APPENDIX 4.1

Review of AER REPEX forecast modelling

Energex revised regulatory proposal – July 2015

AER REPEX Review

Energex

Review of AER REPEX forecast modelling

RO013300R001 | 1.1

15 June 2015

AER REPEX Review

Project no:	RO013300
Document title:	Review of AER REPEX forecast modelling
Document No.:	RO013300R001
Revision:	1.1
Date:	15 June 2015
Client name:	Energex
Project manager:	Jeff Butler
Author:	Cliff Jones/Gerhard Joubert/Jeff Butler
File name:	I:\VFAU\Projects\RO013300 Energex AER REPEX Review\Deliverables\Reports\Final\RO013300R001 Energex AER REPEX Review (final) ver 1.1.docx

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Document history and status

Revision	Date	Description	By	Review	Approved
A	17/04/2015	Draft report for phase 1	C Jones	J Butler	S Hinchliffe
B	15/05/2015	Final draft report for client review	J Butler	G Joubert	S Hinchliffe
1.0	26/05/2015	Final report for client issue	J Butler	G Joubert	S Hinchliffe
1.1	15/06/2015	Amended final report for client issue	J Butler	G Joubert	S Hinchliffe

Contents

Executive Summary

The Australian Energy Regulator (AER) applies a predictive replacement expenditure (REPEX) model to assess and revise Distribution Network Service Provider (DNSP) forecasts of replacement capital expenditure. Jacobs is assisting Energex in reviewing the AER approach to determining efficient replacement expenditure. Jacobs has undertaken a review and analysis of the AER REPEX model used by the AER for forecasting asset replacement capital expenditure, and provided commentary on the appropriateness of the application of the REPEX model to Energex's asset replacement expenditure forecast.

In undertaking this work, Jacobs has provided a review of the AER REPEX model based on comparison with similar models used in other regulatory regimes and guidelines of good engineering industry practice.

The scope of this project included:

- Analysis of the underlying functionality of the AER REPEX model, assumptions made, and the robustness of input data used by the AER
- Review of the general compliance of the model against the assessment principles set out in the AER Expenditure Forecast Assessment Guideline (EFA) for Distribution of November 2013
- Review of the extent to which the AER REPEX model mirrors, replicates functionality and robustness or otherwise, similar models used by the Office of Gas and Electricity Markets (Ofgem) in regulation of utilities in Great Britain
- Analysis of the application of the REPEX modelling in the AER draft determination for Energex, including key aspects of assumptions and parameters used in the modelling

The key findings of the Jacobs review are:

- **AER assessment approach**
    - acknowledges that the AER method is consistent with the assessment requirements set out in the National Electricity Rules, and seeks to identify efficient expenditure for maximum social benefit
    - recognises that the AER modelling attempts to identify business-as-usual expenditure for replacement expenditure forecasts for 2015-20 based on historic replacement activity
    - acknowledges that in doing so, the AER REPEX model adjusts the nominal asset lives for each asset category to reflect the replacement expenditure for the past 5 years, based on assumption that replacement expenditure for the previous regulatory period was prudent and efficient
    - analysis of effect on network health indicators has been based on high level review of estimated residual service life by asset class as a proxy for reliability and asset utilisation as a proxy for asset condition
    - Jacobs is concerned that the AER assumption about the prudency and efficiency of historic REPEX and assessment of impact of revised REPEX allowance on network health has not adequately considered obsolescence and asset condition assessment, and there is a risk that maintaining REPEX expenditure levels at historic expenditure levels will adversely affect Energex ability to maintain network performance as it is currently.
    - Jacobs believes that the AER should consider extending its review into assessing the engineering considerations of the business rather than restricting the assessment to a desktop analysis of selected health indicators as a proxy for network and asset performance.
- **Asset lives**
    - in establishing the implied asset lives based on historic activity, the forecasts for 2015-20 are generated based on the asset category age profiles as provided in the Energex RIN submission
    - The AER REPEX model is very sensitive to changes in asset lives. Jacobs found that ±10% variation in lives can result in significant changes in expenditure forecasting, meaning that applying reasonable implied asset lives is critical in generating a comparative expenditure forecast.

  - Jacobs considers that some of the implied asset lives used by the AER are unreasonable in comparison to industry lives.
  - The need to influence the model output by adjusting asset lives to overcome the impractical expenditure forecast emanating from replacement backlogs are recognised; however a balanced approach is proposed through the introduction of an upper limit to which asset lives are allowed to unfold during the calibration process. Applying a maximum asset life develops the resilience of the model necessary to establish a reasonable and sustainable expenditure forecast. Applying a set of maximum asset lives developed through a study of national and UK asset lives provided a more sustainable expenditure forecast profile.

- **Unit rates**
  - AER has adopted historic unit rates in its calibrated forecast modelling, which are not reflective of the actual costs that Energex are incurring, and due to the manner in which the RIN data was compiled
  - Energex forecast unit costs have been previously independently reviewed and found to be reasonable in comparison to market costs.
  - The analysis revealed anomalies associated with the Energex data that were submitted via the RIN process including unintentional inflation of historical replacement volumes, incomplete replacement volumes, and incomplete historical expenditure data resulting from internal movements in the allocation of replacement programs between cost categories and the inclusion of work-in-progress data. Should data corrections be undertaken it is very likely that the step increase between ‘historical’ and ‘forecast’ unit costs calculated by the AER would reduce significantly.

- **Summary**

  Whilst acknowledging the AER approach to understand business-as-usual expenditure for replacement expenditure forecasting, Jacobs believes that the AER should consider the following:

  - Jacobs considers that the Energex forecast unit rates should be used, resulting in an increase in the REPEX allowance of $98M.
  - Jacobs is of opinion that implied asset lives should be capped and this would result in increase of $201M in the REPEX allowance modelled by the AER.
  - Combining the introduction of the proposed maximum asset life limits and applying the forecast unit costs submitted by Energex, the independent modelling done by Jacobs produced a modelled REPEX forecast highly comparable to Energex’s originally submitted expenditure forecast. It is our conclusion that the modelled REPEX forecast developed by Energex demonstrates the reasonable, appropriate and sustainable level of expenditure required to maintain the safety, service quality, security and reliability of the Energex network consistent with current obligations.
  - Figure 1 shows a comparison between the AER draft determination allowance for REPEX and the Jacobs modelling outcomes using the Energex forecast costs and capped calibrated lives. Figure 2 shows the adjustments to the AER draft determination REPEX allowance.

Figure 1 : Total modelled REPEX

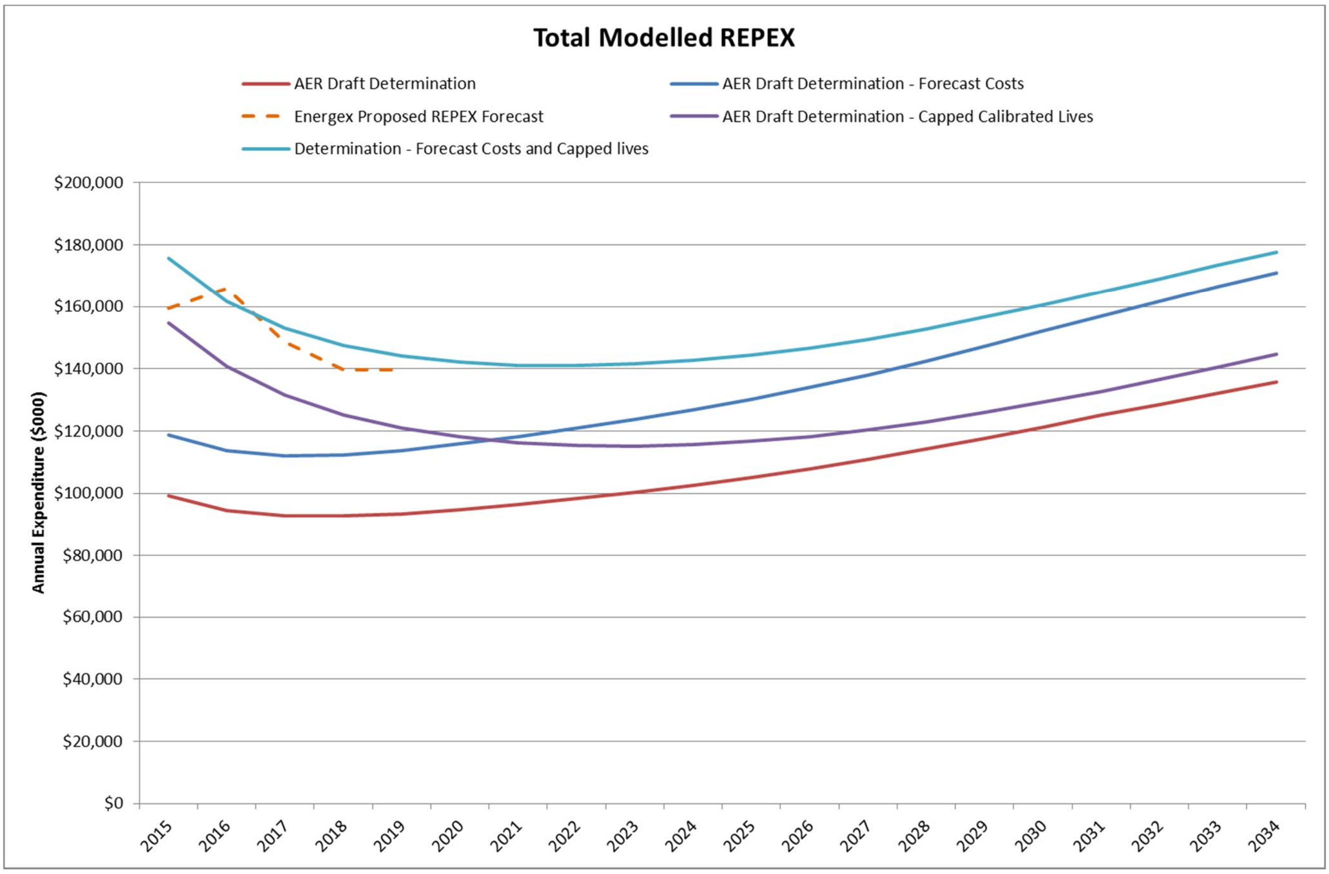
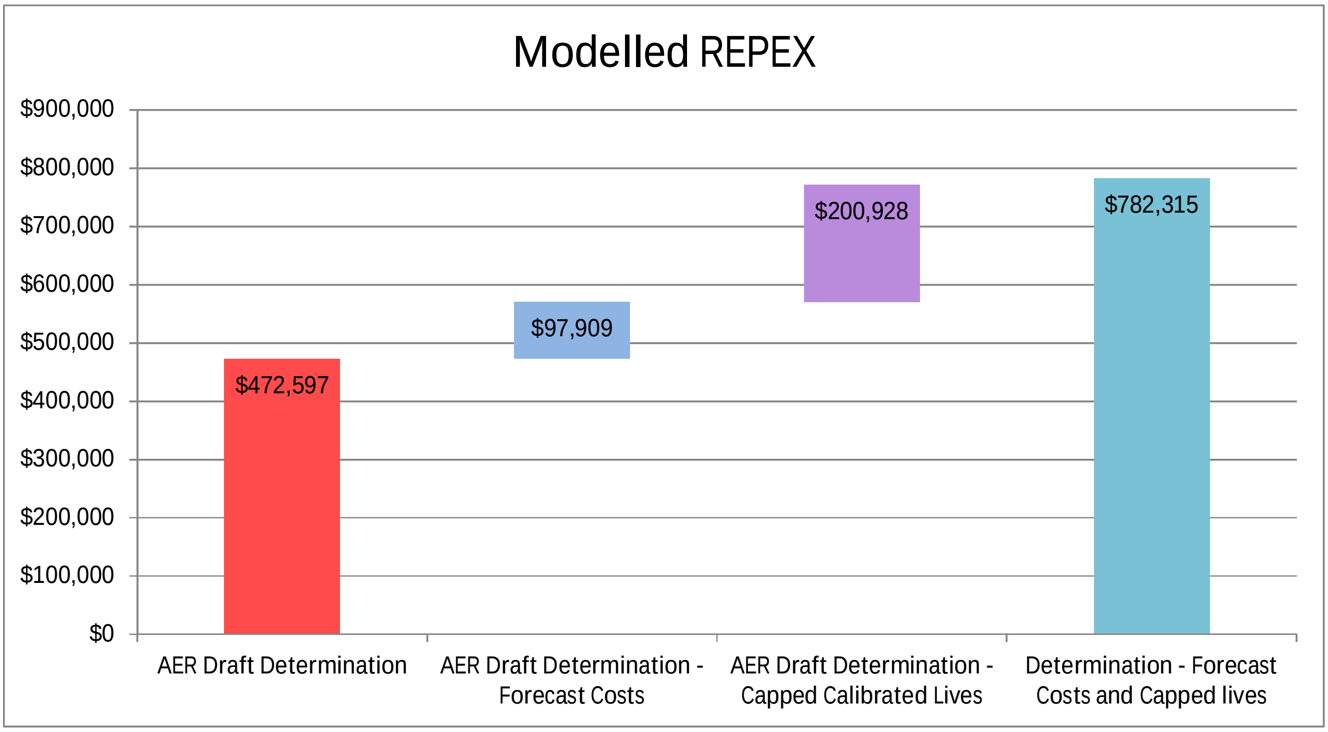


Figure 2 : Adjustments to AER Draft Decision



Important note about your report

The sole purpose of this report and the associated services performed by Jacobs is to provide an independent review and assessment of the AER REPEX modelling process as applied to Energex (“Client”) in accordance with the scope of services set out in the contract between Jacobs and the Client. That scope of services, as described in this report, was developed with the Client.

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and/or from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

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1. Introduction

Energex submitted its regulatory proposal for the period 2015 to 2020 to the Australian Energy Regulator (AER) in October 2014, and is currently preparing a response to the AER draft decision due in July 2015.

Jacobs was engaged to provide a high level qualitative view of the AER replacement expenditure (REPEX) models and a quantitative approach to validating the output of the AER REPEX models with the objective to assess the reasonableness of the AER decision taking into consideration the key 'bottom-up' parameters that drive Energex's replacement capital, and whether it supports the reliability and safety objectives set by Energex.

A significant portion of the Energex capital expenditure (CAPEX) for the forthcoming regulatory period is related to the replacement or repairing of network equipment (55% of CAPEX), with an anticipated 22% capital investment in augmentation expenditure (AUGEX) to building new network substations and circuits to supply growth areas and improve reliability. The Energex revenue proposal[1] estimates a total REPEX of $1.76 Billion (including capitalised overheads).

The key objectives of this REPEX modelling review are to:

a) Understand the AER and Energex replacement capital expenditure model with respect to standard asset lives and unit costs applied in the Industry.

b) Understand the AER REPEX model and the level of compliance of the REPEX model with the guiding principles of the AER Expenditure Forecast Assessment Guideline (EFA) with a view to focussing on the implementation of the principles of transparency and consultation.

c) Compare the AER REPEX modelling approach with the RIIO approach implemented by the Office of Gas & Electricity Markets (Ofgem) in Great Britain (GB) to identify potential areas of enrichment. Ofgem has adopted a sustainable network regulation framework which is recognised internationally as a benchmark in good regulatory practice. The model intends to ensure network operators can maintain reliable, secure and good condition networks while delivering an appropriate quality of service to consumers.

d) Review the results of the Energex draft determination related to REPEX and provide a 'pragmatic and impartial' view of the results of implementing the AER REPEX model.

This report provides a high level view of the Energex REPEX proposal when compared to industry benchmarks together with a comparison of the AER modelling approach to the Ofgem modelling approach.

Jacobs has commented on the robustness of the AER REPEX model and outlined certain adjustments that Jacobs believes will result in a model that is better reflective of the key principles outlined in the EFA.

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[1] Energex five year future plan Regulatory Proposal Summary 2015-2020 (source: AER website - http://www.aer.gov.au)

2. Documents reviewed by Jacobs

The following documents were reviewed:

- AER Draft Decision for Energex 2015 - 2020, April 2015
- AER REPEX model (base-historical), Excel file
- AER REPEX model (base-forecast), Excel file
- AER REPEX model (calibrated-forecast), Excel file
- AER REPEX model (calibrated-benchmark average), Excel file
- Energex, Category Analysis RIN, updated February 2015, Excel file
- Energex, QLD, RESET RIN 2015-20, Consolidated Public, Excel file, update February 2015
- Energex response to AER REPEX Questions, December 2014
- AER Issues paper QLD electricity distribution regulatory proposals, December 2014
- Energex - RDP2015 Regulatory Proposal, October 2014
- Energex Reset RIN, Basis of Preparation, October 2014
- Energex - 4. REPEX Model Supporting Information, October 2014
- Energex 2008-13 - Category Analysis RIN - Basis of Preparation - 2 June 2014 - PUBLIC_1
- AER Replacement expenditure model handbook, November 2013
- Energex - Forecasting methodology, November 2013
- AER Expenditure Forecast Assessment Guideline, November 2013

3. REPEX assessment approaches

In accordance with the statutory requirements of the National Electricity Rules[2], the AER has established the Expenditure Forecast Assessment (EFA) Guideline to specify the approach the AER will use to assess capital expenditure (CAPEX) and operating expenditure (OPEX) forecasts, and the information required from network service providers (NSPs) to support this assessment.

The AER approach uses both quantitative modelling and qualitative reviews to determine the REPEX allowance it considers is efficient and maximises the social benefit[3] to consumers. The REPEX modelling is based on historic replacements for each asset category and adjusts the nominal asset lives to suit these historic volumes. The primary underpinning assumption is that the historic activity represents business-as-usual, and that forecasts should be built on this baseline.

The qualitative reviews include both those asset categories that, for various reasons, cannot be modelled using the REPEX model, and the separate specific replacement programs proposed by Energex for each asset category based on asset condition, obsolescence, performance or safety-related issues.

The method the AER has recently introduced has some similar features to the regulatory framework previously adopted by The Office of Gas & Electricity Markets (Ofgem) which is responsible for regulation in Great Britain. The key difference between the regulatory approaches in Australia and Great Britain is that the AER has relied upon economic modelling of replacement expenditure with a high-level review of selected asset management programs with the main focus on the financial impact for consumers; whilst the Ofgem approach consists of modelling including scenarios and detailed review of all asset management plans to verify reasons for any identified differences in forecast replacement volumes, with consideration of potential impact on network performance and condition.

Additional detail in comparing the AER and Ofgem approaches is included in Appendix C.

3.1 Key modelling considerations

The AER refers in a number of documents that its REPEX model is based on well-established principles of probability and normal distribution and that it has been used by the AER previously and has similar characteristics to the model used by Ofgem. However, Jacobs considers that the results of the REPEX model should be reviewed and adjusted with consideration of physical/engineering factors.

3.1.1 External factors affecting implied asset lives

Jacobs has reviewed the AER REPEX model, and found that it is very sensitive to changes in the asset lives used in determining forecast asset replacement volumes (refer section 4). Changes of ±10% in the implied asset lives can result in substantial changes in the forecast expenditure, and therefore it is imperative that the implied asset lives (based on historic replacement volumes) are reviewed for their reasonableness against industry standards and network specific factors.

