Nuttall Consulting

Regulation and business strategy

AER repex modelling - addendum

consideration of AER preliminary decision

A report to UED

final

December 2015

1 Addendum

This document serves as an addendum to the Nuttall Consulting report to United Energy Distribution (UED), "AER repex modelling: Assessing UED's replacement forecast", dated April 2015 (the repex modelling report). The repex modelling report was provided as a supporting document to the UED regulatory proposal (2016-20) to the Australian Energy Regulator (AER).

This addendum discusses revised repex modelling, conducted by Nuttall Consulting, at the request of UED, in response to the AER's preliminary decision on UED's regulatory proposal (preliminary decision)[1].

This addendum, including the associated analysis and repex modelling, has been prepared by Dr Brian Nuttall. Dr Nuttall was solely responsible for the modelling and drafting of the repex modelling report.

1.1 Background to this addendum

For the repex modelling report, I conducted a series of repex model studies aimed at replicating the analysis I understood the AER would apply to determine an *alternative estimate*[2] for UED's repex forecast. These studies covered the key studies I understood the AER would use, plus some additional studies that were agreed with UED to represent its specific circumstances. Importantly, my assessment used the 5-year period from 2010 to 2014 to calibrated the model parameters.

The results of my studies are summarised in Table 1 of the repex modelling report. My analysis covered $366 million of UED's repex forecast. The various studies produced repex forecasts that ranged between 84% ($306 million) and 103% ($378 million) of the covered UED repex forecast.

As anticipated, the AER used the repex model to develop an *alternative estimate* of a component of UED's repex forecast. The preliminary decision states that $346 million of UED's repex forecast was covered by this assessment, with all the key studies considered by the AER being significantly below UED's forecast (ranging between 64% ($220 million) and 79% ($272 million) of the UED repex forecast covered by this assessment)[3].

In contrast to my analysis, the AER used the 5-year period from 2011 to 2015 to model parameters. It also did not consider the alternative studies presented in my report.

[1] Discussed in Attachment 6 of the AER preliminary decision, United Energy distribution determination, 2016 to 2020, dated October 2015, and associated AER repex model files available on the AER website.
[2] This term was defined as the *reasonable range* in the repex modelling report because this was the term used by the AER at that time. The *reasonable range* term does not appear to have been used in subsequent decisions by the AER, and therefore, I have used the term *alternative estimate* here as this appears to be term preferred by the AER in the UED preliminary decision.
[3] Pg 6-72, Attachment 6, United Energy Preliminary Decision 2016-20

The above clearly indicated that our modelling and results were different. However, because of how our results were presented it is difficult for UED to reconcile the two sets of model results[4].

Therefore, UED has requested that I[5]:

- revise my assessment to allow for
  - the 5-year calibration period from 2011 to 2015 (as used by the AER)
  - revised pole staking data that was provided to the AER in response to an information request subsequent to my modelling
  - only the asset categories covered by the AER assessment
- reconcile my results to the AER repex model files and identify and discuss the key differences
- discuss the circumstances where the studies I have assessed could be used to set the alternative estimate.

To aid in the reconciliation of the AER modelling to my results, UED has provided AER model working files that provide additional detail on how the AER derived the model parameters (i.e. asset lives and unit costs) used in its assessment[6].

UED has also provided a revised repex forecast for my analysis[7]. I understand that the main change in this forecast (from the forecast I used in my original analysis) has occurred in the overhead conductor asset group, where the SWER replacement program has been removed and the HV aerial bundled conductor (ABC) program has been increased.

Before turning to my analysis and findings, it is important that I acknowledge the following. I have considered various matters based upon my best understanding of the AER's analysis and deliberations. However, I cannot claim definitively that this understanding is correct because of various factors, most notably:

- the style and structure of the AER's preliminary decision, and particularly uncertainty (on my part) between the relationship between the sections discussing the AER's repex modelling; the results in the actual AER repex model files (which do not reconcile to figures quoted in the preliminary decision); and other sections in the preliminary decision where the AER discusses its review of other UED repex programs of which its findings on these programs may have adjusted its findings from its repex modelling

[4] This is partly because I included pole top structures and scaled my reported results to cover some asset categories where I could not determine model parameters due to data limitations, and partly because the AER model results quoted in the AER preliminary decision document cannot be easily reconciled to the equivalent repex model files available on the AER website.
[5] Clarified during meeting with UED, dated 27/11/2015
[6] Provided in UED email, dated 30/11/2015
[7] Provided in email, dated 18/12/2015

- the format of the UED repex data used for my analysis, which is provided on an asset basis and not a program/project basis (i.e. the asset basis does not provide a simple reconciliation to project/program discussions in the preliminary decision).

