | $36.39 | $38.95 | $39.26 |
| Maintenance | Expenditure ($m) | $92.00 | $27.70 | $47.30 |
| | Normalised (/km) | $503.31 | $566.46 | $563.10 |
| | Normalised (/pole) | $66.95 | $72.89 | $87.59 |
| Vegetation Management | Expenditure ($m) | $117.00 | $38.90 | $45.10 |
| | Normalised (/km) | $640.08 | $795.50 | $536.90 |
| | Normalised (/pole) | $85.15 | $102.37 | $83.52 |

[30] Safety Performance Report on Victorian Electricity Networks 2013, Energy Safe Victoria, June 2014, Table 1 p. 20

[31] Safety Performance Report on Victorian Electricity Networks 2013, Energy Safe Victoria, June 2014, Table 1 p. 20

**Figure 25: Comparison of Opex normalised by network length ($/km)**

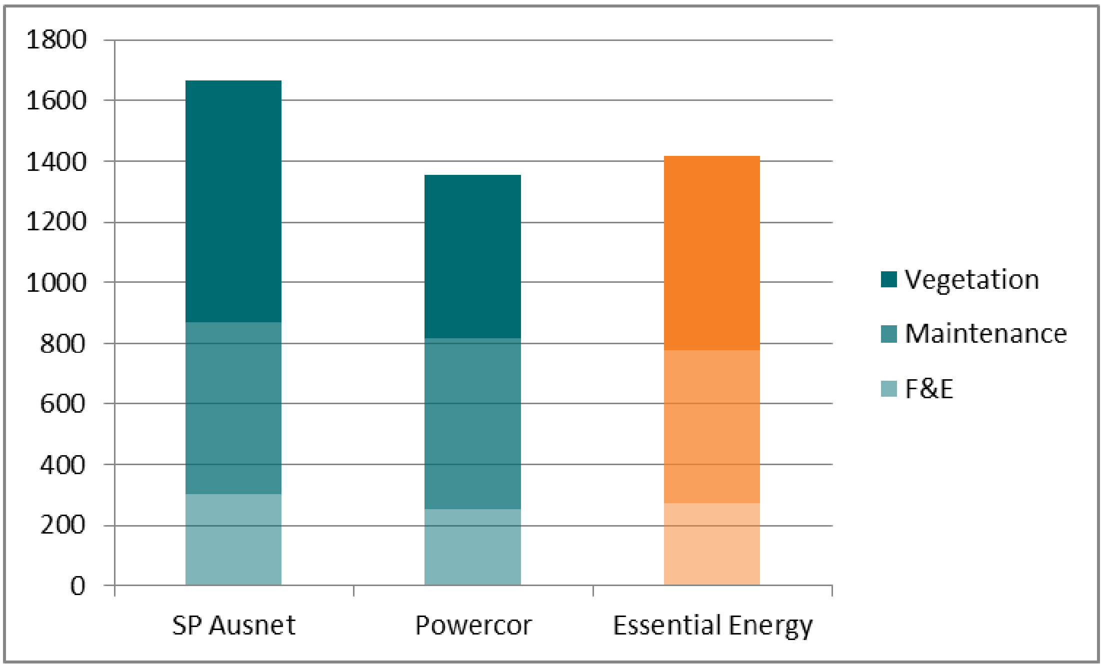
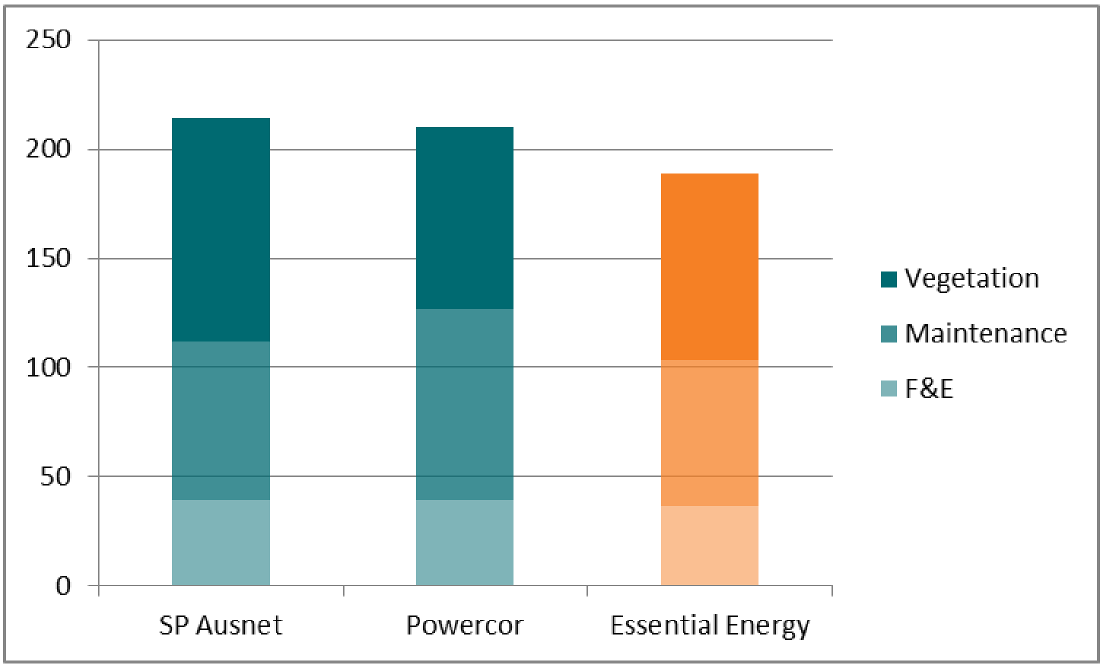