The determination of suitable average asset class lives in different countries is dependent upon the prevailing environmental conditions (eg, ambient summer and winter temperatures, wind speed, salinity), asset management and maintenance practices, asset loading and the system security and planning criteria adopted within that country.

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[2] AEMC, *National Electricity Rules: version 71*, 9 Apr 2015, chapter 6, clause 6.5.7, pp. 670-1

[3] In its explanatory statement to the Expenditure Forecast Assessment Guideline, the AER states that *"… In accordance with COAG best practice regulation we define benefits as **social benefits**. Benefits are 'social' when measured irrespective of the people to whom they accrue and are not confined to formal market transactions. However, societal benefits do not include wealth transfers where one party is simply made better off at the expense of another party. Social benefits are realised if consumers gain more than NSPs lose. When assessing regulatory expenditure allowances we consider societal benefit is maximised when a NSP's expenditure is efficient."* (p. 13)

The differences between the UK and Australian system security and planning criteria, when combined with the more onerous ambient temperatures (particularly Australia's hotter summers) means that most electrical equipment on Australian distribution systems will be loaded, when considering thermal constraints, to a higher level, on average, over the life of the asset. For many classes of assets, this higher level of thermal loading over the life of the asset will result in increased loss-of-life through insulation degradation.

The Ofgem approach includes modelling of various scenarios to reduce the volatility in the implied asset lives so as to generate a range for potential replacement volumes.

3.1.2 Establishment of business-as-usual expenditure

For the purposes of its assessment, the AER has assumed that "*… past actual expenditure was sufficient to achieve the expenditure objectives in the past*"[4] and that *"… when we rely on past actual expenditure as an indication of required forecast expenditure, we assume that the past expenditure incurred by the DNSP was sufficient for it to achieve the expenditure objectives. That is, the DNSP's past expenditure was the amount required to manage and operate its network at that time, in a manner that achieved the expenditure objectives. When we make this assumption, expenditure forecasts need to account for changes to the assumed efficient starting point expenditure. Accounting for such changes … ensures the DNSP receives an efficient allowance that a prudent operator would require to achieve the expenditure objectives for the forthcoming regulatory period.*"[5]

In making the assumption that past historical replacement activity represents prudent and efficient business-as-usual, Jacobs is of the opinion that the AER should satisfy itself that the historic replacement volumes were appropriate and unaffected by any specific factors. As an example, for the purposes of the 2015-20 assessment, Energex has previously replaced some assets under augmentation projects and therefore the historical expenditure is not necessarily a good indicator of past replacement volumes.

In addition, if a risk adverse DNSP replaces assets prematurely then this policy will likely exaggerate the projected need for future replacements. Conversely, if a capital constrained DNSP had a history of replacing too few assets then this can lead to an under-estimation of the future asset replacement need. By comparing replacement data for similar assets across several DNSPs it should be possible to infer where a particular NSP sits in the spectrum of possible responses to the incentive framework. The calibration process should be adjusted to take these circumstances into account.

Therefore, due to these exogenous factors, the core assumption that the AER applies with regards to the prudency and efficiency of historic replacement expenditure could potentially distort the calculation of the implied asset lives for each of the modelled asset categories, and the associated forecast expenditures.

By contrast, Ofgem acknowledges that for fast-track assessments, which uses a similar assessment approach as employed by the AER, the modelling based solely using historic asset replacement volumes to calculate implied asset lives has limitations and does not fully take account of all relevant factors. For example, the implied life approach makes no adjustments for the condition of the assets, only age. Therefore, Ofgem considered it important to overlay a qualitative review of business cases and other asset management documentation on the quantitative assessment.

For slow-track assessments, Ofgem calculated ranges for replacement volumes based on both historic and forecast volumes, and accounts for changes that may occur between past and forecast asset management strategies. This contrasts the AER approach of establishing a business-as-usual baseline using historic replacement activity and then investigating any forecast variances. As a result, the Ofgem approach is more likely to establish a reasonable and efficient forecast based on changing replacement requirements, contrasted with potentially embedding inefficiencies from previous REPEX as may possibly occur with the AER approach.

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[4] AER, *Better Regulation: Expenditure Forecast Assessment Guideline for Electricity Distribution*, Nov 2013, section 2.2.1, p. 8

[5] ibid., p. 9

4. AER REPEX assessment model

4.1 Asset lives

Energex has a fundamental objective to ensure the safety of the public, customers and electrical workers and to meet reliability requirements of the jurisdictional regulator. These objectives require that Energex invest in the timely replacement of aging equipment to mitigate events that could endanger the safety or health of any person. The asset replacement forecast proposed by Energex is aimed at upholding the safety of the network by maintaining the integrity of assets through the replacement of aged and deteriorated equipment. In doing so Energex is also complying with its obligation under the *Electricity Act 1994* and Electricity Industry Code as a responsible electricity distribution service provider.

Beyond a certain extension of asset life, the impact of delaying replacement expenditure or increasing asset lives can have a negative impact on the reliability of Energex's network and negative customer impact. Therefore, to meet its objective it is imperative that adjustments to asset replacement lives and replacement volumes be treated with discretion. Energex has high confidence in the economic lives submitted in their regulatory proposal which have been determined based on the RAB Roll Forward Model (RFM) and Asset Life RFM produced for the AER during the 2010-2015 regulatory determination.

The asset lives proposed by Energex are generally consistent with industry averages and instances where the asset lives exceed industry average are indicative of historic under investment. Extension of Energex's proposed asset replacement lives would be considered inappropriate, if anything, shorter asset lives should be considered allowing for a catch up on under expenditure in particular asset categories.

The following section of this report provides an analysis of Energex's asset lives and the general consistency with industry standards/practice. A sensitivity analysis of the REPEX model using Energex's data was undertaken by adjusting the life of assets in two scenarios, by reducing asset life by 10% and by increasing the asset life by 10%.

The results of the sensitivity analysis highlighted the volatility of AER's REPEX model, the scenario where the asset life was extended by 10% resulted in a 40% reduction in replacement expenditure and a 10% reduction in asset life resulted in an 80% increase in replacement expenditure. It also highlights the implications of applying the appropriate asset lives when using the REPEX model to derive forecasts. The details of the sensitivity analysis are included in Appendix B.

4.2 Replacement asset life

The effective life of an asset is a function of the design, operational, economic, strategic, expected duty and the level of functionality it is expected to maintain. As assets age their effective functionality and integrity reduces and its ability to continue achieving its design and operational duty in a safe and effective manner is reduced.

The replacement lives applied by Energex in the RIN RESET submission are mean economic asset lives determined as per the AER RIN requirements and represent the estimated period after installation of the new asset during which the asset will be capable of delivering the 'effective' service. The economic life could be different from the physical life of the asset and is determined by economic considerations including maintenance costs, performance improvement against capital costs, and loss reduction through improved asset design.

The replacement asset life ranges applied by Jacobs in this review has been based on industry experience from the Australia, UK, South Africa and New Zealand. The voltage levels, design and construction of electrical infrastructure built in these countries over the last century have all been based on the historical British Standards including the design assumptions for ambient and maximum operating temperatures. We therefore consider the average design and safe operational asset lives achieved in these countries to be relevant industry experience and good engineering practice.

The industry asset lives applied in this review has been established by taking into consideration standard asset lives applied in other Australian and relevant international jurisdictions. These asset lives have been sourced from:

- NSW Treasury document, "Valuation of Electricity Network Assets – A Policy Guideline for NSW DNSP's (May 2003)
- Asset lives adopted by the various Distribution Network Operators in the UK
- South African Department of Minerals and Energy's "Valuation Handbook"
- New Zealand Commerce "Handbook for Optimised Deprival Valuation of System Fixed Assets of Electricity Lines Businesses"

Comparing Energex's economic asset lives with industry experience we found that 45% of the asset lives fell within the industry range, 41% where longer and 15% shorter than industry expectations. Longer asset lives were generally associated with ground mounted/chamber type transformers, switchgear, communications and controls, cables and overhead conductors covering the majority of the prominent REPEX categories. The shorter asset lives are associated with pole top transformers, pole tops, and service line replacements. Energex typically has a longer asset life for the high cost categories than the industry 'norm', which results in a conservative REPEX forecast. The asset life comparison is summarised in Figure 4. The longer mean economic lives are indicative of assets in operation and exceeding the expected industry operational life and in need of replacement.

4.3 REPEX model calibrated asset lives

The process that the AER uses to populate and calibrate the AER REPEX Model is described in a published document titled 'AER guide to the REPEX Model – revised November 2013'[6]. The REPEX calibrated model derives business-as-usual forecast replacement volumes by adjusting the applicable asset category replacement life until the replacement volume in the first year of the forecast period equals the average actual replacement volume achieved in the previous regulatory period. A key part of the model's functionality is the 'calibration' stage, during which the model outputs are 'forced' to align to recent past replacement volumes by adjusting input parameters.

The majority asset lives derived by the calibrated REPEX model for Energex exceed industry best practice and provides a measure of the extent to which assets are exceeding industry best practice. On average the theoretical asset lives exceeds the industry expectation by 11 years representing approximately 19% life extension. In individual asset categories, AER's theoretical asset lives exceed the industry average with up to 43 years.

For example, a theoretical life of 85 years was calculated for 33kV circuit breakers and 66kV overhead conductors when the industry norm is for replacement anywhere between 45 - 60 years respectively. Communication and control equipment such as Audio Frequency Load Control (AFLC) devices received a calibrated asset life of 35 years whereas industry experience is 15 years on average before technologies become obsolete. These results are illustrated in Figure 4 and detailed in Appendix A and provide a summary comparison of the following:

- Energex economic asset life (Energex)
- Calibrated asset life for Energex (AER)
- Industry average asset life range (Jacobs)

The calibrated asset replacement lives established through the REPEX model refers to the replacement backlog existing in Energex's distribution network and inadequate replacement approach over the last five years. Perpetuating this under-investment for asset categories such as poles, switchgear, cable, communication and control asset categories will undermine the integrity of the network and the objectives of continued safe and reliable supply of electricity. Ultimately this results in a degradation of the network performance and exacerbates the future need for asset renewals.

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[6] This document is available from http://www.aer.gov.au/node/18864 (last accessed 6/2/2015).

Figure 3 shows the results of the AER modelled REPEX forecast as applied to Energex and demonstrates the noticeable increase in REPEX following the 2015-2020 regulatory period. It is recognised that the existing replacement backlog results in a sharp step-up in expenditure requirements in the initial year of investment and that the calibration approach provides an alternative that seeks to limit investments to a more tolerable level, however, the extent to which the calibration of asset lives is allowed to unfold in the calibrated REPEX model should be controlled in acknowledgement of the need to address a growing asset replacement backlog and maintaining network integrity. Introducing a maximum limit to which the calibrated asset lives are allowed to extend results in a more sustainable investment profile over the long term and is also demonstrated in Figure 3.

Figure 3 : Modelled REPEX forecast

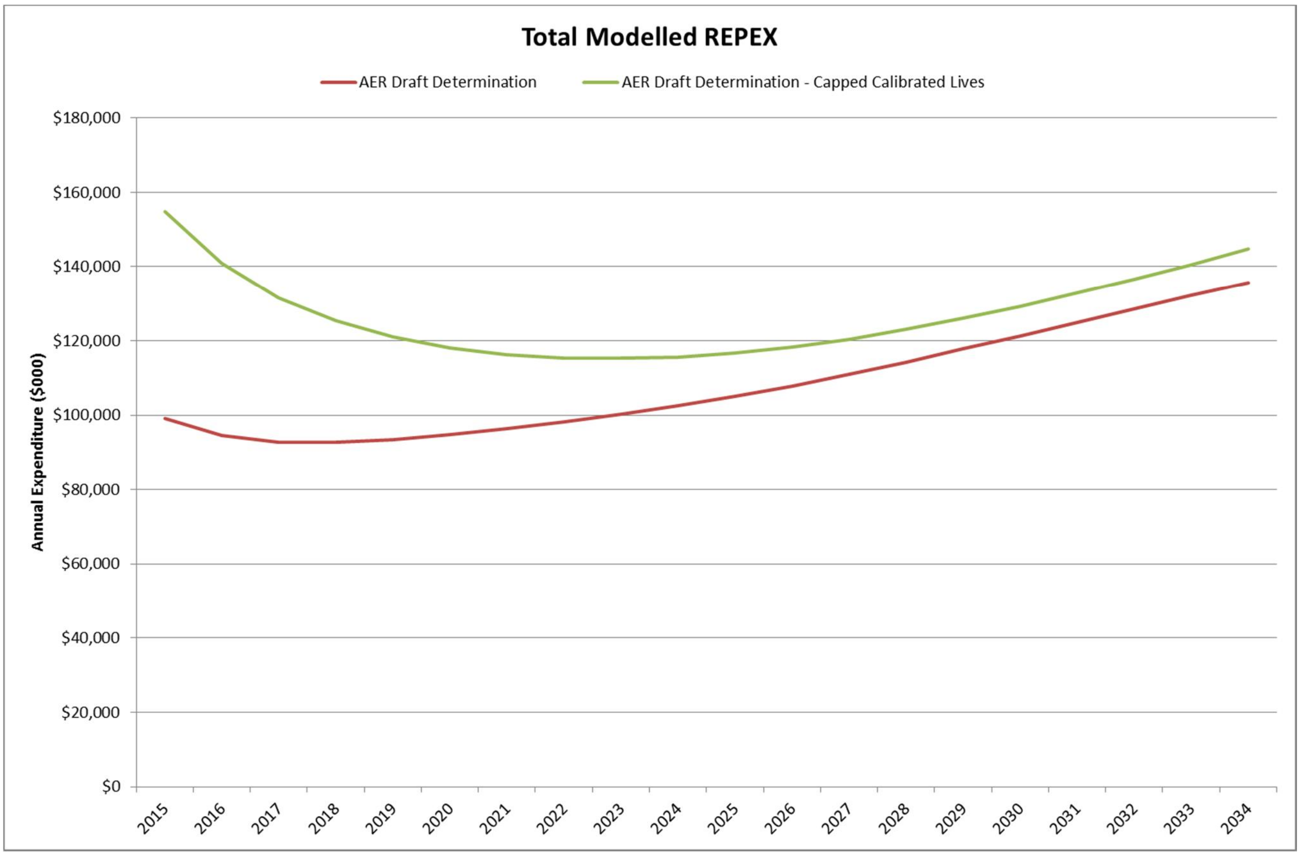
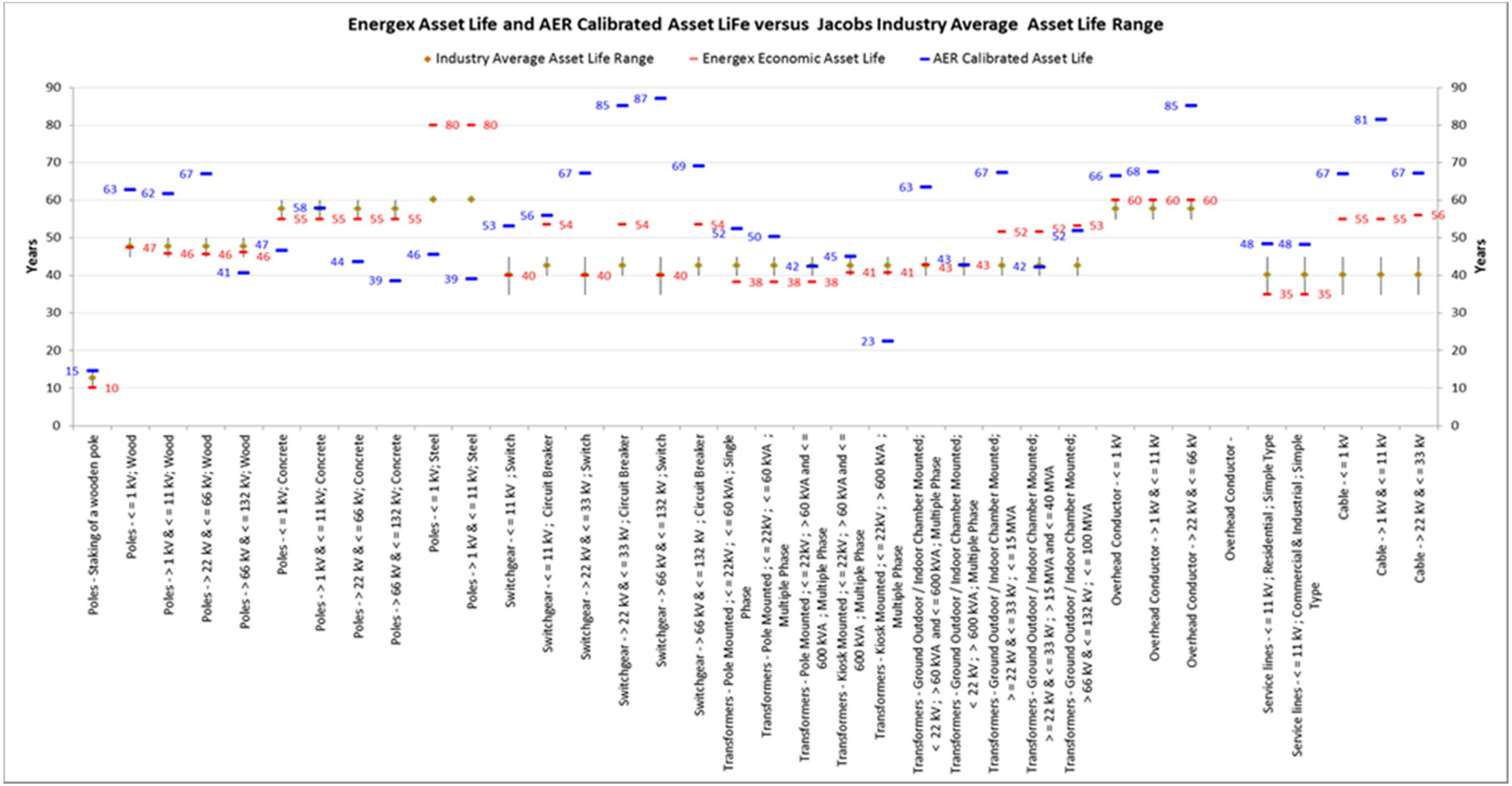


Figure 4 : Energex Economic Asset Lives and AER Calibrated Asset Lives versus Industry Average Asset Life Ranges