I have had to rely on guidance from UED at times to resolve some of these matters.

1.2 Revised study results

The three tables below present my revised study results, reflecting the three variations on the unit cost parameters used in the AER assessment:

- **historical unit costs** (reflecting the average unit cost between 2011-2015)
- **forecast unit costs** (reflecting the average forecast unit cost between 2016-2020)
- **AER benchmark unit cost** (which has been derived by the AER and I have extracted from the relevant AER model file).

For comparative purposes, these tables also indicate the covered UED forecast and the equivalent AER study results.

The following points are important in appreciating the context of the results presented:

- **the model forecast period** – For my studies, I compared the model forecast over the 5-year period reflective of the UED regulatory period (2016 to 2020). This is the second to sixth year of the repex model's forecast – noting the age profile reflects the age of asset in 2014. As far as I can tell, the AER uses the 5-year period from 2015 to 2019, the first to fifth year of the repex model's forecast. I am unsure of the AER's reasoning for this, and therefore, I have presented the results for both periods in the tables.

  I will discuss my views on this matter further in the Section 1.4.2.

- **UED covered forecast** – The covered forecast includes the six asset categories assessed by the AER, namely poles, overhead conductors, underground cables, services, transformers and switchgear. For the avoidance of doubt, this analysis excludes pole top structures, as also excluded by the AER. I also understand that the revised forecast excludes programs in the six covered asset categories defined by UED as "unmodellable" in its RIN template, which I understand the AER also excluded from its assessment. This forecast does however include the LV ABC and a revised version of the HV ABC replacement programs that the AER reviewed separately as bushfire safety-related capex[8].

- **AER study results -** I have not been able to reconcile the AER study results stated in the preliminary decision with results in the AER model files published on the AER website. Therefore, the AER study results discussed here are taken directly from the AER model files.

[8] Section B.5, Attachment 6, United Energy Preliminary Decision 2016-20

With regard to the AER benchmark unit cost study, although this is discussed in the preliminary decision, the AER does not provide the model files on its website.

It also appears that this study is not used explicitly by the AER to set the alternative estimate; instead, it is used for indicative purposes to gauge the suitability of the other two unit cost options. With this in mind, I present these study results for indicative purposes.

- **Treatment of RIN data limitations –** I have made some minor amendments to how I previously treated asset categories with limited data for calibration. For my original analysis, I "switched off" these categories in the model. The AER on the other hand keeps these categories within the model by using substitute parameters; for example, from its benchmark unit costs[9]. I have adopted the AER's approach for this analysis.
- **Volume calibration –** Because I am using one year of forecast data in the calibration, I have changed the life calibration calculations to adjust for this. This results in a small difference in how I understand the AER has calibrated lives. I will discuss this further in the reconciliation section below.

Table 1 revised study results - historical unit costs ($ millions - real 2015)

Study		forecast period	Forecast ($million)	increase from AER study	headroom to UED forecast
AER		**2015-19**	**196**		**-103**
Nuttall	AER groups	2015-19	218	22	-81
		2016-20	227	31	-72
UED forecast modelled (2016-20)			**299**		

Table 2 revised study results - forecast unit costs ($ millions - real 2015)

Study		forecast period	forecast	increase from AER study	headroom to UED forecast
AER		**2015-19**	**248**		**-51**
Nuttall	AER groups	2015-19	272	24	-27
		2016-20	280	32	-19
UED forecast modelled (2016-20)			**299**		

[9] Appendix E, Attachment 6, United Energy Preliminary Decision 2016-2020

Table 3 revised study results - benchmark unit costs ($ millions - real 2015)

Study		forecast period	forecast
Nuttall	AER groups	2015-19	232
		2016-20	232
UED forecast modelled (2016-20)			**299**

The key points to note from these revised studies are as follows:

- My revised studies produce forecasts that are significantly higher than the AER's equivalent studies. Most notably, my study using historical unit costs is $22 million higher than the AER's equivalent study, representing 73% of UED's covered forecast; my study using forecast unit costs is $24 million higher than the AER's equivalent study, representing 91% of UED's covered forecast.

  I will discuss the main causes of the difference between our two studies in Section 1.3 below.

- My studies suggest the AER's *alternative estimate* could range between 73% and 94% of UED's covered forecast, depending on the study adopted by the AER to define this estimate.

  Broadly in line with my previous findings:

  - the study using the **historical unit costs** set the lower band of study results, ranging between 73% and 76% of UED's covered forecast
  - the study using the **forecast unit costs** set the lower band of study results, ranging between 91% and 94% of UED's covered forecast
  - the study using the **AER benchmark unit costs** are between these two sets of results, but closer to the historical unit costs, representing 78% of UED's covered forecast.

