Attachment 5.08

Jacobs - Review of AER Draft Decision - REPEX

January 2015

Ausgrid revised regulatory proposal attachment

Regulatory Submission

AUSGRID

Review of AER Draft Decision - REPEX

RO008302RP00044 | Final

December 2014

Regulatory Submission

Project no: RO008302
Document title: Review of AER Draft Decision - REPEX
Document No.: RO008302RP00044
Revision: Final
Date: December 2014
Client name: Ausgrid
Project manager: Cliff Jones
Author: Gerhard Joubert
File name: E:\Jacobs - September 2014\Projects\RO008302 - Ausgrid AER Determination\Deliverables\Draft Report Master - Update.docx

Jacobs Group (Australia) Pty Limited
ABN 37 001 024 095
32 Cordelia Street
PO Box 3848
South Brisbane QLD 4101 Australia
T +61 7 3026 7100
F +61 7 3026 7300
www.jacobs.com

Document history and status

Revision	Date	Description	By	Review	Approved
Draft	23/12/2014	Draft for client comment	G Joubert	C Jones	C Jones
Final	07/01/2015	For Issue	G Joubert	C Jones	C Jones

Contents

Executive summary **1**
1. Introduction **4**
2. High level AER findings **5**
3. Documents reviewed by Jacobs **6**
4. Relationship between total repex and network scale **7**
5. AER predictive modelling **9**
5.1 Base case model-historical data 9
5.2 Base case model – forecast data 9
5.3 The calibrated forecast model 9
5.4 The "calibrated" model 10
6. Comparison of AER repex model vs Ausgrid repex estimates. **11**
6.1 General 11
6.2 Asset lives 11
6.3 Unit rate costs 7

Executive summary

The AER's Draft Decision document dated Nov. 2014 proposes to reduce Ausgrid's total capital expenditure for the 2014-19 regulatory period from $4.421 billion ($2013/14) to $2.546 billion, a reduction of 42.4%

The main driver for the signification reduction in the total capital expenditure is a reduction in the amount of forecast replacement expenditure (including Duty of Care plans), down from $3.107 billion to $1.769 billion, a reduction of 43% (excluding capitalised overheads).

AER have stated that they do not accept Ausgrid's proposal for replacement expenditure, on the basis that:

- Ausgrid's proposal is around 40 per cent higher than its long-term average and Ausgrid compares unfavourably on a number of benchmarks which take into account Ausgrid's network size.
- Measures of asset health suggest that Ausgrid has not demonstrated that the likely condition of its assets supports its proposed forecast repex.
- There is evidence from an engineering review that Ausgrid's proposal is likely to significantly overstate the amount of repex required to meet the capex objectives. In particular, Ausgrid is likely to be replacing many assets earlier than is necessary to meet the capex objectives.
- The predictive modelling also suggests that Ausgrid's proposal is likely to be overstated. This demonstrates that Ausgrid's asset replacement requirements are likely to be materially lower.

Jacobs, and its predecessor SKM, have undertaken many Repex modelling assignments for both regulators and utilities alike in the electricity transmission and distribution sectors, as well as the gas industry and water supply and waste-water sector.

Typically we have modelled network Repex over 30 year periods, and we have done such modelling in different regulatory regimes such as the UK, NZ, Australia, and various S.E Asian countries. As such we have an intimate understanding of the strengths and weaknesses of such modelling, and the subtleties and nuances associated with data quality, asset groupings, sub-assets, asset lives, and unit costs, etc.

Our key findings and observations about the AER Repex modelling from this review are:

- Above all other issues and factors in our review, we find that the underlying assumptions and methodology used to produce the AER "calibrated forecast" is fundamentally flawed in its logic, and for most asset categories will produce a biased forecast which understates the real levels of Repex that will be required by Australian DNSP's to sustainably maintain asset integrity and system performance in the long term.
- Jacobs fundamentally disagrees with the AER's premise that the future requirement for sustainable long term replacement expenditure for a DNSP can be predicted by looking at recent past expenditure. Such an approach runs the risk of:
    - o Failing to recognise where in the investment cycle each asset class sits, relative to the expected life of the asset class / type. i.e. whether the asset class has a relatively young average age relative to its life-cycle, reflecting the period in time when it was introduced on the system, or whether it is a mature class of asset with a high average asset age, and an age profile or deteriorating asset condition / reliability, which requires increasing replacement expenditure (or somewhere in-between).
    - o Failing to account for replacement expenditure associated with one-off major projects involving the decommissioning and replacement of high cost infrastructure (e.g. major substations or high voltage underground cables)
    - o Failing to account for changes in asset characteristics for example the declining asset quality of wood poles. It is a recognised industry experience that the quality of wood pole species

available in Australia has been declining over a long period, resulting in shorter life expectancies. This change will impact future replacement programs.

  - o Continuing to perpetuate an inadequate level of Repex investment on the basis that "if it was the level of investment that has been made in the recent past, it is therefore adequate for the immediate future". This simplistic approach fails to recognise that power systems in Australia will continue to age (as has been demonstrated in a number of previous regulatory submissions from a variety of DNSP's) and deteriorate based on historical levels of Repex.

- Jacobs has reviewed the various scenarios in the AER Repex model and has found some material "data errors" in certain fields, as well as some erroneous outcomes which appear to be generated by the flawed logic of the model. These are summarised in sections 5 and 6 of this report.

- The AER attempt in part to justify the decision to reduce Repex on the basis of two graphs (Figs A-7 & A-8) which purport to show a correlation between the Repex of a DNSP and customer density and demand density. Jacobs would suggest that any such correlation would have a low correlation co-efficient, and that these two factors are largely unrelated to the underlying drivers of Repex.

- The AER then refers to a graph (Fig. A-9) which shows a relationship between the level of Repex and the size of the asset base (RAB) of the DNSP. Jacobs agrees that there is a strong correlation between these factors, although with some qualifications (refer section 4).

Important note about your report

The sole purpose of this report and the associated services performed by Jacobs is to provide input into Ausgrid's 2014-19 Regulatory Proposal in accordance with the scope of services set out in the contract between Jacobs and the Client. That scope of services is described in:

- Jacobs email dated 17/12/2014: and,
- Ausgrid Purchase Order No.4500919421 dated 17/12/2014

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.

Jacobs derived the data in this report from information sourced from the Client (if any) and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report.

Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Jacobs for use of any part of this report in any other context.

This report has been prepared on behalf of, and for the exclusive use of, Jacobs's Client, and is subject to, and issued in accordance with, the provisions of the contract between Jacobs and the Client.

Jacobs accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

1. Introduction

The AER's Draft Decision Overview document dated November 2014 outlines the analysis undertaken and reasons given for AER's decision to reduce Ausgrid's Replacement Expenditure (Repex) by $1.338 billion (approximately 25.4%) over the 2014/15 – 2018/19 regulatory period,

Attachment 6; Capital Expenditure to the AER's Draft Decision document provides further details and analysis behind the AER's decision.

Ausgrid has engaged Jacobs to undertake an independent review of the AER Repex modelling process as applied to Ausgrid , including a validation of the accuracy of asset lives and unit rate costs used, and an assessment of the appropriateness of the underlying philosophy of the AER "calibrated" model that has been used to determine Ausgrid's Repex allowance in the draft determination.

This will involve identifying any "errors of fact" in the asset data used in the AER Repex modelling, as well as identifying any "flawed logic" in the AER's "calibrated model".

This report reviews the reasons and justifications for AER's reductions given in the draft decision and supporting documents, and also reviews the logic and outcomes of the AER's Repex benchmarking. We also provide a comparison of the unit rate costs and average asset lives derived in the AER's calibrated forecast model, and calibrated benchmark model.