**Figure 26: Comparison of Opex normalised by number of poles ($/1000 poles)**




Given that the Opex is comparable to the industry peers any reduction in Repex will cause an increase in Opex in the future regulatory control periods.

## ATTACHMENT 1 - Sources

### Table 14: CPI and multipliers to $2012/13

| Years | 2008/09 | 2009/10 | 2010/11 | 2011/12 | 2012/13 | 2013/14 |
|---|---|---|---|---|---|---|
| Actual CPI (as applied to annual prices) | | 4.35% | 1.82% | 2.85% | 3.39% | 1.76% |
| Multiplier | 1.129818 | 1.082719 | 1.063366 | 1.0339 | 1 | 0.982704 |

### Table 15: Repex ($000 2012/13)[32]

| Years | 2009 | 2010 | 2011 | 2012 | 2013 | Historical Repex (2009 - 2013) |
|---|---|---|---|---|---|---|
| Multiplier | 1.12982 | 1.08272 | 1.06337 | 1.03390 | 1.00000 | |
| Essential Energy Repex RIN | $66,587 | $106,364 | $144,427 | $147,749 | $137,293 | |
| Essential Energy Repex ($2012/13) | $75,231 | $115,163 | $153,578 | $152,757 | $137,293 | $634,022 |
| SP Ausnet Repex RIN | $74,953 | $56,276 | $71,936 | $102,779 | $102,488 | |
| SP Ausnet Repex ($2012/13) | $84,683 | $60,931 | $76,495 | $106,263 | $102,488 | $430,860 |
| Powercor Repex RIN | $38,583 | $47,913 | $59,941 | $69,992 | $82,068 | |
| Powercor Repex ($2012/13) | $43,592 | $51,876 | $63,739 | $72,364 | $82,068 | $313,640 |

### Table 16: Asset Numbers[33]

| Assets at 2013 EOFY | SP Ausnet | Powercor | Essential |
|---|---|---|---|
| Poles | 339,151 | 466,383 | 1,374,116 |
| OH Line km's | 38,448 | 68,843 | 182,791 |
| UG Cable km's | 6,169 | 6,245 | 7,468 |
| Service line km's | 7,622 | 10,786 | 13,368 |
| Transformers | 58,536 | 84,284 | 135,729 |
| Switchgear | 112,469 | 343,055 | 462,447 |
| SCADA/Control/Protection | 10,455 | 7,059 | 884 |
| Street Lights | 96,282 | 156,598 | 149,307 |
| Total | 669,131 | 1,143,253 | 2,326,109 |

[32] *Attachment 4 2014 Reset RIN Workbook Consolidated*, Essential Energy, 2014, Template 2.2 Repex Table 2.2.1 – Replacement Expenditure, Volume and Asset Failures by Asset Category and Table 2.2.2 – Selected Asset Characteristics (Essential Energy's Repex)

*SP Ausnet (D) 2008-13 – Category Analysis RIN – templates Consolidated*, 2014, Template 2.2 Repex Table 2.2.1 – Replacement Expenditure, Volume and Asset Failures by Asset Category and Table 2.2.2 – Selected Asset Characteristics (SPAusnet's Repex)

*Powercor 2008-13 – Category Analysis RIN – responses Consolidated*, 2 June 2014, Template 2.2 Repex Table 2.2.1 – Replacement Expenditure, Volume and Asset Failures by Asset Category and Table 2.2.2 – Selected Asset Characteristics (Powercor's Repex)

[33] *Attachment 4 2014 Reset RIN Workbook Consolidated*, Essential Energy, 2014, Table 5.2 Asset Age Profile (Essential Energy's Age Profile)

*SP Ausnet (D) 2008-13 – Category Analysis RIN – templates Consolidated*, 2014, Table 5.2 Asset Age Profile (SPAusnet's Age Profile)

*Powercor 2008-13 – Category Analysis RIN – responses Consolidated*, 2 June 2014, Template 2.2 Repex Table 5.2 Asset Age Profile (Powercor's Age Profile)

# 11 APPENDIX G – Essential Energy's Revised Estimated Residual Service Life

Essential Energy has provided an updated and revised estimated residual service life chart as Essential Energy believes that the AER's assertion that *"Essential Energy may be seeking more repex than is necessary for some asset classes"* [143] is inaccurate.