  These results indicate that should the AER accept that UED's forecast replacement unit costs reflect efficient costs for UED's circumstances then the AER's *alternative estimate* would be much closer to UED's covered forecast.

  I will discuss this matter further in Section 1.4.1 below.

The table below provides a more detailed breakdown of the repex modelling results in the broader context of UED's repex forecast and the AER's preliminary decision. This table also indicates some of the significant differences in the study results at the asset group-level, which will be discussed further in Section 1.4.1.

Table 4 Summary of assessment results ($ millions - real 2015)

	UE Regulatory Proposal	AER Preliminary Decision	UE Revised Regulatory Proposal	Nuttall Consulting		
				Historical Unit Costs	Forecast Unit Costs	Benchmark Unit Costs
1. Asset Replacment - Modelled						
a. Poles	39.4	215.8	38.7	45.4	39.2	43.3
b. Overhead conductors	1.4		37.0	14.3	44.9	10.8
c. Underground cables	44.3		43.5	50.4	65.5	30.2
d. Service Lines	34.1		33.6	14.5	15.4	33.5
e. Transformers	70.6		66.0[a]	45.2	44.7	42.5
f. Switchgear	81.9		80.4	57.4	70.2	72.1
Total Modelled Repex	**271.8**	**215.8**	**299.1**	**227.1**	**280.0**	**232.4**
2. Assets replacement - Modelled & Unmodelled	133.7	127.4	See RRP	Not examined		
3. Other Unmodelled	104.8	27.4	See RRP	Not examined		
4. VBRC Projects	74.8	34.8	See RRP	Not examined		
Total Repex	**585.1**	**405.4**	**See RRP**	**Not examined**		

a – the modelled component of the transformers asset group excludes the transformer refurbishment program as I understand this was excluded from the AER's repex modelling.

1.3 Why my results differed from the AER's

As indicated above, there are significant differences between my model results and the AER's for the equivalent studies.

I have reviewed the models and the AER's working files to better understand the main causes of these differences. It is important that I stress that I have not tried to forensically identify and resolve every difference. Rather I have focused on the matters I believe are causing the main differences.

Before turning to these causes, it is important to note that I have found that the AER's and my own application of the repex model is very similar, in principle. In this regard, as far as I can tell, we are modelling similar asset categories and both use a calibration process that is broadly in accordance with the explanation set out in the AER's repex model handbook.

However, there are a number of noticeable differences in application that are causing the majority of the differences in the study results. These are summarised below.

Significant matter 1 – possible error in the AER's modelling of the underground cable asset group

The UED underground cable asset group includes both cable and other assets associated with the underground network, specifically pillars, pits and surge arrestors. For UED, cables have been reported on a per-meter basis, but the other assets are reported on a per-unit basis.

From my investigations it appears that the AER has scaled the age profile volumes of the cable categories by 1/1000 to transform all units to a per-km basis for comparison with other DNSPs. However, it also appears that it has incorrectly scaled the pillars, pits and surge arrestors asset categories by a similar amount.

This causes the AER model to forecast a negligible amount of replacement of these asset categories.

I have estimated that this issue is resulting in the AER repex model understating the forecast by approximately $13 million and $38 million when using historical and forecast unit costs respectively.

It is important to note that in arriving at the above estimated difference, my figures quoted above use the historical and forecast unit costs I have calculated, not the unit costs assumed by the AER in its studies. The AER model uses unit costs that are significantly different from unit costs I calculate, but I cannot determine the basis of these unit costs from the AER working files provided. In the AER model, these unit costs are immaterial on the resulting repex forecast because the forecast volumes are very small due to the error noted above. This would no longer be the case if the scaling was corrected, and therefore, it may be important to clarify the basis of these unit costs with the AER if there is any contention with my views presented here.

Significant matter 2 – difference in concrete pole life

The other significant difference relates to the AER's approach to modelling UED's concrete poles.

UED has only reported the replacement of concrete LV poles historically, and is not reporting any replacements over the forecast period.

In my studies, I have used the UED data to calibrate individual lives for each concrete pole voltage. This assumes the reported LV concrete pole replacements were a like-for-like replacement and there have been zero like-for-like replacements at the other voltage levels[10].

It is not clear from the AER's files how it has derived its lives. However, they are consistent across voltage levels and appear to be similar to the average of the wood poles.

I have estimated that this difference is resulting in the AER's repex model understating my equivalent study forecast by approximately $6 million and $8 million when using historical and forecast unit costs respectively.

Other more minor matter

There are other differences in our approaches that are significant on the forecasts of individual asset categories, but for UED are less significant on the aggregate forecast. These differences are as follows:

[10] For calibration purposes, I assume a replacement volume close to zero to derive a life.