2. High level AER findings

The high level AER findings in regard to Ausgrid's proposed Repex forecast were that:

- On the basis of the information before them, the AER considers the forecast to be overstated, and exceeds the amount required to achieve the capex objectives.
- Ausgrid's proposal is around 40 per cent higher than Ausgrid's historical trend, and compares unfavourably on a number of category level benchmarks.
- Ausgrid use overly conservative risk criteria and multiple contingency allowances that systematically overstate their costs.
- Ausgrid do not adequately justify the timing of its proposal at the project / program level, relying on network age and condition information that is at times inconsistent and contradictory.
- The network health indicators concerning the condition of Ausgrid's assets do not support a significant increase in Repex relative to the longer term trend of actual Repex that Ausgrid has spent in past regulatory control periods.
- Ausgrid faced significant capex deliverability challenges during the 2009–2014 regulatory control period. We have found no evidence to suggest that Ausgrid is better equipped to deal with, or will not face these same challenges during the 2014–2019 period.
- The AER predictive modelling of Ausgrid's long term Repex requirements suggests a reasonable range for repex to be between $1,600 million and $1,769 million, as evidenced by past expenditure.

AER engaged EMCa to undertake an engineering review of Ausgrid's proposed Repex forecast, and EMCa's findings in relation to Repex can broadly be summarized as follows:

- Several systemic issues meant that Ausgrid's repex needs were overstated and its repex forecast was likely to have overestimation bias.
- Ausgrid's asset management decisions are characterised by a lack of robust options being considered, or cost-benefit analysis supporting the timing and volume of replacement activity.
- Ausgrid's repex program is also likely to have material deliverability risk.
- Ausgrid's approach to risk is overly conservative.

3. Documents reviewed by Jacobs

Due to the limited timeframe available to undertake the assignment it was not possible to undertake a thorough review and examination of all available documentation, however already being familiar with the AER Repex model, we were able to selectively target sections of key documents and data sources to undertake our analysis.

The key sources of information used in this review were:

- AER Draft Decision, Ausgrid distribution determination, 2015-16 to 2018-19 – Overview (Nov. 2014)
- AER Draft Decision, Ausgrid distribution determination, 2015-16 to 2018-19 – Attachment 6: Capital Expenditure (Nov 2014)
- AER Repex model (base-historical) – Excel file (Nov. 2014)
- AER Repex model (base-forecast) – Excel file (Nov. 2014)
- AER Repex model (calibrated-forecast) – Excel file (Nov.2014)
- AER Repex model (calibrated-benchmark average) – Excel file (Nov. 2014)
- AER Replacement expenditure model handbook (Nov. 2013)
- Networks NSW Report – Repex Model Review (Appendix C to Attachment 5.33)
- Ausgrid Regulatory proposal 1 July 2014 to 30 June 2019 (30 May 2014)
- Ausgrid Proposal Attachment 5.24, Overview of the Replacement and Duty of Care Plans for 2014 – 19

4. Relationship between total repex and network scale

This section of the AER draft decision displays an appalling misunderstanding of the fundamental drivers of Repex in any DNSP.

The fundamental drivers of Repex are:

- The volumes and types of assets on the system
- The overall age profile of the system assets as a whole
- The overall condition and serviceability of the assets on the system, and any specific deficiencies in individual asset classes
- The estimated unit replacement cost of assets that have reached the end of their economic service life

Figures A-7 and A-8 and the associated commentary suggests that there is some relationship between the magnitude of Repex for individual DNSPs and the customer density (customer/km line), as well as the capacity density (installed capacity/route line length). Such a proposition displays a lack of understanding of the nature of the Repex drivers listed above.

The "clustering" of the majority of the DNSP's in the bottom left hand quadrant of these two graphs, with the remaining DNSP's scattered in different quadrants, gives a strong indication that there is not a strong level of correlation between the independent variables being graphed. When we consider the nature of the real drivers of Repex as listed above, we are not surprised that there would be a low level of correlation, as shown on these two graph's.

To then draw what appears to be a "trend line" (although it is not identified as such), and comment on the relative positioning of an individual DNSP's is statistical nonsense.

We understand that Ausgrid is considered to be an outlier on these graphs, although the "trend lines" appear to indicate that Ausgrid's data is still being used to calculate the trends.

Ausgrid is the largest distributor in Australia, both in terms of customers served, and in terms of the RAB of its network, so it is not surprising all other things being equal, that it's Repex would be higher than the average of all other DNSP's.

For the author to then treat Ausgrid as an outlier and conclude that:

" Ausgrid compares unfavourably under both density measures. Further, these measures suggest that predominately rural based networks incur higher Repex than urbanised networks."

displays an appalling lack of understanding of the fundamental drivers of Repex.

Jacobs agrees in part with the proposition that *"… the size of a service provider's regulatory asset base (RAB) will affect the amount of Repex it incurs."*

We qualify this observation however by pointing out that RAB is not a "perfect" denominator to use in cross DNSP comparison because:

- The RAB's of Australian DNSPs were established at different points in time using different unit rate costs, and using asset quantity data that was not always accurate
- As a particular DNSPs network continues to age, the RAB of existing assets will decline (ignoring new assets added), due to additional depreciation. This will cause the DNSP's Repex/RAB ratio to increase and fall above the average Repex / RAB trend line (making it appear to be inefficient in respect of

Repex). In fact it is an indicator that the ageing system requires more Repex (not less) to control the deteriorating age profile and declining asset condition.

Nevertheless, we accept the general relevance of the information shown in figure A-9, but point out that the ratio of Repex to RAB, based on just the most recent 5 year Repex figure is **not** an indication of the long term sustainable Repex requirement

5. AER predictive modelling

Jacobs has reviewed the manner in which AER's predictive modelling of Repex has been applied to Ausgrid in the draft decision document and comments as follows:

5.1 Base case model-historical data

Jacobs fundamentally disagrees with the AER's premise that *"… our view of Ausgrid's long-term Repex requirements as evidenced by its past expenditure will provide Ausgrid with a reasonable opportunity to recover at least its efficient costs."* (p6-11)

Simply put, future requirements for sustainable replacement and refurbishment expenditure cannot be predicted by past trends and averages of actual expenditure.

We note the past and future base case profile contained in figure A-18 (p6-65), which is not dissimilar to other Repex forecast profiles that we have seen on many occasions previously. The AER commentary following figure A-18 suggests that the step-up/trend down replacement profile is in some way unusual, or unexpected.

In reality it is Jacobs experience, and that of other DNSPs that in a capital constrained environment, expenditure on Repex is to some degree "discretionary", and certainly lower priority than expenditure on customer driven capex, demand driven capex, and regulatory, statutory/environmental and safety capex.

Historically, it is not unusual for DNSPs to underspend on Repex over significant periods of time and to defer "non-critical" replacement and refurbishment of assets, creating a potential bow-wave of impending replacements such as that demonstrated in Figure A-18.

It is naïve, and shows a lack of understanding of basic distribution network replacement / refurbishment practices for the AER to make the statement:

> *"… if Ausgrid's actual asset replacement profile followed its base case replacement lives,….. the older assets would have:*
>
> - *Already reached the end of their economic (replacement) lives and so would have already been largely replaced; and*
> - *Would therefore not be expected to be in the asset age profile, or be in such insignificant volumes that it would not materially affect the outcome of Repex modelling."*

5.2 Base case model – forecast data

5.3 The calibrated forecast model

We note that the calibrated model uses replacement lives and standard deviations based on Ausgrid's replacement volumes over the past five years. However we are not convinced that this modelling approach produces valid results. The use of the past five years Repex spend and volumes is not necessarily representative of a long term sustainable programme that will see Ausgrid manage its assets in an efficient manner into the future, and to sustainably maintain asset integrity and system performance in the long term..