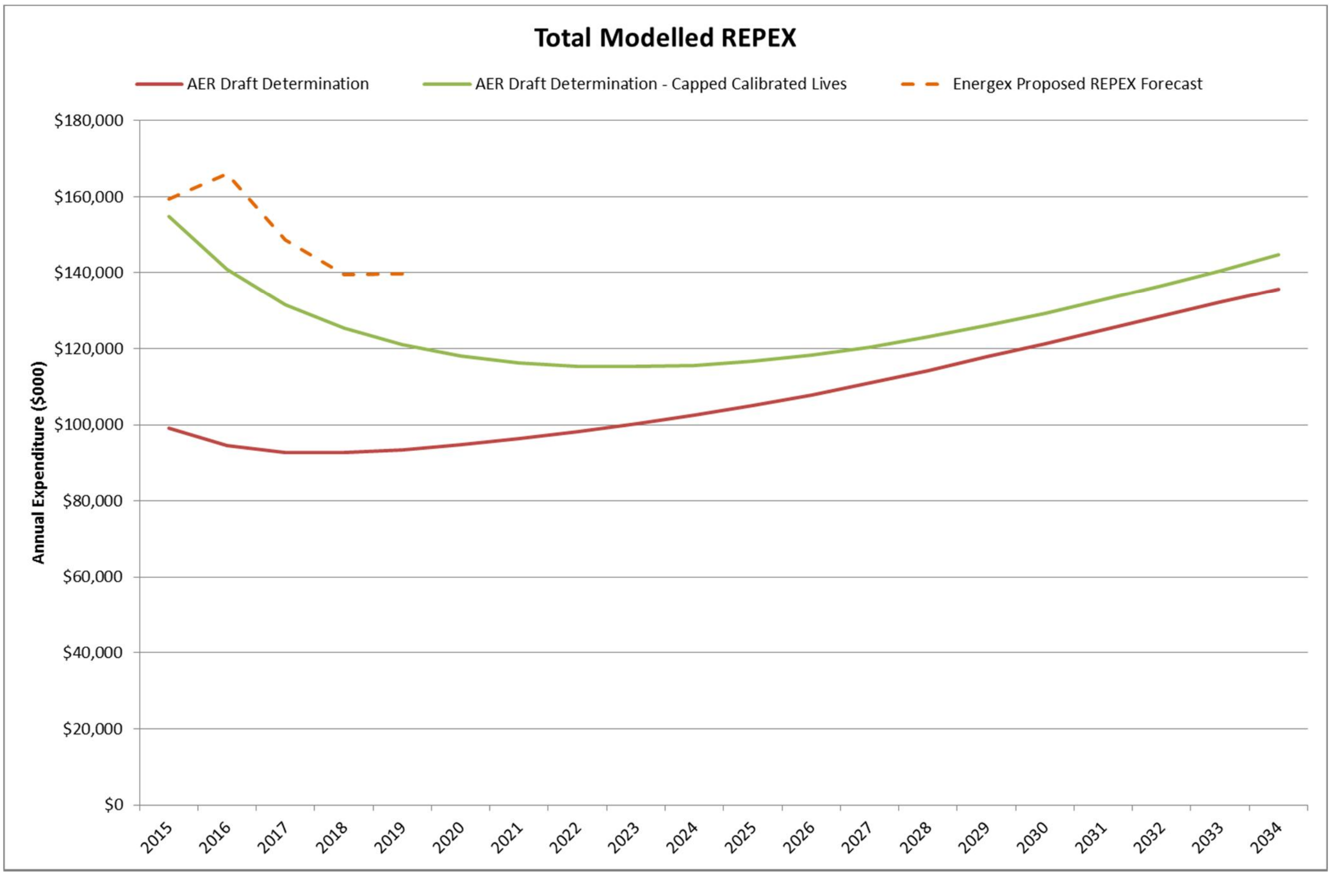


We acknowledge that the replacement backlog existing in the Energex network results in an unworkable modelled expenditure requirement in the initial year of investment as noted by the AER in analysing the results of the base case REPEX model. We also recognise that the calibrated REPEX model approach provides an alternative forecast that seeks to limit investments to a more tolerable level, however, the extent to which the calibration of asset lives is allowed to unfold in the calibrated REPEX model should be controlled in acknowledgement of the need to address a growing asset replacement backlog and to maintain network integrity. Introducing a maximum limit to which the calibrated asset lives are allowed to extend provides necessary flexibility in the investment forecast to address this growing concern. Applying a calibration asset life cap results in the long term investment profile demonstrated in Figure 5. This profile provides for a more reasonable replacement investment in initial years than under the base case scenario, whilst recognising inadequate investments in the current five year regulatory period.

The total REPEX for the 2015 to 2019 regulatory period, resulting from the capped calibrated asset life approach is $674 million, a 43% increase on the AER's preliminary decision of $472 million. Over the longer term, 20 years, the increase in REPEX investment is only 18% or $380 million.

In comparison with Energex's original proposed REPEX forecast and considering the modelled asset categories only, the capped calibrated life forecast is around $80 million which is 11% lower.

Figure 5 : Modelled REPEX forecast



4.4 REPEX model calibrated asset life caps

The maximum calibrated asset lives applied in the REPEX model to obtain the results in Figure 3 have been derived from a combination of maximum asset lives achieved in the UK and the calibrated asset lives calculated by AER for Endeavour Energy.

The primary reason for considering the UK asset lives is that the distribution systems that have been built in Australia over the last 50-100 years were based very much on historical British Standards for the design and construction of electrical infrastructure. Early designs of distribution overhead systems were based on original UK designs, including the selection of system voltages and design assumptions for ambient and maximum operating temperatures. Prior to the introduction of Australian and International Standards for the specification of electrical equipment, most major items of equipment (e.g. power transformers, switchgear, cable, etc.) were purchased to British Standards. We are therefore of the opinion that much can be learned about the life expectancy of distribution systems in Australia by studying the experiences of utilities in the UK.

The UK standard asset classes are predicted to achieve an average economic life of around 10 years greater than currently expected in Australia. This can be seen from Table 11 in Appendix C (section C.7.3.2). We are unaware of any differences in technical, environmental, or operational reasons that would explain the longer asset life expectancy in the UK, and it may be that in due course and with greater experience in the managing of ageing assets, that Australian utilities may also realise longer average asset life expectancy.

For benchmarking purposes Energex compares well with Endeavour Energy on the basis of customer and network density and network age. Benchmarking undertaken by the AER also indicates a good comparison in REPEX by customer density and capacity density, and with general similarities in operational approach. Endeavour Energy's estimated asset lives, which have been accepted by the AER, are on average 13% (or 7 years) longer than the Jacobs industry average lives with the longest asset life exceeding the industry average by 24 years. We consider Endeavour Energy's benchmark asset lives to provide a reasonable alternative to Energex's economic asset lives, providing flexibility for the adjustment of replacement volumes to address the replacement backlog.

The calibrated asset life caps applied in the modelling are provided in Figure 6 in comparison of the following:

- Industry average asset life range (Jacobs)
- Calibrated asset life for Energex (AER)
- Calibrated asset life caps (Jacobs)

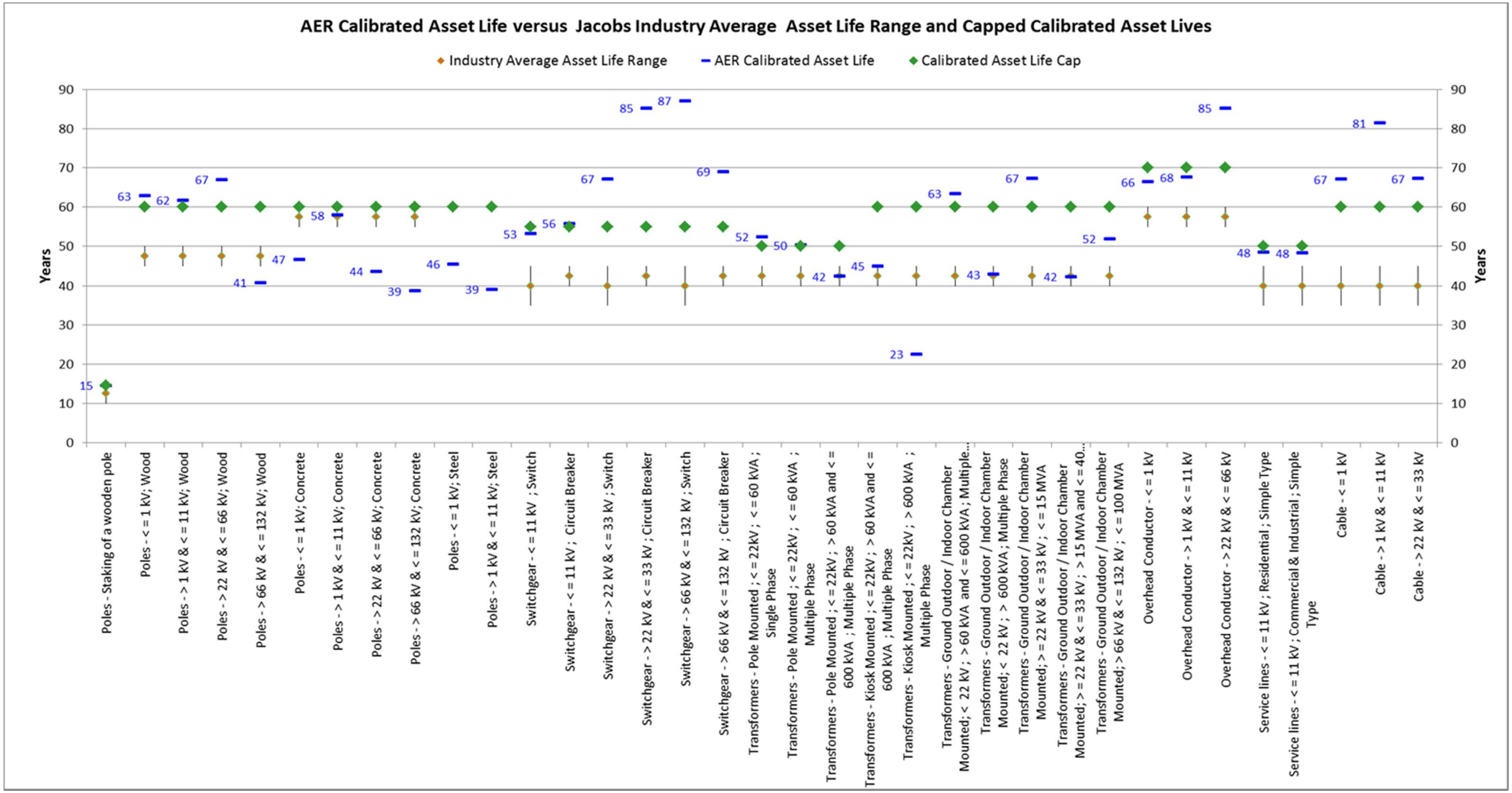
On average the capped calibrated asset lives exceeds the industry expectation by 12 years and at individual asset categories the capped asset lives exceeds the industry average with up to a maximum of 20 years.

In applying the proposed maximum asset life limits not every asset category was capped. The Jacobs proposed capped lives used the AER determination asset lives, except when these were higher than the proposed capped asset lives. Table 1 provides a summary of the calibrated asset lives that were capped in the modelling.

Table 1 : AER calibrated asset lives capped

Group	Category	AER Calibrated Asset Life	Jacobs proposed Capped Asset Life	Endeavour Calibrated Asset Life	Variance of AER Calibrated Life to Capped Asset Life
Poles	> 22 kV & < = 66 kV; wood	67	60	58	7
Poles	> 22 kV & < = 66 kV; steel	80	60	58	20
Poles	> 66 kV & < = 132 kV; steel	80	60	62	20
OH Conductors	> 22 kV & < = 66 kV	85	75	55	10
OH Conductors	> 66 kV & < = 132 kV	96	75	55	21
UG Cables	< = 1 kV	67	60	44	7
UG Cables	> 1 kV & < = 11 kV	81	60	39	21
UG Cables	> 22 kV & < = 33 kV	67	60	46	7
Transformers	Ground outdoor / indoor chamber mounted; > = 22 kV & < = 33 kV ; < = 15 MVA	67	60	66	7
Switchgear	> 22 kV & < = 33 kV ; switch	67	55	n/a	12
Switchgear	> 22 kV & < = 33 kV ; circuit breaker	85	55	47	30
Switchgear	> 33 kV & < = 66 kV ; switch	67	55	n/a	12
Switchgear	> 66 kV & < = 132 kV ; switch	87	55	n/a	32
Switchgear	> 66 kV & < = 132 kV ; circuit breaker	69	55	40	14

Figure 6 : Energex Economic Asset Lives and AER Calibrated Asset Lives versus Industry Average Asset Life Ranges and Capped Calibrated Asset Lives



5. Comparison of unit costs

5.1 Unit replacement cost

Unit cost is a key input to forecasting the expenditure requirements associated with asset replacements and is defined as the average cost to replace one unit within an asset category.

The AER seeks to identify a set of applicable benchmark unit costs that reasonably reflects recent expenditure levels for a utility. This is achieved by either using the average annual actual historical replacement expenditure or adjusting the proposed unit costs to match historic costs indexed by the consumer price index (CPI), or by scaling the proposed asset category unit costs utilising historical costs for the appropriate asset group. In circumstances where the AER is not satisfied that historical replacement expenditure reflect prudent and efficient expenditure, other benchmark DNSP unit costs may be used.

The Jacobs proposed industry unit costs used in evaluating the AER's and Energex replacement expenditure represent the average cost of replacing existing assets in an Australian electricity distribution utility. These unit costs have been developed from market price surveys, procurement cost surveys, multiple and recent unit cost reviews, and asset valuations undertaken over the past 15 years and are reflective of typical costs experienced in a cost competitive market. We consider the Jacobs industry unit costs to be a justifiable gauge for assessing the appropriateness of the unit costs applied by Energex and the AER.

The AER states in their draft determination that they consider the best estimate of business as usual REPEX for Energex is provided by using unit costs derived from Energex's recent forecast expenditure. However, in developing the business as usual REPEX forecast for Energex the AER then decided to use Energex's historical unit costs on the basis that:

> *'There is a significant difference between the calibrated scenario outcomes when using Energex's historical or forecast unit costs. Energex's forecast unit costs for the next five years are, on average, higher than its unit costs over the last five years. However, in the absence of a reasonable explanation, we would not expect forecast unit costs to be higher than historical unit costs given the incentive framework encourages a distributor to become more cost efficient over time.'*[7]

AER also states in their draft determination that a comparison of Energex's historical unit costs against benchmark DNSP unit costs where undertaken and suggested them to more likely reflect a realistic expectation of future costs than its forecast unit costs.

> *'We compared Energex's historical unit costs to benchmark unit costs. This suggested Energex's historical unit costs are more likely to reflect a realistic expectation of future input costs than its forecast unit costs. Accordingly, we adopted Energex's historical unit costs for the purpose of calculating a business as usual repex estimate.'*

We prepared a comparison of the AER modelled REPEX using Energex's historical and forecast unit costs as calculated by the AER as well as Energex's submitted forecast units costs against REPEX modelled using benchmark unit costs used by the AER in recent determinations and Jacobs Industry unit costs. The results are illustrated in Figure 7.

The AER benchmark REPEX provided a REPEX forecast which is very much comparable with the Jacobs industry average forecast at 10% higher. The AER REPEX forecast determined for Energex using historical unit costs fall far short when compared with the AER benchmark and Jacobs industry average forecast. At 73% variance the AER determination forecast is nearly half that of the AER benchmark forecast and cannot be considered reflective of a realistic expectation of future input costs.

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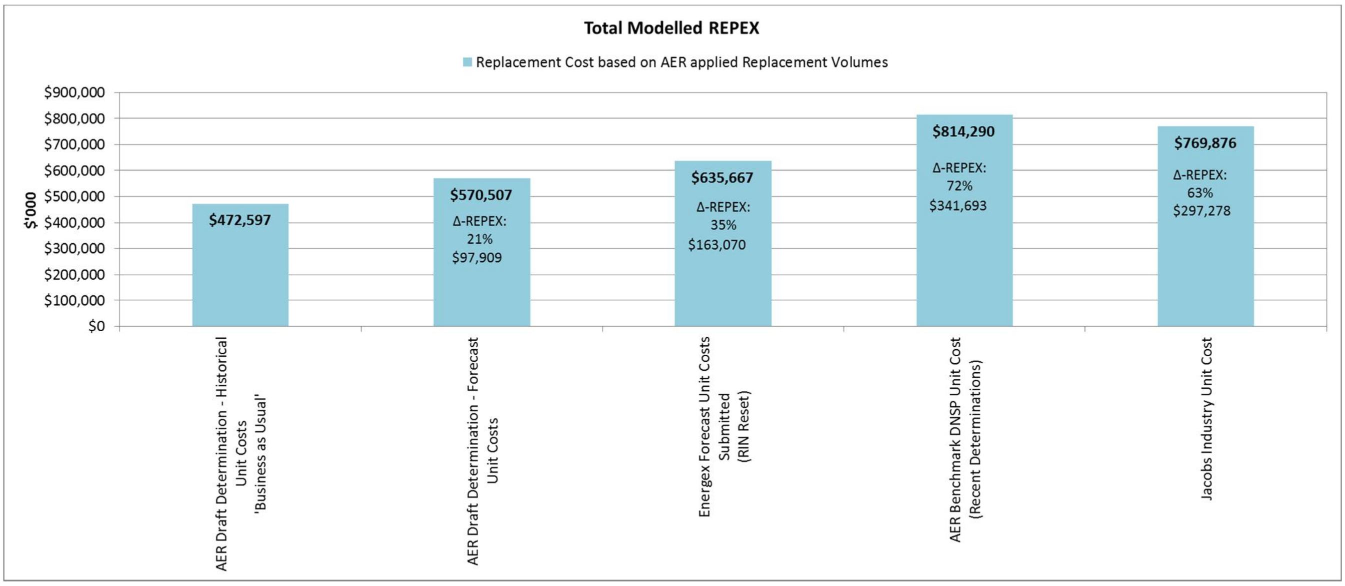
[7] PRELIMINARY DECISION, Energex determination 2015−16 to 2019−20, Attachment 6 − Capital expenditure, April 2015

Figure 7 : AER Determined REPEX in comparison with Forecast and Benchmark REPEX



Energex's submitted forecast unit costs provided a REPEX forecast which at 28% and 21% variance with the AER benchmark and the Jacobs industry calculated forecasts provides a better comparison, however still falling short of industry expectations.

The AER's calculated forecast unit costs provided a REPEX forecast of $571 million which is comparable to the Energex forecast at a variance of 11% lower, however still well below industry experience.

Adopting the AER's calculated forecast unit costs result in the expenditure profile shown in Figure 8. As expected it provides a relative uniform increase in expenditure over the regulatory forecast period and a total 21% increase from the AER determination for the five year regulatory period. In comparison with Energex's original proposed REPEX forecast the AER forecast falls around 24% short.