- **difference in wood pole blended unit costs**

  A minor difference relates to the AER's method to calculate the blended (replacement and staking) unit cost for unstaked wood poles.

  In my studies, I have used the UED data to calculate the blended unit cost individually for each wood pole voltage, using the reported staking/replacement ratios for poles at that voltage. Furthermore, for historical unit costs I use UED's historical staking/replacement ratio and for the forecast unit costs I use UED's forecast staking/replacement ratio.

  From the AER's working files, I believe it is using a similar, but critically different approach. As far as I can tell, it calculates a single average staking/replacement ratio across all voltages, using UED's forecast replacement/staking data.

  These differences account for approximately $4 million in the historical unit cost study, but is immaterial for the forecast unit cost study.

- **asset life calibration method**

  As indicated in the section above, because I am now using a 5-year period that includes one year of the forecast, I have calibrated lives slightly differently to how I would if I was using the last 5 years of historical data. This has resulted in a slightly different approach to that used by the AER, who still appear to have maintained this approach.

  When calibrating the model using historical volumes, a two-step process is required to allow for the historical trend in volumes to the first year of the forecast. For this, the growth rate suggested by the model can be used to approximate this trend.

  The AER has used an approach that is directly equivalent to the approach that is appropriate when using the last 5 years of historical data and an age profile that reflects the last year of this period.

  This is not the case with the calibration period adopted by the AER, which includes one year of the forecast (2015). In these circumstances, I use the two-step process to calculate the contribution of the four years of history (2011 to 2014), but I use the one year of the forecast unadjusted.

  For UED, this difference can be significant for some individual asset categories where the forecast is sensitive to the assumed life. However, at the aggregate level used to set the *alternative estimate*, this difference does not appear to be that material. For example, the AER's method results in about a $1 million increase on the equivalent historical unit cost study and a $3 million increase on the equivalent forecast unit costs study.

1.4 Defining the alternative estimate

In Section 1.2, I showed that the set of studies I have modelled produce a range of values that are used by the AER to define the *alternative estimate* of the covered component of

UED's repex forecast. These studies range from below UED's forecast to above its forecast. The AER has selected the lowest, and in turn, rejected UED's forecast.

In this section, I will discuss matters I believe should be considered when deciding how these study results can be used to define an *alternative estimate*. I will discuss this in terms of two matters:

- UED's forecast unit cost studies
- the model forecast period (2015 to 2019 or 2016 to 2020).

Before turning to each of these matters, it is important that I stress that although I will raise some concerns with certain aspects of how the AER has used the repex model to define an *alternative estimate*, this should not be taken to mean that I do not believe the repex model can be used for this purpose or I have a fundamental disagreement with the approach the AER has taken to use the model for this purpose – that would be an incorrect inference.

I *do* believe however that these concerns could be significant enough, in UED's circumstances, that the AER could have erred in defining its *alternative estimate*.

1.4.1 UED's forecast unit costs

I have shown above that studies using UED's forecast unit costs result in a significant increase in the forecast repex compared to the equivalent studies using UED's historical unit costs. Importantly, the forecast unit cost studies are typically above UED's repex forecast, and so, if such a study was used to define the *alternative estimate* then UED's covered repex forecast would most likely be accepted.

Given the forecast unit cost studies show a significant increase above both the historical and benchmark unit cost studies, then I believe the AER is correct in applying some caution in using this study in these circumstances. However, I believe there are likely to be mitigating circumstances specific to UED that should have led the AER to, at least, conduct further investigations. I note that the AER has conducted further investigations on some programs within UED's bushfire safety-related capex, but my analysis suggests that its investigations may have needed to be broader.

I will discuss this view further below.

The possibility of** false positive **and** false negative **findings through the AER's application of the repex model

I do not strongly disagree with the AER's method to arrive at the *alternative estimate*, which typically means the lowest study is selected as the *alternative estimate*. However, the AER's application of the repex model to set an *alternative estimate* has its limitations. This is most notable with regard to:

- **categorisation limitations** - the predefined asset categories in the RIN (i.e. tables 5.2.1 and 2.2.1), which have the potential to capture a range of activities that could have significantly different unit costs (and possible asset life distributions)

- **calibration data limitation** – the repex allocation rules in the RIN, which have the potential to mean that the replacement of assets (that were very near to their end-of-life) and associated expenditure is allocated to other expenditure categories (e.g. augmentation) if this was seen as the primary driver
- **weakly age-related drivers** – the repex model assumes all asset are replaced due to a driver that is correlated with the age of the asset, but some replacements may be driven by factors that correlate better with other factors
- **aggregation limitation** - the use of an aggregate repex measure across all covered asset groups, which has the potential to lead to inaccuracies if the various over- and under-forecasts at the more granular level (due to other model limitations) do not approximately cancel.