We note that Networks NSW has previously expressed concerns about the use of "calibrated lives" in the AER Repex modelling, and Jacobs has similar concerns. We also note the AER comment (p6-67) that:

> *"After considering the concerns raised by NSW Networks, our view is that these concerns are unfounded. The model is based on well-established principles of probability and normal distribution. It has been used by the AER previously and has similar characteristics to the model used by OFGEM.107 We do not accept that the model is flawed because we use different input data. In our view, it is good practice to scrutinise the inputs having regard to the outcomes and when viewed against the regulatory proposal which is the subject of our determination. We consider this good practice."*

Jacobs considers that the Repex modelling in respect of "calibrated lives" is flawed because "…*we* (AER) *have used different input data."*

We consider it is flawed because of the assumptions that:

- "… *our view of Ausgrid's long-term Repex requirements as evidenced by its past expenditure and will provide Ausgrid with a reasonable opportunity to recover at least its efficient costs." (p6-11):* and
- *"First, if Ausgrid's actual replacement lives were consistent with their base case replacement lives, we would not expect to see the observed asset replacement profile. This is because, if Ausgrid's actual asset replacement profile followed its base case replacement lives, the older assets would have:*
    - *already reached the end of their economic (replacement) lives and so would have already been largely replaced; and*
    - *would therefore not be expected to be in the asset age profile, or be in such insignificant volumes that it would not materially affect the outcome of repex modelling."(p6-65)*

These are the assumptions that are fundamentally flawed.

5.4 The "calibrated" model

The AER's calibrated 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 programmes 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.

However, underground cable replacement, and overhead structures in bushfire prone areas, does not follow a regular cyclical inspection and replacement program, therefore there was not as much spent on it in the last regulatory period, and it is not needed in the next regulatory period. – That is the simplistic logic that the calibrated model applies.

In addition, the calibrated model suffered from some basic data entry errors for unit costs (refer section 7 of our report) which would have impacted the calibrated lives (the calibrated lives are calculated by the model, they are not "real".

It is best not to confuse the "calibrated model" with the "benchmark model", which simply applies average industry benchmark costs to the quantities derived in the "calibrated model".

The benchmark model was not used to arrive at the AER's recommended level of Repex, the calibrated model was used for this purpose.

6. Comparison of AER repex model vs Ausgrid repex estimates.

6.1 General

The REPEX model consists of four parts and is aimed at capturing Ausgrid's historical and forecast replacement program data, which it then adjusts to develop a calibrated benchmark forecast. In general the following clarifications and issues have been summarised.

- **Base Historical data model**, captures asset quantity, age/remaining life, and unit rate data provided by Ausgrid in the RIN submissions
- **Base Forecast data model**, capturing asset quantity, age/remaining life, and unit rate data provided by Ausgrid as part of the Regulatory Submission. In Ausgrid's case the only adjustment between the Historical and Forecast data is in the unit rates were the Forecast unit rates are overall around 35% lower than the Historical.
- **Calibrated Forecast model**, the calibrated model uses actual replacement volumes achieved by the Utility in most recent years (5 years) and then adjusts the mean asset replacement life of the asset group until it reflects this actual achieved replacement volume.

  This has resulted in significant variances between the Ausgrid Repex forecast and the AER calibrated forecast, especially where replacement programs are expected which has not necessarily been in place in historical years. Examples include SWER conductor, single phase Pole Mounted Transformer, and Overhead Earth Wire replacements where historically zero or insignificant quantities were being replaced and more significant replacements are forecast. This highlights a flaw in the calibration approach in that historical replacement programs is not necessarily a reflection on replacement programs going forward.
- **Calibrated Benchmark model**, the benchmark component of the model aims at adjusting the asset replacement cost unit rates to reflect average actual costs incurred in recent years (5 years). It is not always possible to obtain actual costs at the asset category levels required, and a scaling of the costs is required.

  The benchmark unit rates are not specific to Ausgrid and are based on a NEM average. The same unit costs were used to assess the DNSP submissions. In comparison with the Ausgrid unit costs both upward and downward adjustments takes place, however the upward adjustments seems to favour lower ranking asset categories in terms of overall cost impact, whereas the downward adjustments appears to favour the higher ranking asset categories example pole and pole mounted transformer replacements.

  The benchmark unit costs applied by the AER includes a number of anomalies for example the AER adopts an unrealistic $500 replacement cost for a distribution pole, whereas recent surveys undertaken by Jacobs suggests that a unit cost of ~$6000 is a more realistic benchmark, however, it is still lower than the expenditures incurred by Ausgrid. The impact of the AER adopted unit cost is a significant drop in the pole replacement forecast from the Ausgrid forecast of ~$300m to the AER's benchmark forecast of ~$40m.

6.2 Asset lives

The calibrated model derives asset replacement lives by adjusting the replacement lives for each asset category until it reflects the actual replacement volumes achieved by Ausgrid in the most recent five years. This approach assumes that historical practises are representative of future replacement requirements which is not necessarily the case. For example Ausgrid's forecast includes a replacement program for SWER conductor for which no replacement programs were in place previously. The calibrated mean asset life derived for SWER conductor is thus 88 years which is unrealistic given general industry experience shows that overhead lines has a mean life of around 45 years and a potential maximum life of 55 years. Further examples of nonsensical mean lives derived using the calibrated model approach includes 134.3 years for fuse installations and 99.4 years for >33kV & <=66kV switch installation suggesting installations exceeding the existence of the industry.

It is also noted that the calibrated approach does not allow for adjustments in asset lives based on declining asset quality. For example the quality of wood poles have been declining in recent years with genuine hardwood poles such as ‘Regal’ and other higher grade wood species being replaced with ‘Spotted Gum’ and ‘Yellow Gum’ type species. Recent replacement programs are thus resulting in a downward adjustment of the remaining life expectancy of wood pole populations and demonstrate that current and historical wood pole replacement programs are not reflective of future replacement programs as the AER’s calibrated model approach suggests.

The calibrated mean replacement lives applied to the Ausgrid forecast is generally much longer than industry experience. Figure 1 provides an overview of the percentage variance between Ausgrid’s proposed replacement lives and the AER’s Calibrated replacement lives. For the vast majority of assets the replacement lives have been extended and in most cases with more than 30%. The result of the life extensions is a reduction in the volume of replacement requirements and a downward adjustment of the replacement forecast.

Table 1 provides a more detailed assessment of the variance in asset replacement lives and also provides a comparison with general industry experience.