5.2 Unit Cost Review

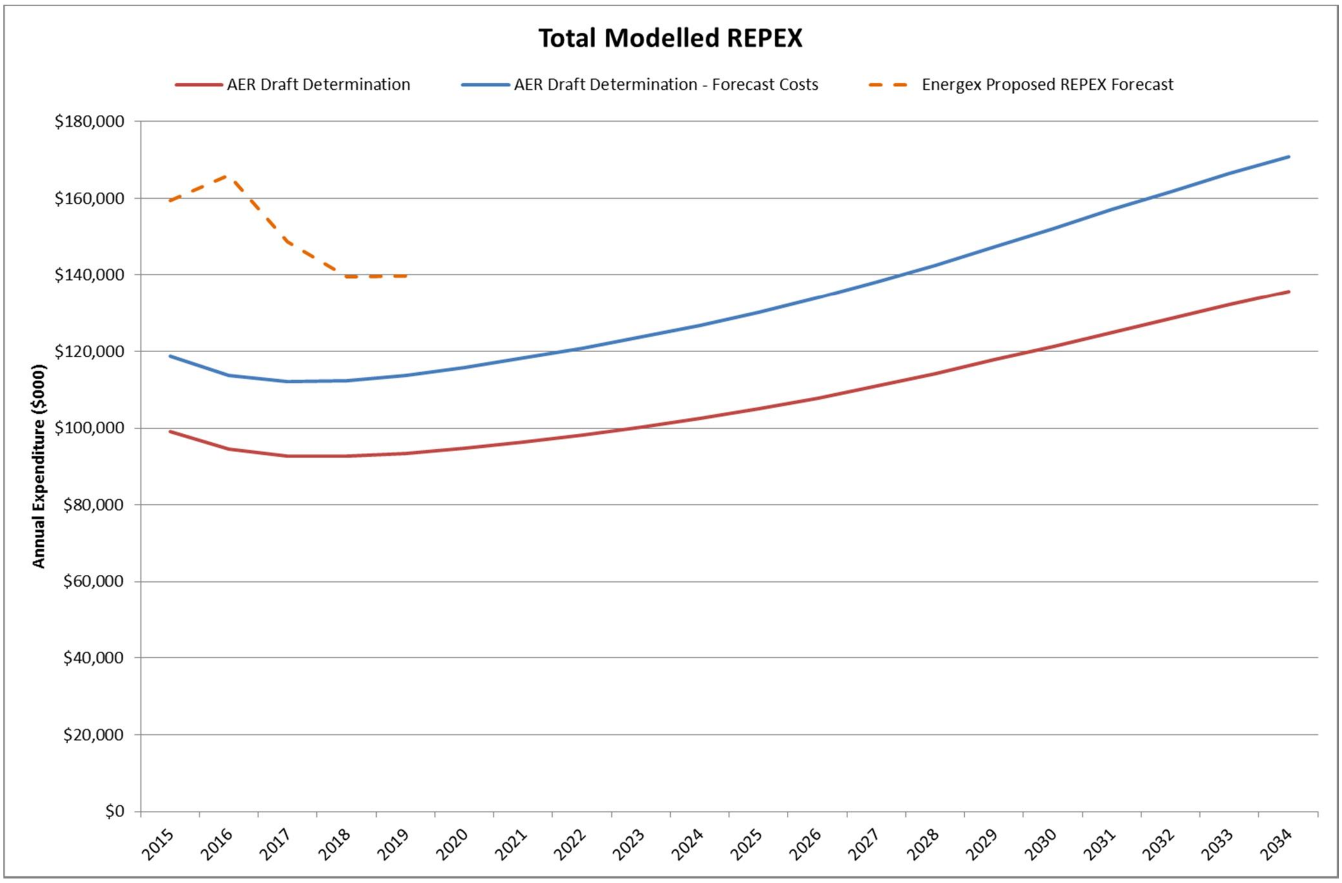
We undertook a high level review of AER's proposed 'business as usual' forecast unit costs and the AER calculated forecast unit costs against DNSP benchmark unit costs applied by the AER in other recent determinations and Jacobs industry average unit costs. Figure 9 illustrates the variances between the AER's calculated forecast unit costs, both the 'business as usual' as applied in the draft determination and the forecast unit costs which was rejected, against the industry benchmark unit costs.

It is noticeable that in all scenarios the majority of the AER calculated unit costs are lower or equivalent to both the industry benchmark unit costs. On a quantity weighted average basis the AER 'business as usual' unit costs, excluding service line, underground cable, and switchgear outliers are 60% lower than AER benchmark unit costs, whereas the AER calculated forecast unit costs are within 10% and 20% of the Jacobs industry and the AER benchmark unit costs respectively.

We therefor consider the AER calculated forecast unit costs to be more commensurable with industry experience and likely to provide a sustainable level of REPEX to maintain the safety, service quality, security and reliability of the Energex network consistent with current obligations.

The unit costs applied by the AER were calculated using cost and volume data provided by Energex through the Regulatory Information Notice (RIN) process. It appears however that the AER may have used an incomplete set of RIN data resulting in instances where unworkable unit costs were determined. For example, the replacement unit costs for service lines are unrealistically low at $104 per service line. The AER calculated the unit costs apportioning a single year (2014/15) actual cost over the current five year regulatory period to determine an annual 'business as usual' unit cost.

Figure 8 : AER Forecast REPEX in comparison with the AER determined REPEX



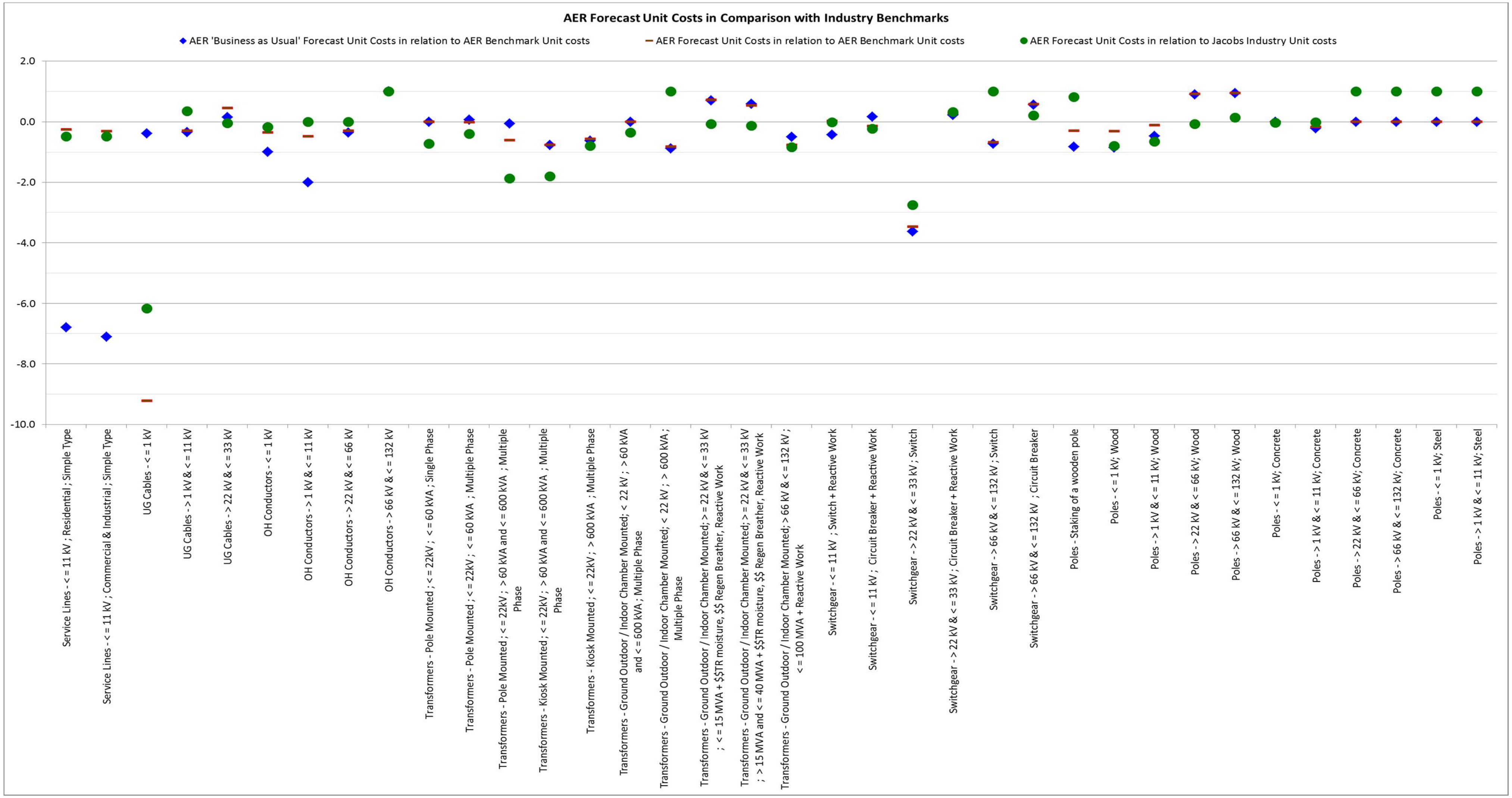
Energex advised that the unit cost data in the RESET RIN and used by the AER in its calculations appears to include anomalies. In the case of service lines the anomaly appears to have been caused by a change in the allocation of replacement activities to expenditure programs.

Overhead service line replacements were historically undertaken as part of the customer services program and have since been moved to be included in the asset replacement program. Historical unit cost for service line replacements were thus submitted in the RESET RIN under the customer services submission. The service line replacement unit cost in the RESET RIN appears to an apportionment from other programs only.

The replacement volumes also appear to only represent a single year of replacement volume captured under the new allocation in the asset replacement program. To obtain a realistic replacement expenditure forecast for service lines it would be necessary for Energex to provide updated unit cost and replacement units in the REPEX model.

Energex submitted their category analysis RIN in May 2014 and provided expenditure and replacement data for financial years 2008/09 to 2012/13. The expenditure data submitted at the time were based on actual REPEX spend during the period 2008/09 to 2012/13. However, the replacement volumes for 2008/09 to 2011/12 were based on commissioned plant for the period 2008/09 to 2011/12, whereas the 2012/13 volumes included a combination of actual commissioned plant and projects with expenditure spanning multiple financial years including 2012/13. The data used by the AER in their determination thus include high replacement volumes for which costs had not been realised at the time resulting in low historical unit costs in comparison with forecast unit costs. For example 131 replacement units were reported in 2012/13 for 11kV circuit breakers, whereas only 28 were actually commissioned. An update of the replacement volumes reported for 2012/13 are likely to see a substantially reduction in the difference between the calculated ‘historical’ and ‘forecast’ unit costs.

Figure 9 : AER Forecast Unit Costs in comparison with AER Benchmark and Jacobs Industry Unit Costs



6. Overview and Findings of the AER REPEX model as applied to Energex

In assessing how the AER applied the REPEX model to Energex, we studied the two key input components of the model which are:

- Replacement lives
- Replacement unit costs

Our review identified the following main considerations associated with the individual inputs.

The REPEX model is extremely sensitive to changes in asset lives which are directly related to Energex's asset age profile. A 10% extension in asset lives results in a 40% reduction in total REPEX and a 10% reduction in asset lives result in an 80% increase in total REPEX. This sensitivity puts an emphasis on having a balanced approach to adjusting asset lives.

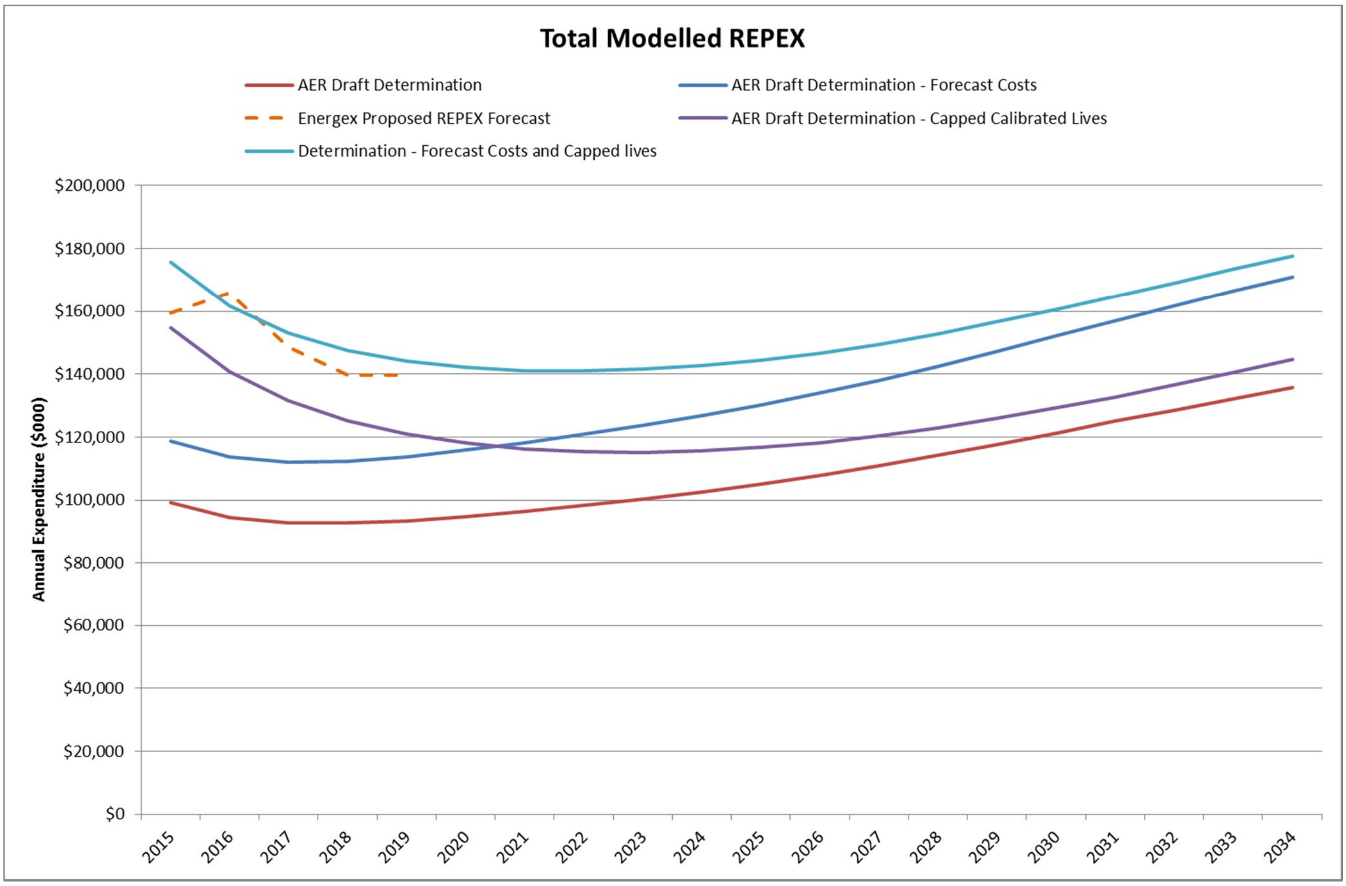
The need to influence the model output by adjusting asset lives to overcome the impractical expenditure forecast emanating from replacement backlogs are recognised; however a balanced approach is proposed through the introduction of an upper limit to which asset lives are allowed to unfold during the calibration process. Applying a maximum asset life develops the resilience of the model necessary to establish a reasonable and sustainable expenditure forecast. Applying a set of maximum asset lives developed through a study of national and UK asset lives provided a more sustainable expenditure forecast profile. The total REPEX forecast using the capped asset lives is $674 million compared with AER's determination of $472 million.

Changes to the unit costs as would be expected changes the REPEX forecast in a corresponding manner; that is, an increase in the unit costs results in a higher REPEX forecast. The unit costs applied in the AER preliminary determination are too low to provide a sustainable replacement forecast and has been calculated based on incomplete historical data drawn from the RIN submissions. The forecast unit rates calculated by the AER are more comparable with Energex's submitted unit costs resulting in a 10-15% variance in total REPEX with the AER forecast being lower. We consider the AER forecast unit costs to be better aligned with industry experience and more likely to result in a sustainable level of REPEX forecast. The total REPEX forecast using the AER calculated forecast unit costs is around $571 million compared to the AER's determination of $472 million.

The analysis revealed anomalies associated with the Energex data that were submitted via the RIN process including unintentional inflation of historical replacement volumes, incomplete replacement volumes, and incomplete historical expenditure data resulting from internal movements in the allocation of replacement programs between cost categories and the inclusion of work-in-progress data. Should data corrections be undertaken it is very likely that the step increase between 'historical' and 'forecast' unit costs calculated by the AER would reduce significantly.

Combining the introduction of the proposed maximum asset life limits and applying the forecast unit costs calculated by the AER we modelled the REPEX forecast as illustrated in Figure 10. Our independent modelling produced a REPEX forecast highly comparable to Energex's originally submitted expenditure forecast. It is our conclusion that the REPEX forecast developed by Energex and shown in Figure 10 demonstrates the reasonable, appropriate and sustainable level of expenditure required to maintain the safety, service quality, security and reliability of the Energex network consistent with current obligations.

Figure 10 : Total modelled REPEX



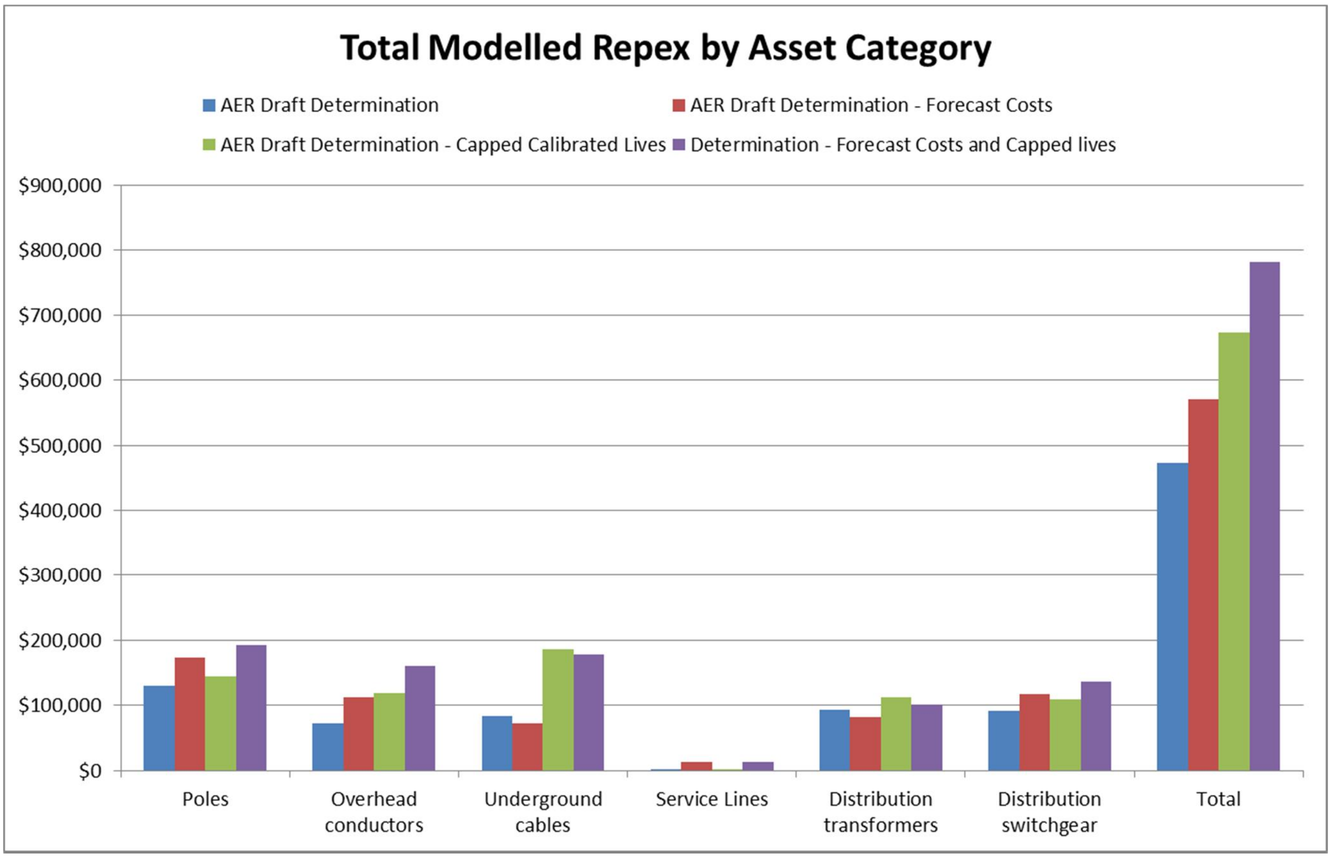
The modelled REPEX forecasts for the regulatory period in comparison with the AER Draft Determination are provided in Table 2.