It is important that I stress that limitations in an assessment technique are not unique to the repex model. I believe all assessment techniques (including other top-down assessment techniques and detailed engineering reviews) will have their advantages and limitations in a regulatory context. Although I note these matters here as limitations, I do not believe that this means that the repex model cannot be used for the purposes required by the AER. However, it is why I believe it is correct to use a suite of techniques to assess expenditure – as the AER does.

Nonetheless, these limitations mean that it has to be recognised that the method used by the AER to accept or reject a DNSP's repex forecast, via the repex model, is subject to a type of *false positive* and *false negative* finding. By this I mean:

- a *false positive* finding would be the acceptance of the DNSP's forecast because it was below the *alternative estimate,* when the DNSP's forecast is not in accordance with the NER[11]
- a *false negative* finding would be the rejection of the DNSP's forecast because it was above the *alternative estimate,* when the DNSP's forecast is in accordance with the NER.

It is particularly important to recognise the possibility of these findings when the *alternative estimate* is used to define a substitute forecast when the DNSP's forecast has been rejected.

Enhanced acceptance/rejection testing via the repex model – the conflict test

To reduce the possibility of an incorrect finding because of these limitations, the AER's application of the repex model has to be overlayed with additional considerations. For illustrative purposes, I will call these considerations the *conflict test* here as they represent the considerations the AER should apply and weigh up to decide whether there is sufficiently strong conflicting evidence against the findings of its repex model assessment.

These *conflict test* considerations would be qualitative and quantitative and would include findings from its other top-down assessment techniques, such as its other top-down

[11] Note, to avoid confusion, I have reversed the meaning that is commonly used when applying these terms to medical testing, where a positive finding from the test is a negative result for the patient. Here a positive finding from the test is a positive results for the DNSP.

benchmarking and assessment approaches, the forecasting methodology review; and asset management and governance reviews.

A *pass* (i.e. no strongly conflicting findings) of the *conflict test* means that the findings from the repex model assessment can stand. However, a *fail* (i.e. strongly conflicting findings) means that the repex model assessment could be a false finding.

For example:

- possible false positive finding
  - repex model assessment *pass* – the DNSP forecast is below the *alternative estimate*, which was set by the historical unit cost study and supported by the benchmark study
  - conflict test *fail* – the DNSP benchmarks poorly, particularly on relevant capex and repex measures, and asset management, governance and forecasting methodology reviews suggest inefficient practices or biased forecasting
- possible false negative finding
  - repex model assessment *fail* – the DNSP forecast is above the *alternative estimate*
  - conflict test *fail* – the DNSP benchmarks favourably, particularly on relevant capex and repex measures, and the asset management, governance and forecasting methodology reviews do not raise significant concerns.

A false finding of the *conflict test* does not mean the repex model assessment should be reversed; only that it is inconclusive without further investigations by the AER.

In these circumstances, the repex model can be used to investigate the extent that specific asset categories are driving the positive or negative repex model assessment findings. The model can also be used to isolate the effect to movements in the asset's life (i.e. replacement volumes) or unit cost parameters. This in turn indicates what specific matters may need to be investigated further by the AER, through detailed reviews. I have explained how this type of identification analysis can be performed in the repex modelling report (and will discuss it further below).

The findings from these further investigations could result in the original findings of the repex model assessment being accepted or reversed. It could also result in the *alternative estimate*, which is being used to set the substitute forecast, being adjusted in some way. This adjustment could be calculated directly within the model, through an adjusted asset model parameter, or externally.

Evidence that the AER's finding could be a false negative finding – i.e. it fails the conflict test

I am not claiming that the AER has not performed any type of *conflict test* in arriving at its preliminary decision. For example, when discussing the AER repex modelling exercise, the preliminary decision clearly states that the AER had regard to the outcomes and the findings

of its technical review[12]. Furthermore, the preliminary decision indicates that the AER considered that UED did not provide sufficient justification that the AER needed to depart from its position. However, these considerations are not discussed in any detail in the preliminary decision.

In UED's case, it appears that it has good cause to consider that the repex model assessment would fail such a *conflict test*, meaning that there is a reasonable possibility that the AER's finding is a *false negative*.