Figure 1: Asset Replacement Life Variance

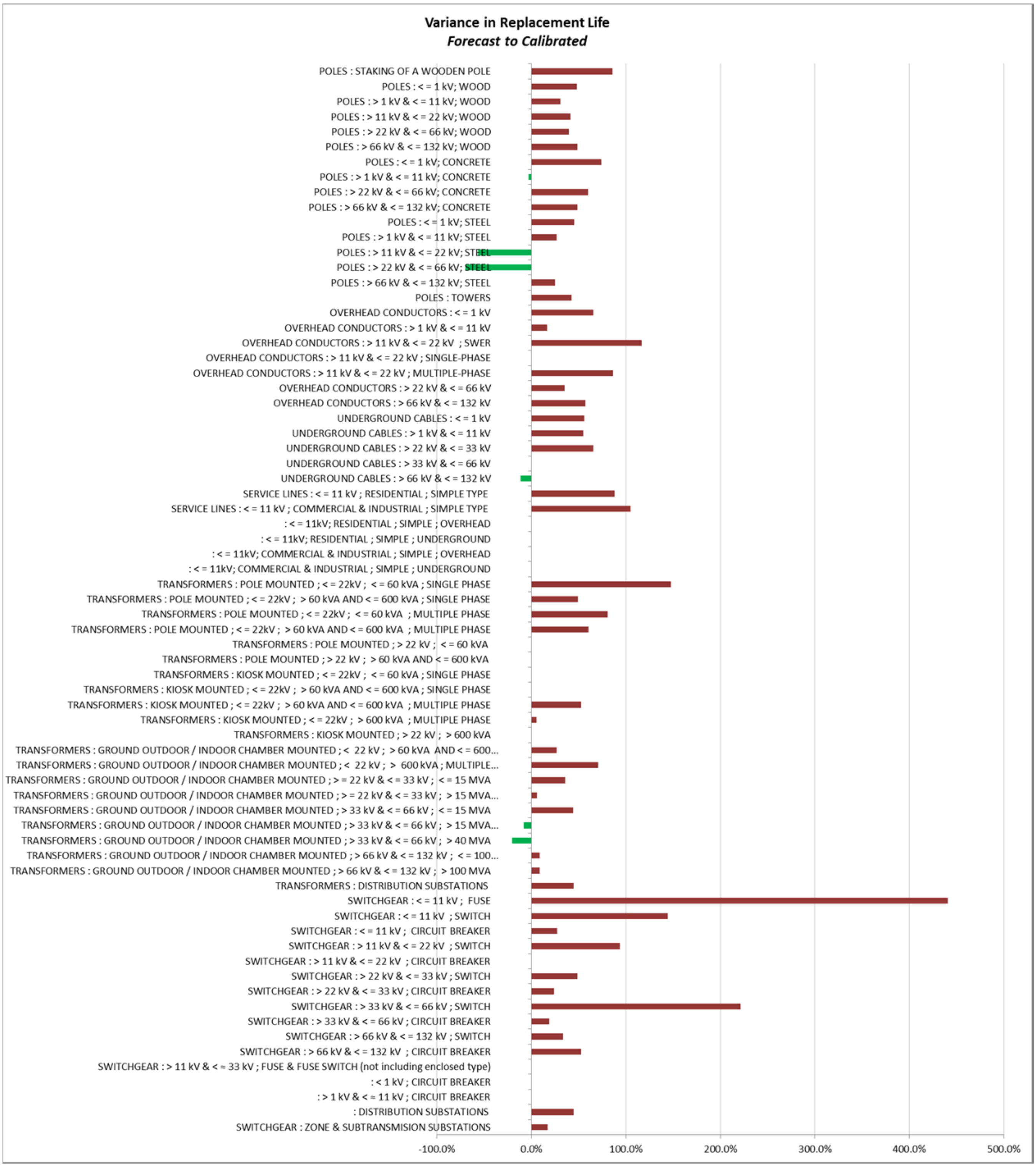


Table 1: Asset Replacement Life comparison

AER Repex Model			Ausgrid Quantity from RIN	Replacement Life			Notes on Replacement Life
				Ausgrid Base Forecast	AER Calibrated	Jacobs	
ID	**Asset category**	**Asset ID**		**mean**	**mean**	**mean - max**	
1	POLES	STAKING OF A WOODEN POLE	23,037	6.8	12.6	-	The Ausgrid replacement life appears low. A 15 year life extension appears reasonable.
1	POLES	< = 1 kV; WOOD	278,900	40.6	60.2	45-50	The AER mean replacement life appears too high for wood poles. Jacobs believes typical industry life is 45 years and a maximum potential life is 50 years.
1	POLES	> 1 kV & < = 11 kV; WOOD	129,070	40.6	53.1	45-50	
1	POLES	> 11 kV & < = 22 kV; WOOD	643	40.6	57.3	45-50	
1	POLES	> 22 kV & < = 66 kV; WOOD	17,641	40.6	56.6	45-50	
1	POLES	> 66 kV & < = 132 kV; WOOD	4,610	40.6	60.4	45-50	
1	POLES	< = 1 kV; CONCRETE	464	27.6	48.1	55-60	The AER mean replacement life appears too low for concrete poles. Jacobs believes typical industry life is 55 years and a maximum potential life is 60 years. The average age of the Ausgrid concrete poles are ~12 years. The low mean asset life is in Ausgrid's favour.
1	POLES	> 1 kV & < = 11 kV; CONCRETE	274	27.6	26.8	55-60	
1	POLES	> 22 kV & < = 66 kV; CONCRETE	3,390	27.6	44.2	55-60	
1	POLES	> 66 kV & < = 132 kV; CONCRETE	2,547	27.6	41.0	55-60	
1	POLES	< = 1 kV; STEEL	7,915	38.2	55.5	60	The AER mean replacement life appears too low for steel poles. Jacobs believes typical industry life is 60 years. The average age of the Ausgrid steel poles are ~24 years. The low mean asset life is in Ausgrid's favour.
1	POLES	> 1 kV & < = 11 kV; STEEL	39	38.2	48.4	60	
1	POLES	> 11 kV & < = 22 kV; STEEL	8	38.2	16.7	60	
1	POLES	> 22 kV & < = 66 kV; STEEL	232	38.2	11.5	60	
1	POLES	> 66 kV & < = 132 kV; STEEL	129	38.2	47.8		

AER Repex Model			Ausgrid Quantity from RIN	Replacement Life			Notes on Replacement Life
				Ausgrid Base Forecast	AER Calibrated	Jacobs	
ID	Asset category	Asset ID		mean	mean	mean - max	
1	POLES	TOWERS	739	47.3	67.2	60	The AER mean replacement life appears too high for Towers. Jacobs believes typical industry life is 60 years.
2	OVERHEAD CONDUCTORS	< = 1 kV	12,901	40.6	67.2	45-55	Although conductors in themselves may have a long design life, the replacement life is often a function of the condition/replacement requirements of other asset associated with the overhead line installation. Therefore Jacobs believes that the typical industry life of conductors is 45-55 years. The AER replacement life appears too high.
2	OVERHEAD CONDUCTORS	> 1 kV & < = 11 kV	9,778	40.6	47.4	45-55	
2	OVERHEAD CONDUCTORS	> 11 kV & < = 22 kV ; SWER	125	40.6	87.9	45-55	
2	OVERHEAD CONDUCTORS	> 11 kV & < = 22 kV ; SINGLE-PHASE	72	40.6	40.6	45-55	
2	OVERHEAD CONDUCTORS	> 11 kV & < = 22 kV ; MULTIPLE-PHASE	54	40.6	75.6	45-55	
2	OVERHEAD CONDUCTORS	> 22 kV & < = 66 kV	1,759	40.6	54.8	45-55	
2	OVERHEAD CONDUCTORS	> 66 kV & < = 132 kV	1,086	40.6	63.7	45-55	
3	UNDERGROUND CABLES	< = 1 kV	5,604	42.5	66.2	60	The AER mean replacement life appears to high for underground cables. Jacobs believes typical industry life is 60 years.
3	UNDERGROUND CABLES	> 1 kV & < = 11 kV	7,771	45.7	70.6	60	
3	UNDERGROUND CABLES	> 22 kV & < = 33 kV	804	46.7	77.1	60	