Table 2 : Modelled REPEX

Model Scenario	Total Modelled REPEX for Regulatory Period	$ Variance to AER Draft Determination	% Variance to AER Draft Determination
AER Draft Determination	$ 472,597	$ -	0%
AER Draft Determination - Forecast Costs	$ 570,507	$ 97,909	21%
AER Draft Determination - Capped Calibrated Lives	$ 673,525	$ 200,928	43%
Determination - Forecast Costs and Capped lives	$ 782,315	$ 309,717	66%

A key contributor to the uplift in REPEX over the regulatory period is underground cables, with the capped calibrated asset life being the main driver. The other asset categories are relatively comparable as demonstrated in Figure 11.

Figure 11 : Modelled REPEX forecast by asset category



Appendix A. Comparison of asset lives

Table 3 provides a summary of Energex's economic asset lives and AER's calibrated asset lives in comparison with industry experience asset life ranges. The majority asset lives derived by AER for Energex in the calibrated REPEX model exceed industry best practice.

Table 3 : Asset life adjustments (years)

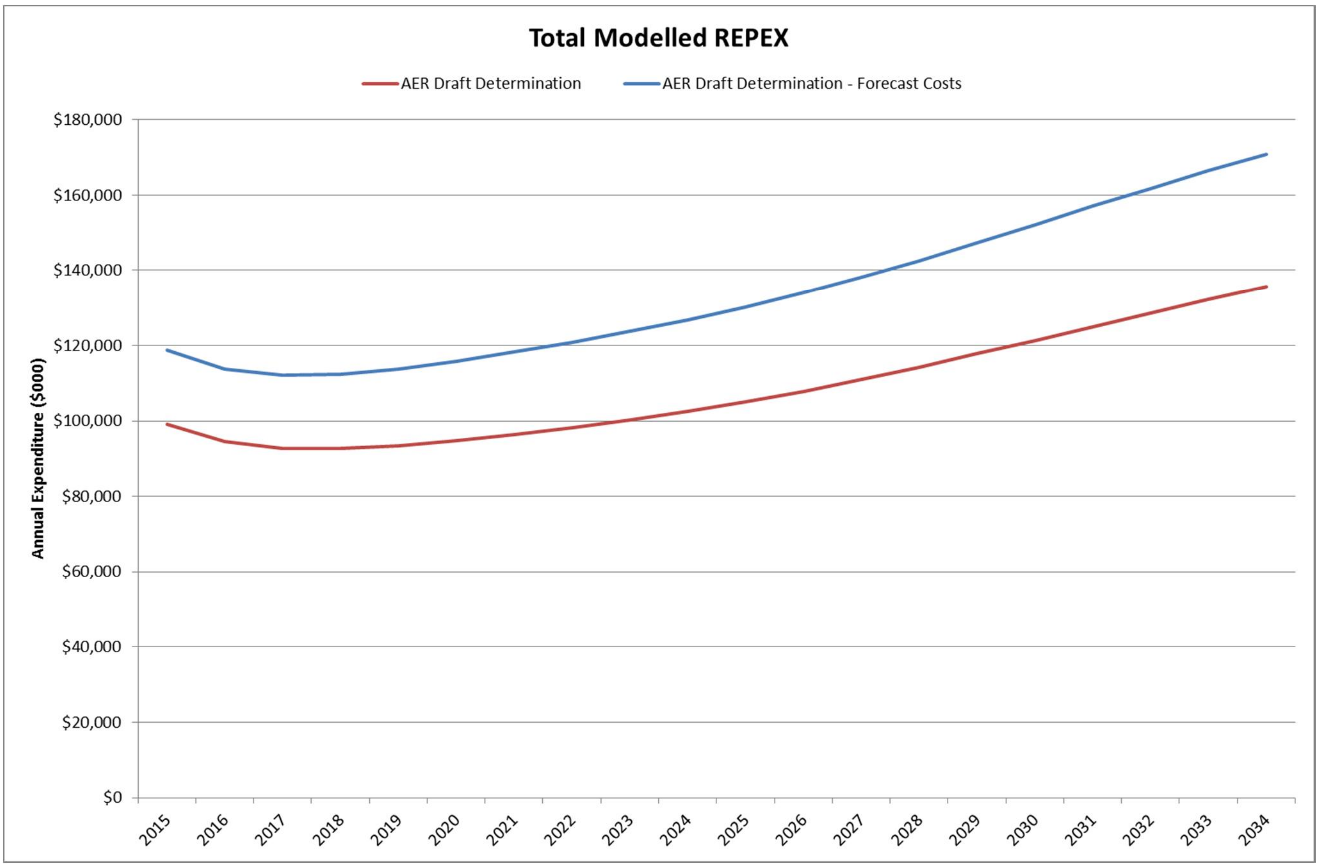
Asset Category	Energex Economic Asset Life	AER Calibrated Asset Life	Jacobs Industry Asset Life
Poles - Staking of a wooden pole	10	15	10 - 15
Poles - < = 1 kV; Wood	47	63	45 - 50
Poles - > 1 kV & < = 11 kV; Wood	46	62	45 - 50
Poles - > 22 kV & < = 66 kV; Wood	46	67	45 - 50
Poles - > 66 kV & < = 132 kV; Wood	46	41	45 - 50
Poles - < = 1 kV; Concrete	55	47	55 - 60
Poles - > 1 kV & < = 11 kV; Concrete	55	58	55 - 60
Poles - > 22 kV & < = 66 kV; Concrete	55	44	55 - 60
Poles - > 66 kV & < = 132 kV; Concrete	55	39	55 - 60
Poles - < = 1 kV; Steel	80	46	60
Poles - > 1 kV & < = 11 kV; Steel	80	39	60
Switchgear - < = 11 kV ; Switch	40	53	35 - 45
Switchgear - < = 11 kV ; Circuit Breaker	54	56	40 - 45
Switchgear - > 22 kV & < = 33 kV ; Switch	40	67	35 - 45
Switchgear - > 22 kV & < = 33 kV ; Circuit Breaker	54	85	40 - 45
Switchgear - > 66 kV & < = 132 kV ; Switch	40	87	35 - 45
Switchgear - > 66 kV & < = 132 kV ; Circuit Breaker	54	69	40 - 45
Transformers - Pole Mounted ; < = 22kV ; < = 60 kVA ; Single Phase	38	52	40 - 45
Transformers - Pole Mounted ; < = 22kV ; < = 60 kVA ; Multiple Phase	38	50	40 - 45
Transformers - Pole Mounted ; < = 22kV ; > 60 kVA and < = 600 kVA ; Multiple Phase	38	42	40 - 45
Transformers - Kiosk Mounted ; < = 22kV ; > 60 kVA and < = 600 kVA ; Multiple Phase	41	45	40 - 45
Transformers - Kiosk Mounted ; < = 22kV ; > 600 kVA ; Multiple Phase	41	23	40 - 45
Transformers - Ground Outdoor / Indoor Chamber Mounted; < 22 kV ; > 60 kVA and < = 600 kVA ; Multiple Phase	43	63	40 - 45
Transformers - Ground Outdoor / Indoor Chamber Mounted; < 22 kV ; > 600 kVA ; Multiple Phase	43	43	40 - 45
Transformers - Ground Outdoor / Indoor Chamber Mounted; > = 22 kV & < = 33 kV ; < = 15 MVA	52	67	40 - 45
Transformers - Ground Outdoor / Indoor Chamber Mounted; > = 22 kV & < = 33 kV ; > 15 MVA and < = 40 MVA	52	42	40 - 45
Transformers - Ground Outdoor / Indoor Chamber Mounted; > 66 kV & < = 132 kV ; < = 100 MVA	53	52	40 - 45
Comms & Controls - Field Devices	29	29	10 - 15
Comms & Controls - Local Network Wiring Assets	50	50	35 - 40

Asset Category	Energex Economic Asset Life	AER Calibrated Asset Life	Jacobs Industry Asset Life
Comms & Controls - Communications Network Assets	12	12	10 - 15
Comms & Controls - Master Station Assets	5	5	10 - 15
Comms & Controls - Communications Site Infrastructure	21	35	10 - 15
Comms & Controls - Communications Linear Assets	35	21	10 - 15
Comms & Controls - AFLC	26	27	10 - 15
Overhead Conductor - < = 1 kV	60	66	55 - 60
Overhead Conductor - > 1 kV & < = 11 kV	60	68	55 - 60
Overhead Conductor - > 22 kV & < = 66 kV	60	85	55 - 60
Pole Top - < = 1 kV	35	35	45 - 50
Pole Top - > 1 kV & < = 11 kV	35	35	45 - 50
Pole Top - > 11 kV & < = 22 kV	35	35	45 - 50
Pole Top - > 22 kV & < = 66 kV	35	35	45 - 50
Pole Top - > 66 kV & < = 132 kV	40	40	45 - 50
Service lines - < = 11 kV ; Residential ; Simple Type	35	48	35 - 45
Service lines - < = 11 kV ; Commercial & Industrial ; Simple Type	35	48	35 - 45
Cable - < = 1 kV	55	67	35 - 45
Cable - > 1 kV & < = 11 kV	55	81	35 - 45
Cable - > 22 kV & < = 33 kV	56	67	35 - 45
Public Lighting - Luminaires ; Major Road	20	20	20
Public Lighting - Luminaires ; Minor Road	20	20	20
Public Lighting - Brackets ; Major Road	43	43	20
Public Lighting - Brackets ; Minor Road	43	43	20
Public Lighting - Lamps ; Major Road	4	4	20
Public Lighting - Lamps ; Minor Road	5	5	20
Public Lighting - Poles / Columns ; Major Road	43	43	20
Public Lighting - Poles / Columns ; Minor Road	43	43	20

Appendix B. Sensitivity analysis – data & results

We tested the sensitivity of the REPEX model forecasts to change in the unit cost and the asset life parameter. For unit costs the results were much as expected, a change in the unit cost, which are on average higher in the forecasts, results in a linear and uniform increase in the expenditure forecast. Figure 12 provides a summary of the results.

Figure 12 : Unit Cost Sensitivity Analysis of Energex’s REPEX forecast using the AER model



Changing the mean asset lives has a more drastic impact. The REPEX model was found to be extremely sensitive, and absolutely particular, to the age profile of the modelled assets.

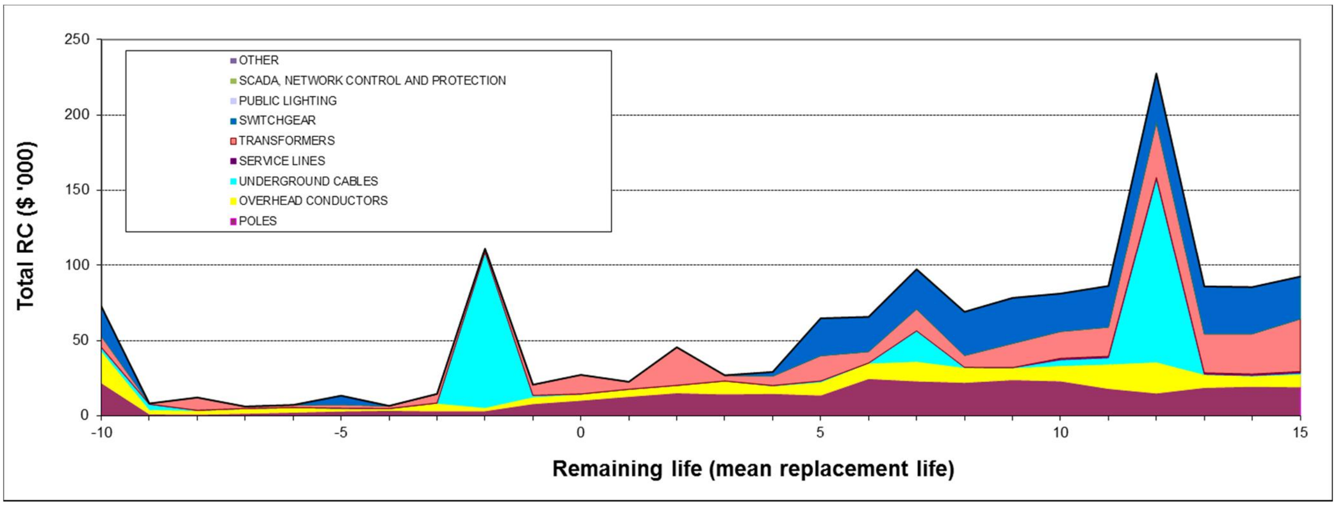
The model uses a conditional forecasting methodology in that all listed assets are assumed to have survived until the beginning of the forecast, but their failure characteristics are uniform. For example if the mean life of an asset group is 20 years, and there is an asset listed as 50 years old, that asset is not treated differently, the model assumes that it is an extremely unlikely outlier by surviving this long, and therefore extremely likely to need immediate replacement. Since any real asset population is made of equipment in different environments, of varying quality and subject to any number of other factors, replacement is never entirely dependent on age. But because the model assumes it is, when a realistic replacement age is applied it generally concludes that there is a lot of equipment that needs to be replaced immediately and it produces results that can be unworkable in the first few years of the forecast.

The ‘calibration phase’ introduces a means of adjusting the model inputs to produce a more pragmatic expenditure forecast. The calibration is applied by adjusting the mean asset replacement life until the first year of the forecast is similar to observed replacements in the past, a business as usual scenario. In the absence of a more robust approach this method provides a useful alternative, however it introduces an important confusion to the terminology of the model. By the time the calibration is completed, the ‘mean life’ is only tangentially related to the age at which an asset might reasonably survive. It’s only a factor which attempts to compensate for all the variables which impact on asset replacement apart from age and is entirely dependent on the age profile of the asset.

Adjusting the calibrated asset life in the model has a dramatic impact on the results of the model, which is directly, related to the age profile of the assets. An age profile where large numbers of assets where installed over a short period of time could deliver significant swings in the REPEX requirements from on year to the next especially if these assets are reaching replacement age. A more moderate age profile with assets introduced over a longer period of time would produce less volatility in replacement requirements from one year to the next.

The Energex network has been developing over the last 90 years with a large number of assets having been installed in the last 50 years. There are however a significant number of assets which are reaching the end of their useful life and that are coming up for replacement. This is demonstrated in Figure 13. It is these aging assets that are contributing to the volatility of the model results. Underground cables, transformers and switchgear are particular examples.

Figure 13 : Energex Asset Remaining Life profile



The sensitivity of the model on the total REPEX forecast is illustrated in Figure 14 and detailed in Table 6, Table 7, Table 8 and Table 9.

The sensitivity analysis was undertaken using Energex's proposed REPEX forecast as a reference and the expenditure predicted by the calibrated REPEX Tool. An adjustment extending and reducing the overall mean asset lives in the REPEX model with 10% was made.

The 10% extension in asset lives resulted in a 40% drop in the 2015-2020 forecast expenditure, while decreasing the lives by 10% increased forecast expenditure by up to 80%.

The extreme sensitivity of the model to changes in the mean asset lives as applied to Energex, places a strong emphasis on making sure that the calibration of the asset lives are controlled and consideration is given to individual asset categories based on the age profile and replacement requirements.

Specific asset categories were not equally sensitive to a change in the mean life parameter; Table 4 and Table 5 show the differences in forecast expenditure of individual asset categories between the calibrated model and the 10% sensitivity scenarios.

Figure 14 : Sensitivity Analysis of Energex's REPEX forecast using the AER model

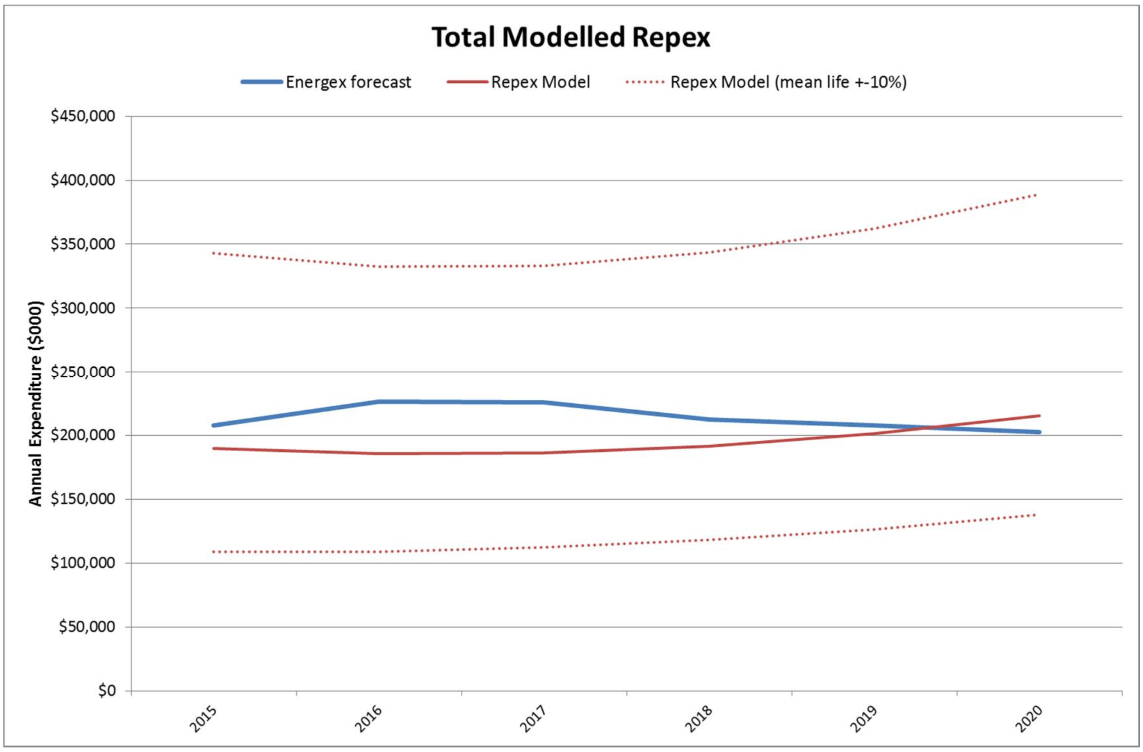


Table 4 shows the difference extending all mean lives with 10% has on total forecast expenditure in the 2015 – 2020 period, by asset category. All figures are expressed in absolute terms, though increasing the mean life results in a decrease in forecast expenditure relative to the reference scenario. Over 25% of the total difference is accounted for by two asset categories – 11kV switches in the Switchgear group and communications linear assets in the Protection/SCADA group.