The repex model assessment suggests that UED's forecast unit costs are much higher than its historical unit costs and the AER's benchmark unit costs. However, this finding conflicts with findings elsewhere. Most notably:

- UED is one of the top performers in the AER's latest benchmarking report[13], where it is typically in the top 2 or 3 for most reported measures – suggesting it and its unit costs are efficient
- UED has advised that the unit costs associated with replacement activities are based directly on competitively tendered service agreements, which the AER reviewed in arriving at UED's current decision and found at that time that these agreements passed its *presumption test* and so could be presumed to reflect efficient costs[14] The AER has also accepted the suitability of the contracted unit costs in its preliminary decision when assessing specific programs; for example, in its assessment of UED's HV ABC program as part of its review of UED's bushfire safety-related capex[15].
- UED has indicated in its forecasting methodology descriptions that it derived its repex forecast by forecasting replacement volumes and then applying the unit rates from these service agreements. The AER conducts a review of forecasting methodologies as one of its assessment techniques but this review does not seem to have raised a significant concern with UED's forecasting methodology with regard to its sourcing, calculation and use of unit cost estimates.

It is beyond the scope of this review to confirm that UED's methodology to prepare and use its forecast unit costs is appropriate, but assuming all three points above are valid then it seems reasonable to conclude that UED's forecast unit costs should reflect efficient costs. Consequently, it seems reasonable to conclude that the assessment would fail the *conflict test*, and so, further investigations should have been applied to determine what was driving the apparently conflicting results and in turn what the appropriate *alternative estimate* should be.

I note that the preliminary decision *does* draw in findings from its technical advisor, Energeia, but the discussion does not seem to address this pertinent matter, which is UED's forecast unit costs[16]. Therefore, it is not clear from the preliminary decision whether there

[12] Pg 6-67, Attachment 6, United Energy Preliminary Decision 2016-20
[13] AER Annual Benchmarking Report, Electricity distribution network service providers, November 2015
[14] Pg 51-52, Appendix H, outsourcing and related party transactions, Victorian distribution determination 2011-2015, draft decision
[15] Pg, 6-97, Attachment 6, United Energy Preliminary Decision 2016-20
[16] Pg 6-67, Attachment 6, United Energy Preliminary Decision 2016-20

was adequate consideration of the possibility of a false finding, and in turn, an examination of what is driving differences between the model results and UED's forecast.

A revised alternative estimate for UED

I noted above that the AER's repex model assessment can be subject to various limitations. Given the conflicting findings discussed above, I have re-examined unit costs (and volume changes) to examine how these could be causing errors in the *alternative estimate* – and gauge their potential effect.

The revised studies I have conducted indicate that using UED's forecast unit costs results in a $54 million increase over UED's historical unit costs. I have examined the forecast unit cost study[17] and I consider that this shows that the majority of the increase from the historical unit cost study is localised to a small number of asset categories, most notably (brackets indicate the contribution to the increase):

- 22 kV overhead multiphase conductor ($32 million of increase)
- LV pits and pillars ($22 million of increase).

To a lesser degree, significant increases also occur in the 22 kV circuit breaker category and some cable categories[18].

UED has provided some commentary on the reasons for the apparent unit cost increases in the categories identified above[19]. Most notably:

- 22kV multiphase conductor – UED has advised that, over the calibration period, it predominantly replaced aged bare conductor, with similar bare conductor. However, commencing this year, it has started a significant program to replace aged ABC conductors with a similar conductor type.

  The apparent increase in the unit cost in this asset category reflects the increased cost of predominantly replacing ABC conductor (over the forecast period) compared to predominantly replacing bare conductor (over the calibration period).

  UED considers that this ABC replacement program is necessary because of an emerging fire risk with this type of HV ABC conductor. In this regard, UED has advised that this ABC conductor type has seen a rapid increase in failures recently. Due to the fire risk associated with such failures and other technical issues with this ABC technology, UED is proposing to replace a significant amount of this conductor.

  As noted above, the AER specifically reviewed (and accepted) UED's previous forecast for this program (volumes and repex) as part of its detailed review of UED's bushfire safety-related capex[20].

- LV pits and pillars- UED has advised that historically, the replacement program for pits and pillars was dominated by standard LV pillar and cabinet replacements.

[17] By examining difference between the historical and forecast unit cost studies.
[18] The increases through HV cable categories are offset by a more significant reduction through the LV cable category.
[19] Advised in emails, dated 14/12/2015 and 21/12/2015
[20] Pg 6-95 to 6-97, Attachment 6, United Energy Preliminary Decision 2016-20

However, over the forecast period, it will need to replace a particular cohort of service pillars (Doncaster pillars), which are significantly more costly to replace.

UED has advised that these pillars are planned for replacement for safety reasons associated with their metal design and because they contain asbestos. The replacement of these pillars is more difficult (and costly) than standard pillars because of the need to a) manage the disposal of asbestos, and b) perform additional work on customer's installations and services, which requires new cables or the extension of existing cables.