AER Repex Model			Ausgrid Quantity from RIN	Replacement Life			Notes on Replacement Life
				Ausgrid Base Forecast	AER Calibrated	Jacobs	
ID	Asset category	Asset ID		mean	mean	mean - max	
3	UNDERGROUND CABLES	> 33 kV & < = 66 kV	3	46.7	46.7	45	The AER mean replacement life appears to align with typical industry experience.
3	UNDERGROUND CABLES	> 66 kV & < = 132 kV	587	53.5	47.3	45	
4	SERVICE LINES	< = 11 kV ; RESIDENTIAL ; SIMPLE TYPE	910,928	33.9	63.9	35-45	The AER mean replacement life appears too high for service lines. Jacobs believes typical industry life is 35 years with a maximum potential life of 45 years.
4	SERVICE LINES	< = 11 kV ; COMMERCIAL & INDUSTRIAL ; SIMPLE TYPE	73,066	37.3	76.3	35-45	
5	TRANSFORMERS	POLE MOUNTED ; < = 22kV ; < = 60 kVA ; SINGLE PHASE	4,648	32.3	80.0	40-45	The AER mean replacement life appears too high. Jacobs believes typical industry life is 40 years with a maximum potential life of 45 years.
5	TRANSFORMERS	POLE MOUNTED ; < = 22kV ; > 60 kVA AND < = 600 kVA ; SINGLE PHASE	439	36.5	54.4	40-45	
5	TRANSFORMERS	POLE MOUNTED ; < = 22kV ; < = 60 kVA ; MULTIPLE PHASE	2,163	33.0	59.6	40-45	
5	TRANSFORMERS	POLE MOUNTED ; < = 22kV ; > 60 kVA AND < = 600 kVA ; MULTIPLE PHASE	8,615	36.5	58.5	40-45	
5	TRANSFORMERS	POLE MOUNTED ; > 22 kV ; < = 60 kVA	6	33.0	33.0	40-45	The AER mean replacement life appears too low. Jacobs believes typical industry life is 40 years with a maximum potential life of 45 years. The low mean asset life is to Ausgrid's favour.
5	TRANSFORMERS	POLE MOUNTED ; > 22 kV ; > 60 kVA AND < = 600 kVA	16	36.5	36.5	40-45	
5	TRANSFORMERS	KIOSK MOUNTED ; < = 22kV ; < = 60 kVA ; SINGLE PHASE	1	36.3	36.3	40-45	
5	TRANSFORMERS	KIOSK MOUNTED ; < = 22kV ; > 60 kVA AND < =	14	36.3	36.3	40-45	

AER Repex Model			Ausgrid Quantity from RIN	Replacement Life			Notes on Replacement Life
				Ausgrid Base Forecast	AER Calibrated	Jacobs	
ID	Asset category	Asset ID		mean	mean	mean - max	
		600 kVA ; SINGLE PHASE					
5	TRANSFORMERS	KIOSK MOUNTED ; < = 22kV ; > 60 kVA AND < = 600 kVA ; MULTIPLE PHASE	7,466	36.3	55.4	40-45	The AER mean replacement life appears too high. Jacobs believes typical industry life is 40 years with a maximum potential life of 45 years.
5	TRANSFORMERS	KIOSK MOUNTED ; < = 22kV ; > 600 kVA ; MULTIPLE PHASE	4,131	36.3	38.2	40-45	The AER mean replacement life appears too low. Jacobs believes typical industry life is 40 years with a maximum potential life of 45 years. The low mean asset life is to Ausgrid's favour.
5	TRANSFORMERS	KIOSK MOUNTED ; > 22 kV ; > 600 kVA	1	36.3	36.3	40-45	
5	TRANSFORMERS	GROUND OUTDOOR / INDOOR CHAMBER MOUNTED ; < 22 kV ; > 60 kVA AND < = 600 kVA ; MULTIPLE PHASE	949	54.4	68.8	40-45	The AER mean replacement life appears to high. Jacobs believes typical industry life is 40 years with a maximum potential life of 45 years.
5	TRANSFORMERS	GROUND OUTDOOR / INDOOR CHAMBER MOUNTED ; < 22 kV ; > 600 kVA ; MULTIPLE PHASE	3,966	36.6	62.4	40-45	
5	TRANSFORMERS	GROUND OUTDOOR / INDOOR CHAMBER MOUNTED ; > = 22 kV & < = 33 kV ; < = 15 MVA	83	45.7	62.0	40-45	
5	TRANSFORMERS	GROUND OUTDOOR / INDOOR CHAMBER MOUNTED ; > = 22 kV & < = 33 kV ; > 15 MVA AND < = 40 MVA	214	45.7	48.2	40-45	
5	TRANSFORMERS	GROUND OUTDOOR / INDOOR CHAMBER MOUNTED ; > 33 kV & < = 66 kV ; < = 15 MVA	13	45.7	65.8	40-45	
5	TRANSFORMERS	GROUND OUTDOOR / INDOOR CHAMBER MOUNTED ; > 33 kV & < = 66 kV ; > 15 MVA	38	45.7	41.9	40-45	