Table 4 : Results for all asset categories for sensitivity analysis - mean life plus 10% relative to base scenario

Asset Group	Asset Category	Change relative to base scenario ($000)
Distribution switchgear	< = 11 kV ; switch	$ 61,874
Protection/SCADA	Communications linear assets	$ 59,579
Distribution switchgear	< = 11 kV ; circuit breaker	$ 27,313
Poles	> 1 kV and < = 11 kV ; wood	$ 24,117
Underground cables	> 22 kV and < = 33 kV	$ 21,526
Overhead conductors	< = 1 kV	$ 20,479
Protection/SCADA	Communications network assets	$ 19,366
Pole top structures	> 1 kV and < = 11 kV	$ 18,472
Poles	< = 1 kV ; wood	$ 16,728
Poles	Staking of a wooden pole	$ 16,344
Overhead conductors	> 1 kV & < = 11 kV	$ 15,854
Public lighting	Lamps ; minor road	$ 11,755
Pole top structures	< = 1 kV	$ 11,397
Protection/SCADA	OTE Environment and Services Migration	$ 10,201

Asset Group	Asset Category	Change relative to base scenario ($000)
Distribution switchgear	> 22 kV and < = 33 kV ; circuit breaker	$ 10,023
Public lighting	Lamps ; major road	$ 9,721
Distribution transformers	Pole Mounted ; < = 22kV ; > 60 kVA and < = 600 kVA ; multiple phase	$ 9,213
Protection/SCADA	Field devices	$ 7,958
Distribution transformers	Ground outdoor / indoor chamber mounted ; > = 22 kV and < = 33 kV ; < = 15 MVA	$ 7,712
Distribution transformers	Ground outdoor / indoor chamber mounted ; > = 22 kV and < = 33 kV ; > 15 MVA and < = 40 MVA	$ 7,712
Underground cables	< = 1 kV	$ 7,397
Overhead conductors	OHEW	$ 6,846
Distribution transformers	Ground outdoor / indoor chamber mounted ; > 66 kV and < = 132 kV ; < = 100 MVA	$ 6,390
Protection/SCADA	AFLC	$ 5,848
Distribution transformers	Ground outdoor / indoor chamber mounted ; < 22 kV ; > 600 kVA ; multiple phase	$ 5,020
Poles	> 22 kV and < = 66 kV ; wood	$ 3,736
Distribution transformers	Pole mounted ; < = 22kV ; < = 60 kVA ; multiple phase	$ 3,717
Public lighting	Luminaires ; minor road	$ 3,407
Overhead conductors	> 22 kV and < = 66 kV	$ 3,344
Underground cables	Cable terminations (all voltage)	$ 3,321
Distribution transformers	Kiosk mounted ; < = 22kV ; > 60 kVA and < = 600 kVA ; multiple phase	$ 3,207
Service lines	< = 11 kV ; residential ; simple type	$ 2,486
Pole top structures	> 22 kV and < = 66 kV	$ 1,933
Underground cables	> 1 kV and < = 11 kV	$ 1,576
Overhead conductors	> 66 kV and < = 132 kV	$ 1,489
Distribution switchgear	> 66 kV and < = 132 kV ; circuit breaker	$ 1,484
Public lighting	Brackets ; minor road	$ 1,443
Public lighting	Luminaires ; major road	$ 1,279
Distribution transformers	Kiosk mounted ; < = 22kV ; > 600 kVA ; multiple phase	$ 1,261
Distribution transformers	Instrument transformer (110/132kV) (VT + CT)	$ 833
Poles	> 1 kV and < = 11 kV ; concrete	$ 807
Protection/SCADA	Communications site infrastructure	$ 787
Distribution switchgear	> 22 kV and < = 33 kV ; switch	$ 778
Poles	> 66 kV and < = 132 kV ; wood	$ 519
Distribution transformers	NER (11kV)	$ 471
Distribution switchgear	Planned batteries	$ 268
Public lighting	Brackets ; major road	$ 256
Service lines	< = 11 kV ; Commercial & Industrial ; simple type	$ 217
Public lighting	Poles / Columns ; major road	$ 200
Public lighting	Poles / Columns ; minor road	$ 86

Asset Group	Asset Category	Change relative to base scenario ($000)
Pole top structures	Insulators 110/132kV	$ 14
Protection/SCADA	Local network wiring assets	$ 7
Distribution transformers	Ground outdoor / indoor chamber mounted ; < 22 kV ; < = 60 kVA ; multiple phase	$ -

Table 5 shows the difference reducing all mean lives with 10% has on total forecast expenditure in the 2015 – 2020 period, by asset category. All figures are expressed in absolute terms. Over 50% of the total difference is accounted for by the same two Asset Categories as in the plus 10% scenario – 11kV Switches in the Switchgear group and Communications Linear Assets in the Protection/SCADA group.

Table 5 : Result for Top 20 highest deviations in sensitivity analysis - Mean life minus 10% relative to base scenario - by Asset Category

Asset Group	Asset Category	Change relative to base scenario ($000)
Protection/SCADA	Communications linear assets	$ 386,598
Distribution switchgear	< = 11 kV ; switch	$ 83,150
Poles	> 1 kV and < = 11 kV ; wood	$ 35,169
Overhead conductors	< = 1 kV	$ 29,702
Distribution switchgear	< = 11 kV ; circuit breaker	$ 29,657
Protection/SCADA	Communications network assets	$ 29,266
Underground cables	> 22 kV and < = 33 kV	$ 29,195
Poles	< = 1 kV ; wood	$ 26,654
Overhead conductors	> 1 kV and < = 11 kV	$ 23,362
Pole top structures	> 1 kV and < = 11 kV	$ 20,437
Public lighting	Lamps ; minor road	$ 17,172
Poles	Staking of a wooden pole	$ 16,844
Public lighting	Lamps ; major road	$ 16,095
Distribution switchgear	> 22 kV and < = 33 kV ; circuit breaker	$ 15,353
Distribution transformers	Ground outdoor / indoor chamber mounted ; > = 22 kV and < = 33 kV ; < = 15 MVA	$ 13,395
Pole top structures	< = 1 kV	$ 13,289
Distribution transformers	Pole mounted ; < = 22kV ; > 60 kVA and < = 600 kVA ; multiple phase	$ 12,749
Protection/SCADA	OTE Environment and Services Migration	$ 12,443
Overhead conductors	> 66 kV and < = 132 kV	$ 10,128
Protection/SCADA	Field devices	$ 9,662
Overhead conductors	OHEW	$ 9,194
Distribution transformers	Ground outdoor / indoor chamber mounted ; > 66 kV and < = 132 kV ; < = 100 MVA	$ 8,989
Distribution transformers	Ground outdoor / indoor chamber mounted ; > = 22 kV and < = 33 kV ; > 15 MVA and < = 40 MVA	$ 7,860
Distribution transformers	Ground outdoor / indoor chamber mounted ; < 22 kV ; > 600 kVA ; multiple phase	$ 7,131

Asset Group	Asset Category	Change relative to base scenario ($000)
Protection/SCADA	AFLC	$ 6,628
Poles	> 22 kV and < = 66 kV ; wood	$ 6,114
Overhead conductors	> 22 kV and < = 66 kV	$ 5,881
Public lighting	Luminaires ; minor road	$ 5,670
Underground cables	< = 1 kV	$ 5,555
Distribution transformers	Kiosk mounted ; < = 22kV ; > 60 kVA and < = 600 kVA ; multiple phase	$ 5,193
Distribution transformers	Pole mounted ; < = 22kV ; < = 60 kVA ; multiple phase	$ 4,728
Underground cables	> 1 kV and < = 11 kV	$ 4,024
Underground cables	Cable terminations (all voltage)	$ 3,326
Service lines	< = 11 kV ; residential ; simple type	$ 2,808
Public lighting	Luminaires ; major road	$ 2,662
Public lighting	Brackets ; minor road	$ 2,445
Pole top structures	> 22 kV and < = 66 kV	$ 2,309
Distribution transformers	Kiosk mounted ; < = 22kV ; > 600 kVA ; multiple phase	$ 2,159
Distribution switchgear	> 66 kV and < = 132 kV ; circuit breaker	$ 1,849
Poles	> 1 kV and < = 11 kV ; concrete	$ 1,342
Distribution transformers	Instrument transformer (110/132kV) (VT + CT)	$ 1,223
Protection/SCADA	Communications site infrastructure	$ 909
Distribution switchgear	> 22 kV and < = 33 kV ; switch	$ 793
Distribution transformers	NER (11kV)	$ 691
Poles	> 66 kV and < = 132 kV ; wood	$ 672
Public lighting	Poles / Columns ; major road	$ 601
Public lighting	Brackets ; major road	$ 530
Public lighting	Poles / Columns ; minor road	$ 331
Distribution switchgear	Planned batteries	$ 295
Service lines	< = 11 kV ; Commercial & Industrial ; simple type	$ 244
Pole top structures	Insulators 110/132kV	$ 14
Protection/SCADA	Local network wiring assets	$ 13
Distribution transformers	Ground outdoor / indoor chamber mounted ; < 22 kV ; < = 60 kVA ; multiple phase	$ -

Table 6 : Forecast Replacement Expenditure - Energex Proposal

Asset Group	2015	2016	2017	2018	2019	2020
Poles	$ 40,872	$ 46,937	$ 50,046	$ 54,276	$ 50,625	$ 51,555
Pole top structures	$ 13,716	$ 20,788	$ 18,692	$ 18,957	$ 17,081	$ 17,320
Overhead conductors	$ 22,669	$ 21,846	$ 25,264	$ 25,629	$ 26,925	$ 27,081
Underground cables	$ 24,330	$ 11,382	$ 11,056	$ 15,715	$ 15,995	$ 14,634
Service lines	$ 2,291	$ 14,119	$ 14,110	$ 14,143	$ 8,948	$ 8,978
Transformers	$ 24,326	$ 37,135	$ 39,245	$ 22,264	$ 23,461	$ 24,459
Switchgear	$ 49,223	$ 39,213	$ 39,244	$ 28,221	$ 34,912	$ 35,079
Public lighting	$ 1,920	$ 1,934	$ 2,020	$ 2,191	$ 1,989	$ 2,029
Protection	$ 28,622	$ 33,401	$ 26,352	$ 30,920	$ 27,913	$ 21,503
Total	**$ 207,969**	**$ 226,756**	**$ 226,030**	**$ 212,317**	**$ 207,850**	**$ 202,637**

Table 7 : Forecast Replacement Expenditure - Calibrated REPEX Tool (Reference Scenario)

Asset Group	2015	2016	2017	2018	2019	2020
Poles	$ 35,654	$ 34,398	$ 33,506	$ 32,839	$ 32,298	$ 31,812
Pole top structures	$ 14,581	$ 15,334	$ 15,857	$ 16,153	$ 16,244	$ 16,163
Overhead conductors	$ 24,441	$ 22,404	$ 20,778	$ 19,529	$ 18,618	$ 18,010
Underground cables	$ 21,115	$ 18,361	$ 16,550	$ 15,169	$ 14,054	$ 13,121
Service lines	$ 2,082	$ 1,810	$ 1,635	$ 1,516	$ 1,429	$ 1,361
Distribution transformers	$ 25,090	$ 22,779	$ 21,361	$ 20,517	$ 20,082	$ 19,962
Distribution switchgear	$ 42,869	$ 42,421	$ 42,262	$ 42,270	$ 42,365	$ 42,489
Zone transformers	$ -	$ -	$ -	$ -	$ -	$ -
Zone switchgear	$ -	$ -	$ -	$ -	$ -	$ -
Public lighting	$ 2,611	$ 3,989	$ 6,209	$ 9,573	$ 14,328	$ 20,549
Protection/SCADA	$ 21,733	$ 24,031	$ 28,056	$ 34,065	$ 42,165	$ 52,232
Total	**$ 190,175**	**$ 185,526**	**$ 186,213**	**$ 191,631**	**$ 201,583**	**$ 215,699**

Table 8 : Forecast Replacement Expenditure - REPEX Tool (Mean Lives Plus 10%)

Asset Group	2015	2016	2017	2018	2019	2020
Poles	$ 21,972	$ 22,331	$ 22,795	$ 23,288	$ 23,748	$ 24,122
Pole top structures	$ 7,990	$ 9,076	$ 10,102	$ 11,030	$ 11,832	$ 12,487
Overhead conductors	$ 13,858	$ 13,264	$ 12,737	$ 12,291	$ 11,937	$ 11,680
Underground cables	$ 12,748	$ 11,405	$ 10,683	$ 10,216	$ 9,882	$ 9,616
Service Lines	$ 1,393	$ 1,250	$ 1,168	$ 1,124	$ 1,102	$ 1,092
Distribution transformers	$ 15,481	$ 14,389	$ 13,798	$ 13,523	$ 13,470	$ 13,592
Distribution switchgear	$ 23,031	$ 23,797	$ 24,769	$ 25,882	$ 27,092	$ 28,365
Zone transformers	$ -	$ -	$ -	$ -	$ -	$ -
Zone switchgear	$ -	$ -	$ -	$ -	$ -	$ -
Public lighting	$ 1,017	$ 1,644	$ 2,748	$ 4,588	$ 7,464	$ 11,649
Protection/SCADA	$ 11,187	$ 11,942	$ 13,526	$ 16,205	$ 20,182	$ 25,495
Total	**$ 108,678**	**$ 109,098**	**$ 112,327**	**$ 118,148**	**$ 126,709**	**$ 138,097**

Table 9 : Forecast Replacement Expenditure - REPEX Tool (Mean Lives Minus 10%)

Asset Group	2015	2016	2017	2018	2019	2020
Poles	$ 56,045	$ 51,653	$ 48,319	$ 45,718	$ 43,634	$ 41,931
Pole top structures	$ 23,756	$ 23,198	$ 22,386	$ 21,406	$ 20,347	$ 19,289
Overhead conductors	$ 41,638	$ 37,064	$ 33,697	$ 31,300	$ 29,677	$ 28,670
Underground cables	$ 32,882	$ 27,476	$ 23,729	$ 20,874	$ 18,638	$ 16,870
Service Lines	$ 2,979	$ 2,487	$ 2,156	$ 1,919	$ 1,741	$ 1,604
Distribution transformers	$ 39,615	$ 35,052	$ 32,082	$ 30,130	$ 28,881	$ 28,149
Distribution switchgear	$ 73,278	$ 68,891	$ 65,247	$ 62,116	$ 59,357	$ 56,883
Zone transformers	$ -	$ -	$ -	$ -	$ -	$ -
Zone switchgear	$ -	$ -	$ -	$ -	$ -	$ -
Public lighting	$ 6,042	$ 8,686	$ 12,584	$ 17,946	$ 24,770	$ 32,736
Protection/SCADA	$ 66,930	$ 77,855	$ 92,819	$ 112,016	$ 135,417	$ 162,764
Total	**$ 343,167**	**$ 332,363**	**$ 333,020**	**$ 343,424**	**$ 362,462**	**$ 388,895**

Appendix C. REPEX assessment approaches

C.1 National Electricity Market statutory requirements

The National Electricity Rules state that for forecast capital expenditure (including replacement expenditure) *"…*

(c) The AER must accept the forecast of required capital expenditure of a Distribution Network Service Provider that is included in a building block proposal if the AER is satisfied that the total of the forecast capital expenditure for the regulatory control period reasonably reflects each of the following (the capital expenditure criteria):

> *(1) the efficient costs of achieving the capital expenditure objectives;*
>
> *(2) the costs that a prudent operator would require to achieve the capital expenditure objectives; and*
>
> *(3) a realistic expectation of the demand forecast and cost inputs required to achieve the capital expenditure objectives.*

(d) If the AER is not satisfied as referred to in paragraph (c), it must not accept the forecast of required capital expenditure of a Distribution Network Service Provider.

(e) In deciding whether or not the AER is satisfied as referred to in paragraph (c), the AER must have regard to the following (the capital expenditure factors):

> *(1) [Deleted]*
>
> *(2) [Deleted]*
>
> *(3) [Deleted]*
>
> *(4) the most recent annual benchmarking report that has been published under rule 6.27 and the benchmark capital expenditure that would be incurred by an efficient Distribution Network Service Provider over the relevant regulatory control period;*
>
> *(5) the actual and expected capital expenditure of the Distribution Network Service Provider during any preceding regulatory control periods;*
>
> *(5A) the extent to which the capital expenditure forecast includes expenditure to address the concerns of electricity consumers as identified by the Distribution Network Service Provider in the course of its engagement with electricity consumers;*
>
> *(6) the relative prices of operating and capital inputs;*
>
> *(7) the substitution possibilities between operating and capital expenditure;*

whether the capital expenditure forecast is consistent with any incentive scheme or schemes that apply to the Distribution Network Service Provider …"[8]

C.2 General AER approach

To comply with the requirements of the National Electricity Rules, the assessment techniques used by the AER rely upon a nationally consistent reporting framework for network businesses, and then compares costs of conducting similar activities across the networks. The general approach is to assess the efficiency of a network business and decide whether previous expenditure is an appropriate starting point for analysis. If so, the AER

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[8] AEMC, *National Electricity Rules: version 71*, 9 Apr 2015, chapter 6, clause 6.5.7, pp. 670-1

considers past expenditure as a reasonable indicator of future spending. Therefore, the AER's assessment approach is primarily based on economic benchmarking, predictive modelling, trend analysis, historic expenditure (divorced from underlying drivers) and cost benefit reviews.

In its expenditure forecast assessment guideline, the AER states the following summary of the approach to be used in assessing replacement capital expenditure:

"*Replacement capex is typically incurred to address deterioration of assets, including works driven by reliability deterioration or as a result of an assessment of increasing risk. This type of capex is closely related to maintenance opex, so we will expect DNSPs to identify and explain potential work and efficiency trade-offs between these two expenditure categories".*

We will likely assess the level of forecast replacement capex by:

- *analysing information supporting the DNSP's building block proposal*
- *benchmarking the DNSP's forecast capex with historical expenditure and/or the expenditure of other DNSPs*
- *replacement expenditure modelling*
- *detailed project review*

A key input into the analysis will be the outputs from modelling the condition or age-based replacement rates of assets. This approach will estimate the efficient volumes and cost of replacement works required during each year of the regulatory control period, and to target more project reviews. Age-based replacement expenditure modelling typically involves consideration of:

- *the DNSP's historical and forecast mean standard lives of different asset categories*
- *the change over time in the distribution of different categories of the DNSP's assets."*[9]

C.3 Expenditure Forecast Assessment Guideline

In November 2013, the AER issued the Expenditure Forecast Assessment (EFA) Guideline to specify the approach the AER will use to assess capital expenditure (CAPEX) and operating expenditure (OPEX) forecasts, and the information required from network service providers (NSPs) to support this assessment.

C.3.1 Assessment approach

In describing the proposed general approach, the AER stated that it will *"…typically compare the DNSP's total forecast with an alternative estimate that we develop from relevant information sources. To calculate this alternative estimate we will consider a range of assessment techniques. Some of our techniques will assess the DNSP's forecast at the total level; others will assess components of the DNSP's forecast. Our estimate is unlikely to exactly match the DNSP's forecast. However, by comparing it to the DNSP's forecast, we can form a view as to whether or not we consider the DNSP's forecast reasonably reflects the expenditure criteria.*

Therefore, if a DNSP's total capex or opex forecast is greater than the estimates we develop using our assessment techniques, and there is no satisfactory explanation for this difference, we will form the view that the DNSP's estimate does not reasonably reflect the expenditure criteria. In this case, we will substitute our own estimate that does reasonably reflect the expenditure criteria. If our estimate demonstrates that the DNSP's forecast reasonably reflects the expenditure criteria, we will accept the forecast."[10]

The AER's general approach assumes that past actual expenditure was sufficient to achieve the expenditure objectives in the past[11] and that this is considered as the efficient starting point for determining future expenditure.