UED's explanations suggest that category limitations within the model could be a reason for the conflicting results when using forecast unit costs. That is, the unit cost associated with the historical activity in a model asset category is significantly less than the unit cost of the forecast activity in the same asset category because that model category has not adequately captured the underlying replacement dynamics.

If the change in activity causing these increases in unit costs can be justified by UED then a movement towards the forecast unit cost study would be a more appropriate basis for the *alternative estimate*[21]. The extent of the movement toward the forecast unit cost study depends very much on the specific circumstances.

In the case of the HV ABC program, based upon my understanding of this program, I do not agree that it would be appropriate to simply substitute the forecast unit cost. This would result in an anomaly between the driver of the volume forecast, which seems to be driven by bare wire end-of-life dynamics (via the historical life calibration), and the forecast unit cost, which is dominated by the new HV ABC replacement program.

Assuming the AER's considerations on this HV ABC program are valid then it suggests that the current modelling of this 22 kV conductor category is suffering from a form of category and calibration limitation. In this regard, the replacement dynamics of the bare wire and ABC conductor types are not being captured adequately, resulting in the bare wire replacement volumes being significantly overstated and the ABC replacement volumes being significantly understated.

A solution here would be to try to model this more accurately, by introducing sub-categories that more accurately capture the cohorts driving these two programs. This solution however may be difficult because the ABC program is so new, and so, it may be difficult to determine an appropriate life for modelling purposes.

An alternative solution is largely what the AER has done, which is to separately review the programs outside of the model. In these circumstances, I would expect the model results for the entire 22 kV multiphase conductor category (i.e. bare wire and ABC) to be excluded from the repex model results, and this category to be assessed outside the model and the findings substituted in place of the model results to define the *alternative estimate*.

In the case of the LV pits and pillars, it is less clear to me what the best solution would be as this depends on the specific circumstances. If it can be assumed that the life model for this

[21] This assumes that there are not countervailing reductions in unit costs elsewhere in UED's forecast that it has not allowed for.

group is appropriate (that is the life distribution of these Doncaster pillars is similar to other pillars replaced over the calibration period) then it can be assumed that the model's volume forecast is valid (in the aggregate sense of the assessment), and the replacement program is just moving into a phase where unit costs are higher. In these circumstances, it would be valid to adopt the forecast unit costs if the AER is satisfied that they reflect efficient unit costs[22]. If the life assumption was not valid then this asset category would need to be reviewed in detail outside the model in a similar manner as discussed above with the 22 kV multiphase conductors.

My assessment of UED's revised forecast still indicates that the forecast unit cost study is below UED's revised forecast, by $18 million to $25 million depending on the model forecast period. This suggests that UED's revised volume forecast (in aggregate) is also above the volume forecast that could be inferred from its historical replacement levels.

Therefore, I have also re-examined the repex model to identify the asset categories causing this aggregate volume difference (see Appendix A). As with unit cost differences above, the cause of the volume difference is very localised to a small number of model asset categories, most notably (brackets indicate the cost-weighted volume difference):

- 15-40 MVA transformers ($18-$20 million of increase)
- HV switches ($29-$22 million of increase)
- Services, simple residential ($16-$17 million of increase).

UED's explanations of the causes of some of these volume differences were discussed in the repex modelling report. Most notably:

- For the 15-40 MVA transformer category (i.e. UED's largest zone substation transformers), it was noted that UED considered that the historical volumes reported in Table 2.2.1 did not capture all of its aged transformers in this category that it replaced[23]. A significant number were replaced through its augmentation program. Modelling I have performed suggests that if these other transformers are allowed for in the calibration process then the forecast for this category would increase by $13 million.
- For the services category, the repex model studies are forecasting a significant reduction in replacement volumes. UED considered that a large component of this category was weakly-age related (covering its reactive and safety-related programs) and so the model replacement dynamics, through the asset life model, may not adequately capture the true dynamics. The repex model report discussed how this reduction could be being significantly over stating, if UED's views were valid[24].

[22] Assuming the AER is satisfied that there are no countervailing changes (in aggregate) that should be offsetting this cost increase.
[23] See the discussion on pg 22, repex modelling report
[24] See the discussion on pg 30, repex modelling report

If the volume increases can be justified by UED then its forecast volumes need to be allowed for in the AER's *alternative estimate*, which suggests it would increase by a further $18 million to $23 million, depending on the accepted unit cost assumptions.

It is beyond the scope of this review to conduct a detailed assessment of UED's justification of its unit cost and volume increases. Therefore, I cannot say whether these unit cost or volume movements are justified. However, it will be important that UED explains and justifies the need for these increases in its revised proposal.

Based upon the reasoning above, I believe the AER would need to consider these justifications to be appropriately satisfied that the *alternative estimate* (derived as assumed here) can be applied in UED's circumstances.