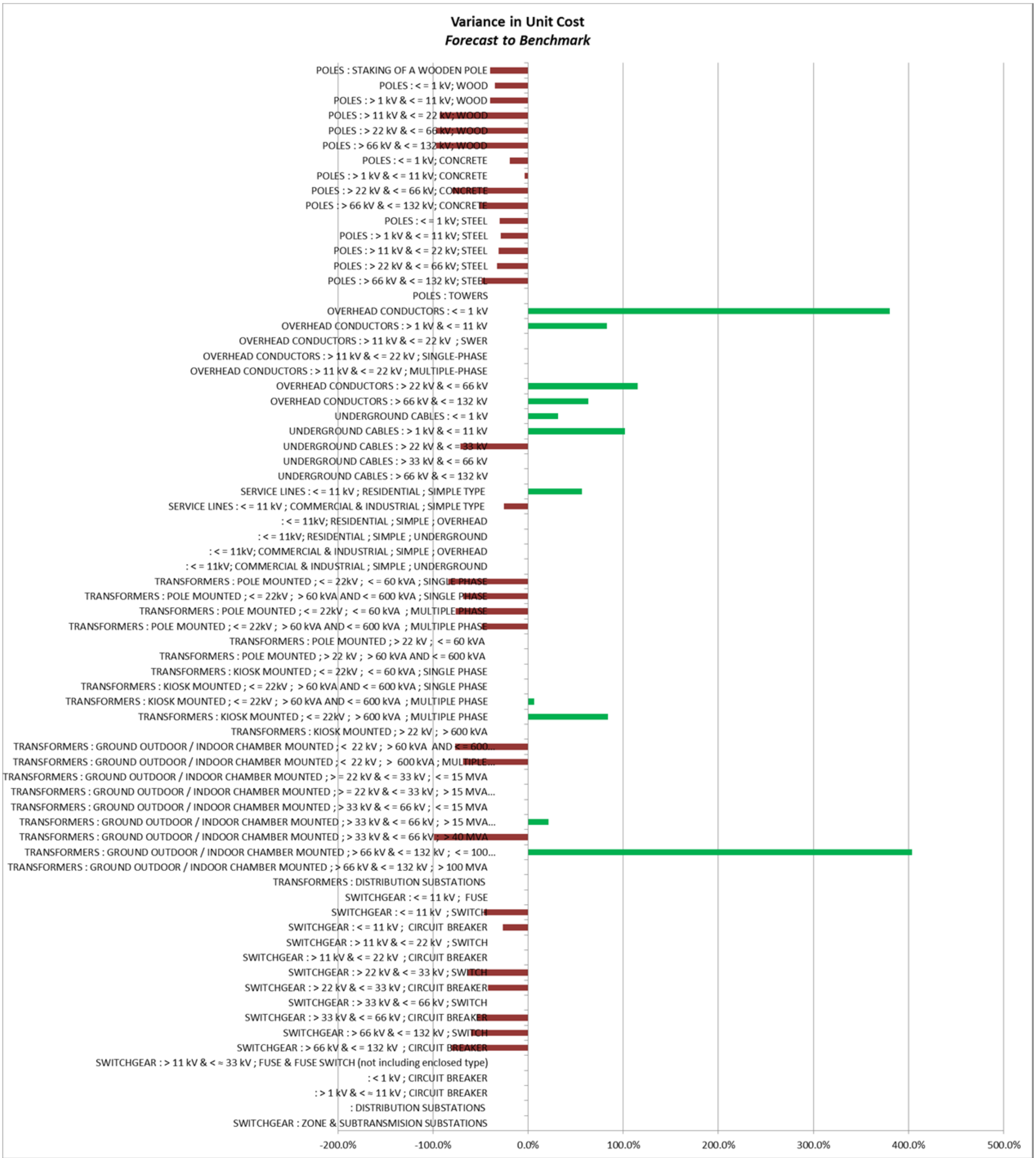
AER Repex Model			Ausgrid Quantity from RIN	Replacement Life			Notes on Replacement Life
				Ausgrid Base Forecast	AER Calibrated	Jacobs	
ID	Asset category	Asset ID		mean	mean	mean - max	
		AND < = 40 MVA					
5	TRANSFORMERS	GROUND OUTDOOR / INDOOR CHAMBER MOUNTED ; > 33 kV & < = 66 kV ; > 40 MVA	2	45.7	36.1	40-45	
5	TRANSFORMERS	GROUND OUTDOOR / INDOOR CHAMBER MOUNTED ; > 66 kV & < = 132 kV ; < = 100 MVA	194	45.7	49.6	40-45	
5	TRANSFORMERS	GROUND OUTDOOR / INDOOR CHAMBER MOUNTED ; > 66 kV & < = 132 kV ; > 100 MVA	43	45.7	49.6	40-45	
5	TRANSFORMERS	DISTRIBUTION SUBSTATIONS	15,209	32.9	47.5	40-45	
6	SWITCHGEAR	< = 11 kV ; FUSE	37,903	24.9	134.3	35-45	The AER mean replacement life appears generally too high. Jacobs believes typical industry life of circuit breakers is 40 years with a maximum potential life of 45 years, and switches have a typical industry life of 35 years and a maximum potential life of 45 years. A mean asset life for Fuse installations of 134.3 years is nonsensical and suggests that fuse installations generally exceeds the life expectancy of the entire network, and that fuse installations existed or were mostly installed prior to the existence of the electricity industry in Australia. Similarly the mean remaining life of 99.4 years derived for >33kV & <=66kV switches are nonsensical suggesting installations prior to the first of these networks being installed in Australia.
6	SWITCHGEAR	< = 11 kV ; SWITCH	78,410	29.1	71.0	35-45	
6	SWITCHGEAR	< = 11 kV ; CIRCUIT BREAKER	7,934	50.6	64.2	40-45	
6	SWITCHGEAR	> 11 kV & < = 22 kV ; SWITCH	55	39.7	76.9	35-45	
6	SWITCHGEAR	> 11 kV & < = 22 kV ; CIRCUIT BREAKER	7	41.8	41.8	40-45	
6	SWITCHGEAR	> 22 kV & < = 33 kV ; SWITCH	2,665	39.7	59.1	35-45	
6	SWITCHGEAR	> 22 kV & < = 33 kV ; CIRCUIT BREAKER	956	41.8	51.8	40-45	
6	SWITCHGEAR	> 33 kV & < = 66 kV ; SWITCH	468	30.9	99.4	35-45	
6	SWITCHGEAR	> 33 kV & < = 66 kV ; CIRCUIT BREAKER	137	31.8	37.8	40-45	
6	SWITCHGEAR	> 66 kV & < = 132 kV ; SWITCH	2,063	43.1	57.4	35-45	
6	SWITCHGEAR	> 66 kV & < = 132 kV ; CIRCUIT BREAKER	484	32.6	49.8	40-45	
6	SWITCHGEAR	> 11 kV & < ≈ 33 kV ; FUSE & FUSE SWITCH (not including enclosed type)	123	18.6	18.6	35-45	

AER Repex Model			Ausgrid Quantity from RIN	Replacement Life			Notes on Replacement Life
				Ausgrid Base Forecast	AER Calibrated	Jacobs	
ID	Asset category	Asset ID		mean	mean	mean - max	
6	SWITCHGEAR	ZONE & SUBTRANSMISION SUBSTATIONS	211	40.7	47.5	40-45	

6.3 Unit rate costs

The calibrated benchmark model applies a set of NEM benchmark unit rates to the Ausgrid replacement programs to develop a benchmarked Repex forecast. It aims to adjust the Repex forecasts to reflect actual average costs incurred in the NEM in the recent five years. Figure 2 provides an overview of the variances between the AER benchmark unit costs and Ausgrid's forecast unit costs.

Figure 2: Asset Replacement Unit Cost Variance



The AER unit rates vary both upward and downward in comparison with the Ausgrid unit costs across the asset categories. The downward adjustments appears, however, to be more heavily weighted towards the higher ranking cost asset categories with the unit rates for pole replacement down on average with around 45%, pole mounted transformers 46%, and switchgear 31%. The unit rates for cables, conductors, and services are adjusted upwards on average between 12% and 45%. The result of these variances is a significant downward adjustment in for example the forecast for pole replacements which drops from Ausgrids' $300m to the Calibrated Benchmark forecast of $40m.

Table 2 provides a more detailed assessment of the unit costs at an asset category level and also compares it with Jacobs' unit costs obtained through market surveys and recent benchmark assessments.

A number of anomalies are evident in the unit rates one of which includes the unit cost for 11kV pole replacements. The benchmark unit rate adopted by the AER is around $500 which is not a realistic reflection of the actual costs associated with this activity. Jacobs believe that a unit cost of around $6000 is more aligned with industry experience without allowing for project specific variables such as access, location, and scope complexity. The application of the AER unit cost has a significant impact on Ausgrid's replacement program and forecast.

A few cases also exist where the Ausgrid unit costs appears high in relation to industry average. These can also be seen in Table 2.

It should be noted that the overall impact of unit cost adjustments to the total repex forecast was only around 5%, suggesting that the AER may have based their modelling primarily on the calibrated model unit costs which reflects the unit costs proposed by Ausgrid.

The analysis, however, highlights some of the issues identified with the benchmark model approach.