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[9] AER, *Better Regulation: Expenditure Forecast Assessment Guideline for Electricity Distribution*, Nov 2013, section 3.1, p. 18

[10] ibid., section 2.2, p. 7

[11] ibid., section 2.2.1, p.8

C.3.2 Assessment principles

The principles the AER applies to form a view on the level of reliance placed upon different assessment techniques are:

- validity - any technique should appropriate for the assessment need. For the AER, this typically relates to an assessment of efficiency.
- accuracy and reliability - a technique is considered accurate when it generates unbiased results, and reliable when the results are consistent.
- robustness - techniques must be complete and should remain valid under different assumptions, parameters and initial conditions
- transparency - techniques should be capable of being tested through an assessment of results for changes in assumptions, parameters and conditions.
- parsimony - AER prefer simpler techniques over more complex techniques, provided the simpler technique measures equally against the other principles.
- fitness for purpose - techniques must be appropriate for the task.

The primary focus of the AER assessment approach is on economic efficiencies, which is consistent with the National Electricity Objective.[12] The AER believes that the use of consistent reporting templates contributes to an assessment that is rigorous, transparent and cost effective, and which allows the development of more sophisticated benchmarking techniques. In addition, the AER considers the greater use of economic benchmarking techniques in assessing the efficiency of utilities relative to their performance across time and against other utilities allows the development of an "*efficient production frontier*".

Jacobs is of the view that:

- the AER focus is on the use of benchmarking to drive what it considers as efficient outcomes. This is consistent with the general AER approach and complies with the requirements of the National Electricity Rules.
- the current use of the AER age-based replacement model is analogous to the fast-track approach used by Ofgem for its assessment of utilities in Great Britain. Ofgem notes that this particular approach has limitations that need to be addressed through a rigorous review of business cases for particular programs, asset specific condition information and network and asset performance data. The AER has continually reiterated that it does not see its role as reviewing particular projects.[13] As a result, the current AER assessment technique could potentially compromise the robustness of the result.
- the output of the AER age-based replacement model is particularly sensitive to the calculated implied asset lives that are used. In addressing this, Ofgem uses a technique that calculates a range of replacement volumes as part of its assessment to reduce the volatility. Jacobs is of the opinion that the AER should consider reviewing the implied asset lives calculated in its assessment technique and review their reasonableness and any factors that may have affected the forecast replacement volumes in comparison to the historic replacement volumes to ensure their result is valid and transparent.

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[12] The National Electricity Law defines the National Electricity Objective as "*promote efficient investment In, and efficient operation and use of, electricity services for the long term interests of consumers with respect to price, quality, safety, reliability and security of supply; and the reliability, safety and security of the national electricity system.*"

[13] AER, *Better Regulation: Expenditure Forecast Assessment Guideline for Electricity Distribution*, Nov 2013, section 2.5, p. 16

C.4 AER REPEX models

The AER’s REPEX modelling consists of four parts: a base historical data model, a base forecast data model, a calibrated forecast model, and a calibrated benchmark model. It incorporates both historical and forecast replacement program data, which is then adjusted to develop a calibrated benchmark forecast.

- **Base Historical data model**

  This model uses asset quantities; age/remaining lives, and unit rate data provided by Energex in its RIN submissions.

- **Base Forecast data model**

  The inputs to this model are asset quantities; age/remaining lives, and unit rate data provided by Energex as part of its Regulatory Submission.

- **Calibrated Forecast model**

  The calibrated model uses actual replacement volumes achieved by Energex in the most recent 5-year period and adjusts the mean asset replacement life of the asset group until it reflects this actual achieved replacement volume. The unit rate data used in the model was the historical unit rates for assets provided by Energex in its RIN submission.

- **Benchmark Calibrated model**

  The benchmark component of the model adjusts the asset replacement cost unit rates to reflect average actual costs incurred in the most recent 5-year period. It is not always possible to obtain actual costs at the asset category levels required, and therefore a scaling of the costs is used.

  For the purposes of this report, it is best not to confuse the ‘calibrated model’ with the ‘benchmark model’, which applies average industry benchmark costs (benchmark first quartile, benchmark average, and benchmark lowest) to the quantities derived in the calibrated model. The benchmark model was not used to arrive at the AER’s recommended level of REPEX, but the AER have indicated in their draft decision that they may consider applying benchmark unit costs in the future.

In its most recent draft decisions for utilities in NSW and ACT, the AER has used the Calibrated Forecast model as the basis for their alternate REPEX allowances.

C.5 Ofgem assessment approach

Electricity network companies are natural monopoly businesses; therefore their revenues need to be regulated in a privatised electricity market to protect the interests of consumers. This regulation is implemented in Great Britain by the Office of Gas & Electricity Markets (Ofgem).

Ofgem has adopted a Sustainable Network Regulation framework, which is intended to ensure network companies can maintain reliable, secure and good condition networks while delivering an appropriate quality of service to consumers.

It is a performance based model referred to as “RIIO” for setting price controls for network companies. The stated intentions for the RIIO model are to encourage network companies to:

- put stakeholders at the centre of the decision-making process
- ensure efficient investment to maintain safe and reliable services
- introduce innovation to reduce network costs
- contributing to sustainability and delivering a low carbon economy

For previous price control reviews, the Ofgem approach has been predominately based on information provided by the network utilities and reviews from independent engineering consultants who relied upon their own asset management expenditure modelling and knowledge. The introduction of the RIIO regulatory model allows Ofgem to focus its asset replacement assessment on the impact of asset replacement expenditure on the network output measures consisting of asset health condition and criticality.

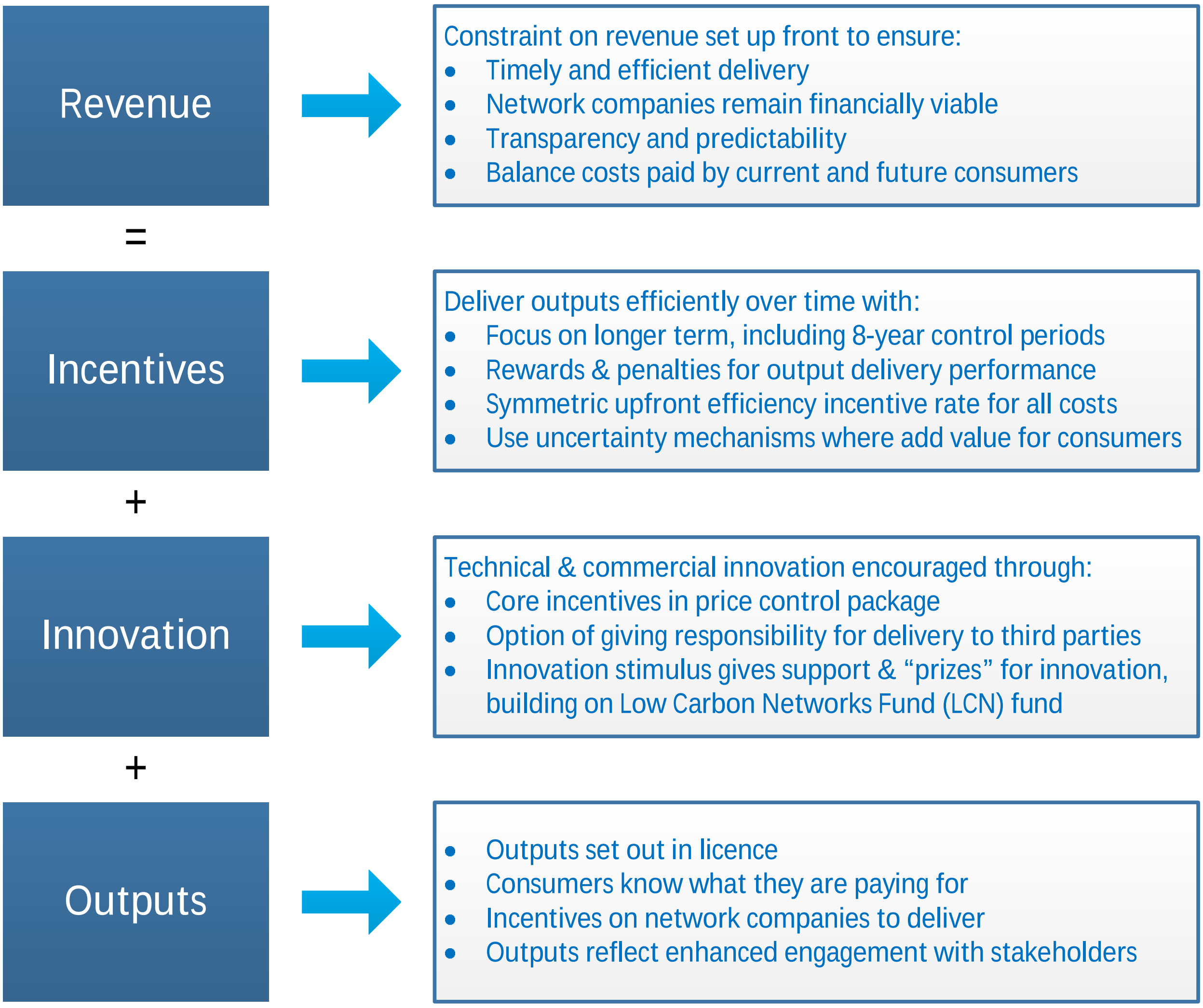
This change of approach is important to ensure that network companies can maintain reliable, secure and good condition networks whilst delivering an appropriate quality of service to consumers. To achieve this intent, Ofgem has developed an age-based survival model complemented by Monte-Carlo simulations to predict asset replacement volumes together with reviewing network companies' asset replacement plans in the context of their network asset health condition, criticality and replacement priority information as well as mixture of asset intervention techniques[14].

The RIIO model is based on the following components:

Revenue = Incentives + Innovation + Outputs

The following figure shows the various components of the model, highlighting the main considerations.

Figure 15 : Components of RIIO Model[15]



Revenue

Constraint on revenue set up front to ensure:

- Timely and efficient delivery
- Network companies remain financially viable
- Transparency and predictability
- Balance costs paid by current and future consumers

=

Incentives

Deliver outputs efficiently over time with:

- Focus on longer term, including 8-year control periods
- Rewards & penalties for output delivery performance
- Symmetric upfront efficiency incentive rate for all costs
- Use uncertainty mechanisms where add value for consumers

\+

Innovation

Technical & commercial innovation encouraged through:

- Core incentives in price control package
- Option of giving responsibility for delivery to third parties
- Innovation stimulus gives support & "prizes" for innovation, building on Low Carbon Networks Fund (LCN) fund

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Outputs

- Outputs set out in licence
- Consumers know what they are paying for
- Incentives on network companies to deliver
- Outputs reflect enhanced engagement with stakeholders

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[14] Shijun Yi, Watts et al, *A Regulatory Approach to the Assessment of Asset Replacement in Electricity Networks*, section 2

[15] Ofgem, *RIIO: A new way to regulate energy networks - Final decision*, October 2010, p. 3

Under the RIIO framework, a company's revenue is closely linked to its outputs and the price control period is extended from five years to eight years. As part of this systematic approach, there are three key quantitative aspects - an age-based asset replacement forecast model, a Monte-Carlo simulation and a network output measures based assessment.

The age-based asset replacement model considers the asset age profile and the probability of an asset failing at a given age (known as the hazard function). The key parameters for the hazard function are the anticipated asset life, the earliest inset of significant unreliability and the latest onset of significant unreliability. This typically results in a skewed normal distribution for the hazard function, which is tuned to recognise discrepancies between the key parameters and actual replacement volumes. Any significant variances between actual volumes and forecast quantities could be due to either a back-log created by postponing work, or an improved efficiency which may reflect advanced asset management techniques.

To generate a confidence level around the age-based modelling (which produces a single forecast), simulations produce a range of possible outcomes by substituting a range of values for any factor that has inherent uncertainty, such as asset lives and replacement needs.

Whilst this modelling is useful in reviewing asset replacement forecasts provided by utilities, it does not reveal the key information about the aspects of the network outputs delivered by the asset replacements plans. These plans establish a replacement priority based on a detailed engineering judgement from the network service provider's view of asset condition and network risk.

Taking into account the asset replacement volume forecast and the forecast of network output measures from the network companies, Ofgem reviews the relationship with consideration of the asset survival/failure and the simulation results.

C.6 Ofgem assessment techniques

A number of analytical techniques are used to *"… assess asset replacement volumes:*

- *an age-based replacement model (survival model) based on asset age profiles and the probability of assets of different ages failing*
- *run rate and trend analysis where asset volumes* [are] *assessed as a proportion of the total asset base*
- *a review of the asset health and criticality information and supporting narrative*

Unit cost benchmarking and expert review [are] *used to assess unit costs which were applied to the final volumes."*[16]

C.6.1 Volume assessment

For a fast-track assessment, the age-based asset replacement model is *"… designed around the assumption that industry asset lives can either be maintained at the levels achieved in the past or longer lives can be achieved in the future through improved asset management. The model* [calculates] *the highest of the lives achieved across the industry that were implied from historical asset replacement volumes … This benchmark set of asset lives* [is] *then combined with each DNO's*[17] *individual asset age profile to give a DNO modelled volume for each asset … The main inputs to the model are the current age profile and life assumptions based on a normal distribution. The current age profile is the number of assets that remain in service from the years in which they were installed. The life assumptions or asset lives indicate the likelihood of asset failure based on age … The model* [calculates] *implied asset lives from actual replacement using a normal distribution for the*

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[16] Ofgem, *RIIO-ED1 Draft determination for slow-track electricity distribution companies: Business Plan expenditure assessment,* chapter 7, sections 7.2 and 7.3, p. 47

[17] Distribution Network Operator

cumulative probability of failure. This is done by matching actual and forecast volumes against the calculated asset life."[18]

However, Ofgem acknowledges that this modelling approach has limitations as the implied life approach makes no allowance for the condition of the assets, and instead relies solely on age. Therefore, the qualitative assessment of any supporting evidence regarding asset replacement volumes is a critical aspect of the review.

This includes technical assessment of the following, and adjustments to the replacement volumes where Ofgem is satisfied any adjustments to volumes are appropriate:

- business cases for asset replacement programs and high-value assets;
- asset specific condition information;
- relationship to health indices;
- evidence of poor or worsening performance;
- evidence of type faults, failure modes and safety issues.

In circumstances where Ofgem is not satisfied by the information provided by the utility, additional emphasis is given to the output of the age-based replacement model in setting the replacement volumes than the asset replacement programs provided by the utility.

For a slow-track assessment, the age-based asset replacement model is run using two profiles rather than one, with the results of both factored into the final volume assessment to ensure the modelling is based on both historic and forecast replacement volumes. The aggregate age profile across all of the DNOs is used to reduce volatility in the implied lives due to the different DNOs' different age profiles. The two implied asset lives give a range for the replacement volumes, against which the modelled DNO forecast volume is assessed.

The following table summarises the final volumes assessed depending upon a line-by-line qualitative assessment.

Table 10 : Ofgem asset volumes use in assessment[19]

Scenario	Volumes use
DNO forecast volumes below both profiles modelled volumes	DNO volumes
DNO forecast volumes above either or both profiles modelled volumes	Following further review of each of the DNO's supporting evidence one of the following: a) DNO volumes b) the average between the two age profiles c) the average of the lowest volume and the DNO's proposed volume

Where a DNO's forecast replacement volumes are below those modelled by Ofgem, the DNO receives its own forecast values. Otherwise:

- If Ofgem is satisfied by the justification for the DNO volumes, then these volumes are allowed.
- If Ofgem is not satisfied, where both age profiles provided volumes lower than the DNO submitted volumes, the assessed volume is set as the average between the two profiles. Where one age profile is above the DNO's forecast volume, the average of the lowest modelled volume and the DNO's proposed volume is used for the assessment.

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[18] Ofgem, *RIIO-ED1 Draft determination for slow-track electricity distribution companies: Business Plan expenditure assessment,* chapter 7, sections 7.4 to 7.6, p. 48

[19] Ofgem, *RIIO-ED1 Draft determination for slow-track electricity distribution companies: Business Plan expenditure assessment,* chapter 7, section 7.23, p. 51

C.6.2 Unit cost assessment

Ofgem develops a view on the unit costs submitted by the utility based on qualitative input from technical consultants and industry historical and forecast asset replacement costs. The review includes consideration of each asset building block.

C.7 Comparison of AER and Ofgem approaches

The AER refers in a number of documents that its REPEX model is based on well-established principles of probability and normal distribution and that it has been used by the AER previously and has similar characteristics to the model used by Ofgem.

From our review, we consider that the AER has attempted to adopt UK asset lives for Australian DNSPs via the REPEX model. However, from our review of the AER REPEX model, the model is more arbitrary in its design and application than the Ofgem model.

The determination of suitable average asset class lives in different countries is dependent upon the prevailing environmental conditions (eg, ambient summer and winter temperatures, wind speed, salinity), asset management and maintenance practices, asset loading and the system security and planning criteria adopted within that country.

The differences between the UK and Australian system security and planning criteria, when combined with the more onerous ambient temperatures (particularly Australia's hotter summers) means that most electrical equipment on Australian distribution systems will be loaded, when considering thermal constraints, to a higher level, on average, over the life of the asset. For many classes of assets, this higher level of thermal loading over the life of the asset will result in increased loss-of-life through insulation degradation.

C.7.1 Volume assessment techniques

Jacobs has noted that the AER determines the implied asset lives for each asset category for each DNSP separately, using the most recent 5-year actual replacement volumes to "calibrate" the asset lives. As a result, the implied asset lives are "*… derived from each individual DNSP's RIN submissions, they will be different for each DNSP*."[20] As an example, the implied asset life for a wood pole for ActewAGL Distribution was deemed by the AER to be 71 years, whilst for Ausgrid, the implied asset life ranged from 53 to 60 years. Given that there are no underlying factors that would result in a wood pool lasting longer in the ActewAGL region than in Ausgrid's it can be concluded that the AER method for deriving asset life is not robust.

The AER's approach in deriving a calibrated replacement volume for the calibrated forecast expenditure considers the actual replacement volumes achieved over the most recent five years and then adjusts the asset replacement life for the specific asset category until the forecast replacement volume reflects the historically achieved volumes. We consider that this method does not account for engineering or condition assessment, and relies heavily on historic replacement volumes that may not adequately reflect ongoing or forecast replacement requirements and strategies. In the application of this approach in recent draft decisions, the AER's calibrated model generated unsubstantiated variations in replacement volumes (in some instances, higher than those forecast by the DNSPs) and distorted asset lives that in some instances materially exceeded industry experience and were out of alignment with the asset management practices of a responsible network operator.