1.4.2 The appropriate repex model forecast period

In section 1.3, I noted that a difference between my original approach and the AER's is the forecast period we have used to compare with UED's forecast. I used 2016 to 2020 as it reflected the regulatory period being determined by the AER, but the AER has used 2015 to 2019. The significance of this difference is that for most studies, the use of 2016 to 2020 increases the study forecast (because the repex model is typically predicting the need for repex to increase over the next 10-year period).

The preliminary decision is unclear why the AER has selected this period, which does not coincide with the regulatory period. Therefore, I am unable to critique its rationale.

I still believe 2016 to 2020 should be the appropriate period, and this reflects the approach I have applied previously when using the model through engagements with the AER (e.g. the current Victorian DNSP decisions). That said, I cannot claim that this is a settled matter, and so, the AER may have a good reason for using this approach.

For example, one possible reason could be that the AER is assuming that the 2014 age profile is a reasonable proxy for UED's 2015 age profile, and therefore, it is assuming that the 2015 to 2019 period is an appropriate estimate for the 2016 to 2020 period. However, if that was the case, I do not think it would be appropriate for UED as the repex model suggests the asset base will be on-average aging over the forecast period. Therefore, the 2014 age profile is unlikely to be a suitable proxy for these modelling purposes.

On this point, I do note that the AER indicates in its preliminary decision that average asset ages reported in UED's economic benchmarking RIN suggests UED's network age has been maintained historically[25]. This view may be correct when looking at that measure, which I understand relates to RAB and depreciation considerations. However, that measure will not reflect whether the existing asset base will be on-average aging, because new asset through connections and augmentation may be masking the asset aging that affects repex.

Given this uncertainty in the AER's rationale, it seems reasonable to me that the AER should be expected to clearly set out its rationale for this assumption if it materially affects its findings.

[25] Pg 6-84, Attachment 6, United Energy Preliminary Decision 2016-20

A Appendix A – analysing the contribution of volume changes

Volume changes can be measured by comparing UED's forecast volumes against the repex model study using the historical calibrated lives. Typically, aggregate volumes cannot be compared directly because there is not an equivalence between units in each model asset category (e.g. a unit increase in LV fuses is not equivalent to a unit increase in large power transformer). Therefore, when assessing aggregate volume changes it is usual to weight category volumes using unit costs. This is equivalent to using the model to produce a repex forecast but ensuring that the unit costs are held constant between the history and forecast studies.

The possible options for this analysis are:

- **historical unit cost** weighting, which reflects a comparison between a model forecast using forecast calibrated lives and historical unit costs and a model forecast using historical lives and historical unit costs
- **forecast unit cost** weighting, which reflects a comparison between the DNSP's repex forecast and a model forecast using historical lives and forecast unit costs
- **AER benchmark unit cost** weighting, which reflects a comparison between a model forecast using forecast calibrated lives and AER benchmark unit costs and a model forecast using historical lives and AER benchmark unit costs.

The table below summarises the aggregate increase in UED's forecast volumes using these three unit cost weightings.

Unit cost weighting	Aggregate increase in volume forecast
historical unit cost	12%
forecast unit cost	7%
AER benchmark	*49%*

These studies indicate that UED's revised volume forecast is 7% to 12% *higher* than its historical volumes, if historical or forecast unit costs are used to weight volumes. The significant volume increases (in this unit cost weighted sense) are localised to only a few asset categories, most notably:

- 15 MVA to 40 MVA zone substation transformers
- residential simple services
- 11kV and 22 kV switches.

Interestingly, the contribution of the volume increases of the transformer and 11 kV switch categories is more pronounced when using the historical unit cost weightings because UED's historical unit costs are noticeably *higher* than its forecast unit costs for these two categories. This magnifies the volume changes of these two categories when using the historical unit costs causing these weightings to suggest a higher increase in volumes compared to the forecast unit cost weightings.

Similarly, when the AER benchmark unit costs are used as volume weightings the volume increases of the 11 kV switch and residential services categories are *very* pronounced because AER's benchmark unit costs are *significantly higher* than UED's historical and forecast unit costs (in the order of 3 to 4 times higher). The apparent increase in volumes is so dominated by these two categories when using these benchmark unit costs that I believe this result should be treated as too heavily affected by aggregation errors. Consequently, I do not consider that the AER benchmark unit cost weightings can be used as a guide to volume changes for UED using an aggregate measure.

This assessment suggests that, to a large extent, UED's forecast volumes (in aggregate) are in accordance with its historical practices. In this aggregate sense, there is a modest volume increase. But the increase is localised to a small number of asset categories, and so, its scale is sensitive to the unit cost weightings used to measure it.