Table 2: Asset Replacement Unit Rate comparison

AER Repex Model			Quantity from RIN	Unit Costs			Notes on Unit Costs
				Ausgrid Base Forecast	AER Calibrated Benchmark	Jacobs	
ID	Asset category	Asset ID		$ ('000)	$ ('000)	$ ('000)	
1	POLES	STAKING OF A WOODEN POLE	23,037	12.5	7.5	1.1	The unit cost for staking of poles appears high in relation to comparable costs identified by Jacobs. Ausgrid's unit cost for pole staking has been based on the AER's approach in which 50% of condemned poles would be staked and the remainder would be replaced with a new pole.
1	POLES	< = 1 kV; WOOD	278,900	6.7	4.4	~6.0	Recent work for a distribution survey suggests that Ausgrid's base unit cost is reasonable. The benchmark unit rate is considered too low.
1	POLES	> 1 kV & < = 11 kV; WOOD	129,070	6.7	4.1	~6.0	Recent work for a distribution survey suggests that Ausgrid's base unit cost is reasonable. The benchmark unit rate is considered too low.
1	POLES	> 11 kV & < = 22 kV; WOOD	643	7.5	0.5	~6.0	Unit rate in Calibrated Benchmark is significantly too low - $500 is insufficient for pole procurement, and would not allow for installation.
1	POLES	> 22 kV & < = 66 kV; WOOD	17,641	16.0	0.5	-	Unit rate in Calibrated Benchmark is significantly too low - $500 is insufficient for pole procurement, and would not allow for installation.
1	POLES	> 66 kV & < = 132 kV; WOOD	4,610	16.0	0.5	7.5-8.0	Unit rate in Calibrated Benchmark is significantly too low - $500 is insufficient for pole procurement, and would not allow for installation.
1	POLES	< = 1 kV; CONCRETE	464	11.9	9.6	10.0	Unit rate in Calibrated Benchmark appears reasonable.
1	POLES	> 1 kV & < = 11 kV; CONCRETE	274	11.9	11.5	10.0	Unit rate in Calibrated Benchmark appears reasonable.
1	POLES	> 22 kV & < = 66 kV; CONCRETE	3,390	98.3	20.2	-	
1	POLES	> 66 kV & < = 132 kV; CONCRETE	2,547	29.4	14.4	-	

AER Repex Model			Quantity from RIN	Unit Costs			Notes on Unit Costs
				Ausgrid Base Forecast	AER Calibrated Benchmark	Jacobs	
ID	Asset category	Asset ID		$ ('000)	$ ('000)	$ ('000)	
1	POLES	< = 1 kV; STEEL	7,915	11.9	8.4	-	
1	POLES	> 1 kV & < = 11 kV; STEEL	39	11.9	8.5	-	
1	POLES	> 11 kV & < = 22 kV; STEEL	8	13.4	9.2	-	
1	POLES	> 22 kV & < = 66 kV; STEEL	232	29.4	19.8	-	
1	POLES	> 66 kV & < = 132 kV; STEEL	129	29.4	15.1	-	
1	POLES	TOWERS	739	176.3	176.3	-	Ausgrid unit cost adopted
2	OVERHEAD CONDUCTORS	< = 1 kV	12,901	12.3	58.9	51.0	Recent work for a distribution survey suggests that the benchmark unit rate is high.
2	OVERHEAD CONDUCTORS	> 1 kV & < = 11 kV	9,778	38.3	70.2	48.0	Recent work for a distribution survey suggests that the benchmark unit rate is high.
2	OVERHEAD CONDUCTORS	> 11 kV & < = 22 kV ; SWER	125	36.2	36.2	-	Ausgrid unit cost adopted
2	OVERHEAD CONDUCTORS	> 11 kV & < = 22 kV ; SINGLE-PHASE	72	73.2	73.2	-	Ausgrid unit cost adopted
2	OVERHEAD CONDUCTORS	> 11 kV & < = 22 kV ; MULTIPLE-PHASE	54	62.5	62.5	-	Ausgrid unit cost adopted
2	OVERHEAD CONDUCTORS	> 22 kV & < = 66 kV	1,759	106.2	228.5	-	
2	OVERHEAD CONDUCTORS	> 66 kV & < = 132 kV	1,086	35.4	57.8	-	
3	UNDERGROUND CABLES	< = 1 kV	5,604	157.2	206.8	145.0	Calibrated benchmark unit cost appears too high.
3	UNDERGROUND CABLES	> 1 kV & < = 11 kV	7,771	283.7	572.8	Urb/Rul: 290.0	Calibrated benchmark unit cost appears too high.

JACOBS

AER Repex Model			Quantity from RIN	Unit Costs			Notes on Unit Costs
				Ausgrid Base Forecast	AER Calibrated Benchmark	Jacobs	
ID	Asset category	Asset ID		$ ('000)	$ ('000)	$ ('000)	
3	UNDERGROUND CABLES	> 22 kV & < = 33 kV	804	1,706.0	488.4	Urb/Rur: 536.0 CBD:1,320.0	Calibrated benchmark unit cost appears low based on medium sized installations in urban/rural areas and much too low for CBD type installations.
3	UNDERGROUND CABLES	> 33 kV & < = 66 kV	3	1,101.5	1,101.5	1,591.0	Calibrated benchmark unit cost appears too low. Ausgrid unit cost adopted
3	UNDERGROUND CABLES	> 66 kV & < = 132 kV	587	1,101.5	1,101.5	-	Calibrated benchmark unit cost appears too low. Ausgrid unit cost adopted
4	SERVICE LINES	< = 11 kV ; RESIDENTIAL ; SIMPLE TYPE	910,928	0.5	0.8	1.3	Calibrated benchmark unit cost appears too low
4	SERVICE LINES	< = 11 kV ; COMMERCIAL & INDUSTRIAL ; SIMPLE TYPE	73,066	1.1	0.8	1.5	Calibrated benchmark unit cost appears too low
		< = 11kV; RESIDENTIAL ; SIMPLE ; OVERHEAD	670,058	0.0	0.0	-	No unit costs applied
		< = 11kV; RESIDENTIAL ; SIMPLE ; UNDERGROUND	240,870	0.0	0.0	-	No unit costs applied
		< = 11kV; COMMERCIAL & INDUSTRIAL ; SIMPLE ; OVERHEAD	37,363	0.0	0.0	-	No unit costs applied
		< = 11kV; COMMERCIAL & INDUSTRIAL ; SIMPLE ; UNDERGROUND	35,703	0.0	0.0	-	No unit costs applied
5	TRANSFORMERS	POLE MOUNTED ; < = 22kV ; < = 60 kVA ; SINGLE PHASE	4,648	34.9	5.7	9.8	Calibrated Benchmark unit cost is too low and does not allow fo rthe purchase and installation of a single phase (10-25kVA) transformer on an existing pole.
5	TRANSFORMERS	POLE MOUNTED ; < = 22kV ; > 60 kVA AND < = 600 kVA ; SINGLE PHASE	439	34.9	11.1	-	
5	TRANSFORMERS	POLE MOUNTED ; < = 22kV ; < = 60 kVA ; MULTIPLE PHASE	2,163	34.9	8.4	11.6	Calibrated Benchmark unit cost is considered too low.
5	TRANSFORMERS	POLE MOUNTED ; < = 22kV ; > 60 kVA AND < =	8,615	34.9	17.9	32.0	Calibrated Benchmark unit cost is too low. And does not allow for the purchase and installation of a multiphase transformer