We consider that the AER approach may be capable of justification if the underlying drivers for and circumstances impacting on expenditure prevailing at the time of past expenditure were used to normalise such expenditure and if the future forecast took into account drivers and circumstances impacting on expenditure forecast to pertain for future expenditure.

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[20] Jacobs, *Focussed Critique of AER's REPEX - Calibrated Model: ActewAGL Distribution*, Jan 2015, section 1.3, p. 7

In contrast to the AER method, to reduce the volatility in the implied asset lives due to the different age profiles for each network operator, Ofgem uses an aggregate age profile across all of the DNSPs. Ofgem uses two sets of disposal values rather than one to infer asset lives. The first is based on actual replacement volumes from the previous regulatory period, and the second is based on forecast replacement volumes submitted by the DNSP. The two models provide a range for potential replacement volumes. As a result, the sensitivity of the age-based replacement modelling to changes in the implied asset lives is moderated by assessing against a forecast replacement range rather than a specific value.

One point that should be noted is that Ofgem assumes that "*… the DNOs*[21] *would have built in some uncertainty into their forecasts and therefore we do not consider it appropriate to base our volume allowance on an estimate higher than the DNO's submitted volumes. While this approach is slightly different from those adopted in other areas we consider this is a pragmatic approach given the difference in age profiles and the DNO's ability to trade-off between refurbishment and replacement*"[22]

C.7.2 Volume verification techniques

Jacobs has noted in recent AER draft decisions for electricity distribution utilities that the AER does not compare the asset volumes generated by its "calibrated" model against the asset management plans used by the utilities, or assess the impact of reduced replacement volumes on the future weighted average age of assets. As a result, some of the volumes determined by the AER modelling are materially inconsistent with volumes proposed by the utilities in their regulatory proposals. Whilst the AER draft decisions make reference to replacement programs proposed by the utilities, the commentary provided is of a high-level review only; as an alternative to a detailed analysis and comparator against its models. As such, the AER places greater reliance upon historic replacement volumes.

By comparison, Ofgem reviews the DNO asset management plans to understand and reconcile material variations in the modelled and proposed volumes through the consideration of three key questions:

1) Has the DNO proposed a substitute asset?
2) Has the DNO provided additional evidence as to why the volumes are higher e.g. a higher level of deterioration than age would indicate?
3) Are there any complimentary assets which have been allowed?

C.7.3 Asset life assessment techniques

C.7.3.1 AER approach

The AER's Calibrated Forecast model basically assumes that the "volume of work" (quantities), and the total replacement expenditure on each category of assets spent over the previous regulatory period (as reported in the RIN) is adequate for all future regulatory periods going forward, and certainly adequate for the next regulatory period.

Since for most asset classes, the amount of previous expenditure would not have been sufficient to stop the whole fleet of assets from ageing, they need to "back-engineer" the average asset class lives to make the level of expenditure look adequate forever into the future. These calibrated class lives are nothing more than "notional" or "implied" class lives. They do not reflect any reasonable electricity industry assessment of actual expected technical / economic life, except by pure coincidence that the actual expenditure in the previous regulatory period was reasonably close to the long term average needed.

For example, most DNSP's pole replacement programs are run to a defined frequency of inspection, and a reasonably constant pole failure rate. Therefore, what was replaced in the last regulatory period, will be roughly the same as the next.

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[21] Distribution Network Operator

[22] Ofgem, *RIIO-ED1 Draft determination for slow-track electricity distribution companies: Business Plan expenditure assessment,* chapter 7, section 7.31, p. 52

However, underground cable replacement, power transformer replacement, and overhead structure replacement in bushfire prone areas, are categories of replacement expenditure which do not follow a regular cyclical inspection and replacement program, therefore since there was not as much spent on it in the last regulatory period, there is no justification for increased spending in the next regulatory period. – That is the simplistic logic that the "calibrated model" applies.

Jacobs fundamentally disagrees with the AER's premise that the future requirement for sustainable long term replacement expenditure on network assets can be predicted by looking at recent past expenditure. Such a premise assumes that the asset age profile characteristics, and asset condition and performance can be maintained ad-infinitum into the future with the same level of expenditure.

Such a proposition would only seem to be reasonable where a network had been in service for such a period of time that the average age of all classes of assets were approaching their average asset class lives, and where the replacement expenditure in the past, and in the future, were designed to maintain the average asset age at a stable level and approximately equal to the average asset class lives. In addition, such a proposition would have to assume that the network would have grown at a constant rate over time, with no peaks or troughs in investments in the past.

C.7.3.2 Ofgem approach

Jacobs has reviewed several documents relating to the application of asset replacement modelling in the UK, including the latest Ofgem publication "*RIIO – ED1: Draft determinations for the slow-track electricity distribution companies - Business Plan Expenditure Assessment*". We have compared and contrasted the overall expenditure assessment approach taken by Ofgem with the overall expenditure assessment approach taken by AER in the NSW/ACT draft decision.

It is Jacobs' view that the stated approach in the Ofgem documentation is much more embracing of a wider range of considerations in arriving at its replacement expenditure forecast, rather than just exclusive reliance on the REPEX model. Examples of the wider range of considerations include:

- Giving separate consideration to the magnitude of civil works costs, in addition to asset replacement and refurbishment costs.
- Giving greater credence to the use of asset health index and criticality data
- A greater use of independent expert review of unit cost data, and less reliance on asset substitution, combined unit costs, and blended unit costs. Ofgem instead consider each asset on an individual, line-by-line basis, reflecting a greater depth of their qualitative review.
- Ofgem run their age-based model using two age profiles rather than one, with the results of both factored into their final volume assessment. This ensures that the model is based on both historical and forecast data, not just historical data, as is the case with AER.
- Recognition that separate consideration needs to be given to unique or high value projects (HVP's), which cannot be modelled using historical volume, age profiling, and unit cost information

Although the Ofgem replacement modelling approach takes account of a much broader range of considerations than does the AER approach, it still suffers from the underlying issue that the "calibrated model" calculates derived average asset lives, based on historical expenditures and volumes, which are for some asset classes materially higher than realistic average economic lives that can be achieved for such asset classes.

Table 11 provides a summary of typical UK and Australian derived asset class lives from the REPEX model, compared with typical actual economic lives that are achieved in practice. The material difference is clearly demonstrated.

Table 11 : REPEX model implied asset lives vs Australian actual economic lives

Asset Categories	Typical range of Australian average asset class lives	Typical range of UK average asset class lives	Ofgem REPEX model “implied” average asset class lives	AER REPEX model “implied” average asset class lives as determined for Ausgrid
LV (415/240V) services OH	35	50-55	67	64
LV (415/240V) services UG	35	80-85	105	76
LV (415/240V) mains OH	45-55	50-55	74	67
LV (415/240V) poles and structures - wood	45-55	60-65	70	60
HV (22/11/6.6kV) mains OH	45-55	50-55	66	62
HV (22/11/6.6kV) mains UG	60	60-70	91	71
HV (22/11/6.6kV) poles and structures - wood	45-55	55-60	66	55
HV (22/11/6.6kV) switchgear - indoor	45	45-55	55	53
HV (22/11/6.6kV) distribution transformers - wood pole	35-45	45-55	63	59
HV (22/11/6.6kV) distribution transformers - cubicle	45	45-55	62	42
EHV (66/33kV) mains OH	45-60	55-65	66	55
EHV (66/33kV) mains UG	45	60-70	74	62
EHV (66/33kV) poles and structures - wood	45-55	55-65	65	57
EHV (66/33kV) poles and structures - concrete	55	55-65	71	44
EHV (66/33kV) switchgear - outdoor	45	40-55	54	45
EHV (66/33kV) power transformers	45-50	50-60	60	50
132kV mains OH	55-60	40-75	80	64
132kV poles and structures - tower	60	50-65	95	48
132kV switchgear - outdoor	45	45-55	52	50
132kV power transformers	45-50	50-60	60	50

C.7.4 Key findings

The key difference between the regulatory approaches in Australia and Great Britain is that the AER has relied upon economic modelling of replacement expenditure with a high-level review of selected asset management programs with the main focus on the financial impact for consumers; whilst the Ofgem approach consists of modelling including scenarios and detailed review of all asset management plans to verify reasons for any identified differences in forecast replacement volumes, with consideration of potential impact on network performance and condition.

Appendix D. Energex RIN data review

The following commentary is provided in the form of notes for Energex to be aware of the issues identified and to understand how the AER will be treating Energex' proposed REPEX using the modelling tool employed by the AER.

D.1 Excluded asset categories

A number of asset categories listed in Table 12 are excluded from the AER REPEX modelling process for forecasting the REPEX in the upcoming regulatory period. These exclusions align with the AER final determination of the NSW and ACT DNSPs where the same set of asset categories were deemed not suitable for forecasting REPEX. These asset categories are excluded because of the nature of these assets, drivers, and difficulty in establishing an asset boundary in project work. In many cases their replacement may not be a function of their age, or the asset age profile information is not available. The replacement work in many of these instances are driven by various factors other than age related conditions, deterioration, operational or maintenance issue, and failure.

Table 12 : Excluded asset categories

Asset Group	Asset Category
SCADA, Network Control and Protection Systems	Field devices
	Local network wiring assets
	Communications network assets
	Master Station assets
	Automation replacement expenditure
Other	Recoverable work - faults
	Pole chemical treatment
	Plant and Stations miscellaneous
	Major Zone Substation replacement works
	TV interference related expenditure
	Environmental related replacement expenditure
	Bushfire mitigation related replacement expenditure
	Lines miscellaneous
	VBRC SWER ACRs

Jacobs considers that the AER REPEX model is only suitable to predict replacements of assets that are reasonably homogenous and have at least a moderate asset population. Given that the historical age information provided by Energex in the Category Analysis RIN indicates sparsely populated assets and difficulty in segregating historical expenditure to derive consistent unit cost input data, Jacobs considers that exclusion of these asset categories from the REPEX modelling is appropriate.

It is expected that the proposed forecast REPEX for the excluded asset categories will be reviewed through historic trend analysis and engineering assessments, as this has been the case for each of the NSW and ACT DNSPs.

D.2 Average unit cost calculation

The average unit cost to be used in the REPEX modelling process can be calculated for individual asset categories in two ways: a weighted; or an unweighted average unit cost as shown below. These recent historic five years data were provided to the AER in the Category Analysis RIN Table 2.2.1.

$$Weighted\ average = \frac{Expenditure1 + Expenditure2 \ldots + ExpenditureN}{Volume1 + Volume2 \ldots + VolumeN}$$

$$Unweighted\ average = \frac{\left(\frac{Expenditure1}{Volume1} + \frac{Expenditure2}{Volume2} \ldots + \frac{ExpenditureN}{VolumeN}\right)}{N}$$

Review of the NSW and ACT DNSPs draft determination indicates that the AER used an unweighted average method to derive unit cost input data for its NSW and ACT DNSP determinations. However, Jacobs considers that the weighted average method is more appropriate rather than the ‘average of the average’ approach employed by the unweighted method. The weighted average is the total cost (in real June 2015 dollar terms) of replacement over the past regulatory period divided by the total volume of replacements over the same period. This contrasts with the unweighted method, which calculates a unit cost for each year, and then averages these results.

The advantage of the weighted averaging method is that it better accounts for variable levels of replacement in different years, and better represents outliers by proportionally weighting the annual data of various years. For example, if only a minimal number of assets were replaced in one year, at a relatively high price, we would not want to consider that unit price to be of equal weight to one derived from a year with a large number of replacements. The average price of an asset should be closer to the replacement cost for the majority of the replaced assets. Additionally, if only a few assets in a particular category are replaced in one year, economies of scale will not be appropriately represented in the cost derived by the unweighted method.

D.3 Unit cost of asset categories which did not incur expenditure in last 5 years

Energex has reported age information for several asset categories in its Category Analysis RIN Table 5.2.1, for which no recent historical REPEX has been reported in Table 2.2.1. Deriving the unit cost input data for the AER REPEX model for these asset categories on first principal will therefore be not possible. This lack of data may be mostly due to the fact that such asset categories have small populations, or/and sparsely distributed age profiles, or/and are relatively new, thereby not incurring replacement in the recent past. Energex may nominate a substitute unit cost input data based on derivation of unit cost of similar type and capacity assets.

However, Energex should note that in its recent draft determination of NSW and ACT DNSPs’ regulatory submissions, the AER has relied on benchmarked unit cost input data derived from across the National Electricity Market (NEM) DNSPs Category Analysis RIN reporting to populate the AER REPEX model in such instances. It is noted that the AER has used the uniform benchmarked unit cost input data for Asset Categories with missing cost information to review the DNSPs’ proposed REPEX in all its draft determinations.

Jacobs notes the use of the AER’s benchmarked unit cost input data from the NSW and ACT DNSPs final determination. Jacobs notes that in a number of instances there are inconsistencies in the unit cost input data in the AER’s benchmark data for some asset categories. The impact of the AER’s review on proposed REPEX for such asset categories may be material. In some cases of Distribution Transformer asset group, the AER benchmark unit cost input data are low and does not reflect realistic and efficient market pricing. Similarly, in some cases the AER benchmark unit cost is contrary to what an engineer would logically consider, for e.g. a low voltage wood pole installation costs nearly 10 times as much as a 66kV wood pole installation. Jacobs believes that, whilst the AER benchmarking calculation may be correct, there might be data quality issues with various costing information supplied by the NEM DNSPs that forms the input to the AER benchmarking determination. It is very likely that for many DNSPs the costing data required by the AER for its benchmarking and analytical review purpose had not been historically recorded in the required format and breakdown structure, as there previously has been no business requirement to record this data. The supplied costing data therefore have required extensive manipulation of the data that does exist involving proportioning; assumption and determining project boundaries to establish disaggregate level of work item costs to align the data format to the requirement.

Jacobs recommends that Energex explains the lack of recent historical REPEX records in its Reset RIN reporting to the AER.

D.4 Asset Mean Life calibration of asset categories which did not incur expenditure in last 5 years

The AER REPEX model produces extremely high forecast volumes and expenditure compared to the historical replacement expenditure trend when populated with data directly from the previously reported Category Analysis RIN. The AER has developed a 'calibration' process whereby the model inputs are adjusted until forecast replacement volumes match recent historical volumes. The average replacement volumes over the previous regulatory period are averaged, and this averaged volume is set as the target of an optimisation function (goal seeking process). The process works as follows, for each individual asset category.

- The Standard Deviation input parameter of all asset categories is set to the square root of the asset Economic Life Mean parameter.
- The unit cost and age profile of assets are derived from the previously reported Category Analysis RIN, and remain unchanged during the calibration process.
- The Asset Age Mean parameter is adjusted or varied, using an optimisation function (such as Microsoft Excel's Goal Seek) until the AER REPEX model produces the average historical replacement volume in the first year of its forecast.

Energex should replicate this calibration process for the majority of asset categories. However, asset categories for which expenditure was not recorded in the past regulatory period requires special treatment.

When an asset category has no recent REPEX, the goal seeking function will attempt to adjust the Asset Age Mean parameter until zero assets are replaced in the first year of the forecast. Because the AER REPEX model predicts replacement volumes on a probabilistic basis, and will therefore predict fractional replacement with an extremely high Asset Age Mean parameter, the goal seek algorithm in most cases will not be able to find a solution to this problem, or only a solution with an unrealistically high Asset Age Mean parameter compared to industry benchmarks (>100 years in some cases).

Jacobs recommends that Energex does not perform a replacement volume calibration for asset categories with no recent historic replacement, and leaves the calibrated REPEX Model populated with an Asset Age Mean based on the previously reported Category Analysis RIN Table 5.2.1 for those asset categories.

D.5 Two-step calibration process

Once the first volume calibration is complete (as described in Section D.4), the REPEX model will produce forecasts based on individual asset age profiles and historic replacement volumes. However, because the first year of the forecast period is matched to volumes from previous years, the forecast needs to be adjusted to reflect any ongoing trends in replacement volumes.

The forecast replacement volumes output by the REPEX model from the first volume calibration step are recorded for each asset category and used to determine an annual percentage increase or decrease (i.e. whether the model predicts increasing or decreasing replacement year to year when looking at the future volumes forecast). The annual changes in replacement volumes forecast are then averaged, and the annual trend added to or subtracted from the replacement target of the first volume calibration step. This produces a new target, so that the model predicts 'next' year's replacement rather than the average 'this' year volumes. This adjustment is generally a minor one. The model is then recalibrated to match the new target, using the same goal seeking algorithm as during the first volume calibration step.

The annual trend can be derived by averaging the changes in forecast volume over all the years of the forecast, by considering just the first two forecast years, or considering any number of year in between. The AER guidance documents and the materials released as part of the NSW and ACT final determinations do not make clear exactly how this function is calculated, only its purpose i.e. to ‘offset’ the forecasts by one year.

Forecast trends can be averaged over the full forecast period to generate a trend for the second volume calibration. This method captures the largest possible amount of data, but may not reflect the current trends in replacement for certain asset categories.

D.6 Verification of wood pole staking information

Wood pole staking is an ‘activity’ to reinforce and prolong the life of an existing wood pole. It is noted that a ‘staked’ wooden pole is replaced with a new wood pole, and an existing wood pole maybe either replaced with a new wood pole or reinforced with staking to prolong its life. In other words, the asset age profile of the staked wood poles does not determine the expenditure for this activity. The asset age profile of a proportion of the existing non-staked wood pole populations determines the staking activity. The main driver for this expenditure or activity is the asset management practice for existing wood poles (and not staked wood poles).

This particular asset category, i.e the staked wood pole category, denotes wooden poles that are staked and therefore have longer asset lives than wooden poles. The proposed replacement Economic Life Mean for the staked wood pole category is the additional years extended by this activity to an existing wooden pole. Staked Poles represent a non-like-for-like replaced asset so the unit cost input data for the staked wooden pole asset category will be same as the unit cost of Wood Pole asset categories. Similarly, some proportion of Wood Pole asset categories will be staked instead of immediately replaced and therefore such replacement unit cost input data will be different to Wood Pole replacement. The unit cost of wooden poles used for REPEX modelling must therefore account for this non-like-for-like replacement, and a ‘blended’ unit cost calculated based on the proportion of wood poles that get staked. Drawing on the AER REPEX model handbook guideline and final determinations for NSW and ACT DNSPs, the AER will request information from Energex of the proportion of wood poles staked, in order to arrive at this blended unit cost.

Jacobs suggests that Energex confirms that the age profile of staked poles is exclusive of wooden poles, i.e. they are not double counted with other wooden poles (or mutually exclusive). Drawing on recent historical asset replacement quantities data or work practice, Energex should calculate the average percentage proportion of existing wood poles that are staked each year (non-like-for-like replacement) instead of assuming a like-for-like replacement. Using this proportion, the AER will calculate the blended unit cost for the Wood Pole asset categories to apply for the REPEX modelling.

D.7 Verification of CPI used to convert nominal historic expenditure to real 2015 dollar

The previously reported Category Analysis RIN Table 2.2.1 reports recent historic annual expenditure in nominal dollars for June each year. Energex should escalate those historic expenditures to real terms base June 2015 dollar values using an appropriate basket of indices , or, but less reflective of actual likely cost increases and hence less preferable, the Consumer Price Index (CPI) based on the Australian Bureau of Statistic (ABS) published indices and CPI forecast.