The original data was worked out using a simple weighted average of the existing asset base against asset additions for each class. This incorrectly weighted the asset lives towards new asset additions. When the calculation has been performed at a more granular level, it is clear that a lot more of Essential Energy's assets are significantly aged and, in general, the rate of capex spend is not keeping pace with the ageing network. The updated chart can be seen below in Figure 11-1.

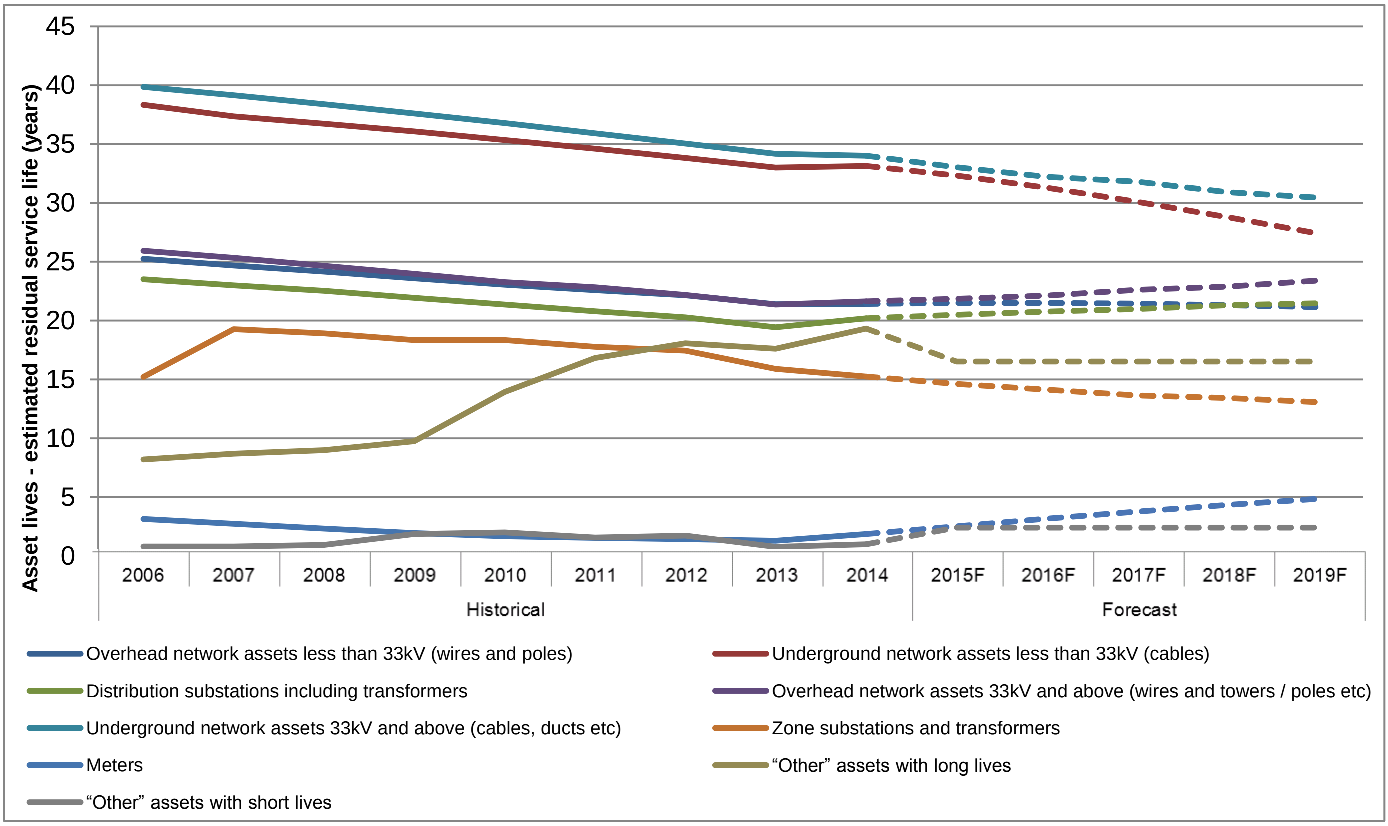



*Figure 11-1: Essential asset age - estimated residual service life*

[143] Draft decision Essential Energy distribution determination 2015-16 to 2018-19 Attachment 6, AER, November 2014, section A3.1 p56