AER Repex Model			Quantity from RIN	Unit Costs			Notes on Unit Costs
				Ausgrid Base Forecast	AER Calibrated Benchmark	Jacobs	
ID	Asset category	Asset ID		$ ('000)	$ ('000)	$ ('000)	
		600 kVA ; MULTIPLE PHASE					(100-200kVA) on an existing pole.
5	TRANSFORMERS	POLE MOUNTED ; > 22 kV ; < = 60 kVA	6	10.4	10.4	11.6	Calibrated Benchmark appears reasonable.
5	TRANSFORMERS	POLE MOUNTED ; > 22 kV ; > 60 kVA AND < = 600 kVA	16	13.5	13.5	32.0	Calibrated Benchmark unit cost is too low. And does not allow for the purchase and installation of a mulitphase transformer (100-200kVA) on an existing pole.
5	TRANSFORMERS	KIOSK MOUNTED ; < = 22kV ; < = 60 kVA ; SINGLE PHASE	1	1.7	1.7	-	Unit cost is too low and there appears to be a data error as the quantity only shows 1.
5	TRANSFORMERS	KIOSK MOUNTED ; < = 22kV ; > 60 kVA AND < = 600 kVA ; SINGLE PHASE	14	35.4	35.4	-	Ausgrid unit cost adopted
5	TRANSFORMERS	KIOSK MOUNTED ; < = 22kV ; > 60 kVA AND < = 600 kVA ; MULTIPLE PHASE	7,466	35.4	37.7	60.0	Calibrated Benchmark unit cost is considered too low, but in favour of Ausgrid. (Jacobs unit cost based on 315kVA, metro installation)
5	TRANSFORMERS	KIOSK MOUNTED ; < = 22kV ; > 600 kVA ; MULTIPLE PHASE	4,131	40.5	74.5	85.0	Calibrated Benchmark unit cost is considered too low, but in favour of Ausgrid. (Jacobs unit cost based on 1000kVA, metro installation)
5	TRANSFORMERS	KIOSK MOUNTED ; > 22 kV ; > 600 kVA	1	35.4	35.4	-	Ausgrid unit cost adopted
5	TRANSFORMERS	GROUND OUTDOOR / INDOOR CHAMBER MOUNTED ; < 22 kV ; > 60 kVA AND < = 600 kVA ; MULTIPLE PHASE	949	208.0	48.7	65.8	Calibrated Benchmark unit rate too low. Calibrated Benchmark asset life is reasonable.
5	TRANSFORMERS	GROUND OUTDOOR / INDOOR CHAMBER MOUNTED ; < 22 kV ; > 600 kVA ; MULTIPLE PHASE	3,966	208.0	65.7	-	
5	TRANSFORMERS	GROUND OUTDOOR / INDOOR CHAMBER MOUNTED ; > = 22 kV & < = 33 kV ; < = 15 MVA	83	371.5	371.5	-	
5	TRANSFORMERS	GROUND OUTDOOR / INDOOR CHAMBER	214	706.2	706.2	-	

AER Repex Model			Quantity from RIN	Unit Costs			Notes on Unit Costs
				Ausgrid Base Forecast	AER Calibrated Benchmark	Jacobs	
ID	Asset category	Asset ID		$ ('000)	$ ('000)	$ ('000)	
		MOUNTED ; > = 22 kV & < = 33 kV ; > 15 MVA AND < = 40 MVA					
5	TRANSFORMERS	GROUND OUTDOOR / INDOOR CHAMBER MOUNTED ; > 33 kV & < = 66 kV ; < = 15 MVA	13	1,041.6	1,041.6	-	
5	TRANSFORMERS	GROUND OUTDOOR / INDOOR CHAMBER MOUNTED ; > 33 kV & < = 66 kV ; > 15 MVA AND < = 40 MVA	38	1,166.4	1,417.4	-	
5	TRANSFORMERS	GROUND OUTDOOR / INDOOR CHAMBER MOUNTED ; > 33 kV & < = 66 kV ; > 40 MVA	2	10,076.3	108.1	-	
5	TRANSFORMERS	GROUND OUTDOOR / INDOOR CHAMBER MOUNTED ; > 66 kV & < = 132 kV ; < = 100 MVA	194	571.5	2,880.1	-	
5	TRANSFORMERS	GROUND OUTDOOR / INDOOR CHAMBER MOUNTED ; > 66 kV & < = 132 kV ; > 100 MVA	43	2,608.6	2,608.6	-	Ausgrid unit cost adopted
5	TRANSFORMERS	DISTRIBUTION SUBSTATIONS	15,209	11.4	11.4	-	Ausgrid unit cost adopted
6	SWITCHGEAR	< = 11 kV ; FUSE	37,903	1.8	1.8	2.3	The Calibrated Benchmark unit rate is considered too low.
6	SWITCHGEAR	< = 11 kV ; SWITCH	78,410	32.9	17.6	18.3	The Calibrated Benchmark unit rate appears reasonable.
6	SWITCHGEAR	< = 11 kV ; CIRCUIT BREAKER	7,934	142.7	104.6	111.8	Calibrated Benchmark unit rate too low. Jacobs believes that the unit cost for an indoor feeder circuit breaker complete with equipped protection panel is around $111k and is higher for installations with more complex protection scheme considerations such as transformer and bus-coupler installations.
6	SWITCHGEAR	> 11 kV & < = 22 kV ; SWITCH	55	17.8	17.8	18.3	The Calibrated Benchmark unit rate appears reasonable.

AER Repex Model			Quantity from RIN	Unit Costs			Notes on Unit Costs
				Ausgrid Base Forecast	AER Calibrated Benchmark	Jacobs	
ID	Asset category	Asset ID		$ ('000)	$ ('000)	$ ('000)	
6	SWITCHGEAR	> 11 kV & < = 22 kV ; CIRCUIT BREAKER	7	46.6	46.6	111.8	Calibrated Benchmark unit rate too low. Jacobs believes that the unit cost for an indoor feeder circuit breaker complete with equipped protection panel is around $111k and is higher for installations with more complex protection scheme considerations such as transformer and bus-coupler installations.
6	SWITCHGEAR	> 22 kV & < = 33 kV ; SWITCH	2,665	135.7	49.5	41.6	The Calibrated Benchmark unit rate appears reasonable.
6	SWITCHGEAR	> 22 kV & < = 33 kV ; CIRCUIT BREAKER	956	206.0	119.0	111.8	Calibrated Benchmark unit rate is considered reasonable. Jacobs believes that the unit cost for an indoor feeder circuit breaker complete with equipped protection panel is around $111k and is higher for installations with more complex protection scheme considerations such as transformer and bus-coupler installations.
6	SWITCHGEAR	> 33 kV & < = 66 kV ; SWITCH	468	0.0	48.7	41.6	The Calibrated Benchmark unit rate appears reasonable.
6	SWITCHGEAR	> 33 kV & < = 66 kV ; CIRCUIT BREAKER	137	223.5	103.2	94.8	Calibrated Benchmark unit rate is considered reasonable. Jacobs believes that the unit cost for an outdoor 66kV feeder circuit breaker with protection relays and excluding an equipped bay is around $94k. The cost would be higher for circuit breaker installations requiring more complex protection scheme considerations such as transformer and bus-coupler installations.
6	SWITCHGEAR	> 66 kV & < = 132 kV ; SWITCH	2,063	180.9	72.7	-	
6	SWITCHGEAR	> 66 kV & < = 132 kV ; CIRCUIT BREAKER	484	655.5	127.3	237.2	The Calibrated benchmark unit rate is considered too low. Jacobs' believe that the unit cost for the replacement of a 132kV circuit breaker complete with protection is around $237k.
6	SWITCHGEAR	> 11 kV & < ≈ 33 kV ; FUSE & FUSE SWITCH	123	135.7	135.7	-	Ausgrid unit cost adopted

AER Repex Model			Quantity from RIN	Unit Costs			Notes on Unit Costs
				Ausgrid Base Forecast	AER Calibrated Benchmark	Jacobs	
ID	Asset category	Asset ID		$ ('000)	$ ('000)	$ ('000)	
		(not including enclosed type)					
		< 1 kV ; CIRCUIT BREAKER	2,858	0.0	0.0	-	
		> 1 kV & < ≈ 11 kV ; CIRCUIT BREAKER	5,076	0.0	0.0	-	
		DISTRIBUTION SUBSTATIONS	15,209	0.0	0.0	-	
6	SWITCHGEAR	ZONE & SUBTRANSMISION SUBSTATIONS	211	96.0	96.0	-	Ausgrid unit cost adopted