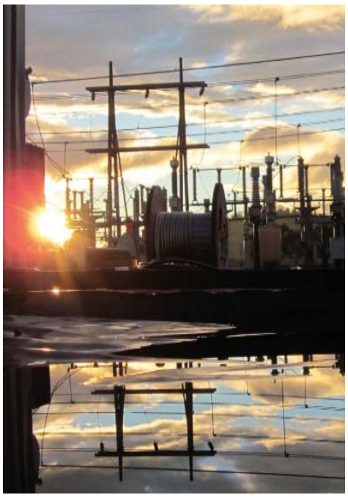


Modelled Repex Forecast 2019-24

TasNetworks Distribution

24 January 2018

Contents

Appendices

1. Executive Summary

1.1 Background

Replacement expenditure (or repex) is one of the largest components of a utility's network investment, and as such, its forecasting, regulatory review and determination is important. Typically, the non-demand driven replacement of an asset with its modern equivalent, where the timing of the need can be directly or implicitly linked to the age of the asset, forms the major portion of the network repex. The timing of the need for asset replacement can be driven by a number of factors such as increasing asset maintenance and operating costs, decreasing network reliability, increasing failure risk, deteriorating network performance and conditions, and asset management issues. These factors often are related to the age of the asset and the management of the asset over its life cycle impacting condition. Therefore the asset age can be used as a proxy for many factors that drive individual asset replacements.

The Australian Energy Regulator (**AER**) has been using a tool (repex model) to inform its review of the repex forecast proposed by the Distribution Network Service Providers (**DNSPs**) in the National Electricity Market (**NEM**) in its recent determinations to establish the respective maximum allowable revenues.

1.2 Purpose and Scope of this Report

TasNetworks utilises a number of tools to develop and stress test forecast capex programs. One of the tools utilised as part of the review process for repex, includes repex modelling with the application of similar benchmarking as that adopted by the AER. GHD has been engaged by TasNetworks to undertake this repex modelling by performing the following to assist in its upcoming 2019-24 regulatory submission to the AER:

- Apply the AER repex model to assess TasNetworks' proposed repex for 2019-24 period; and
- Use the AER repex model to prepare alternative forecasts based on approach recently adopted by the AER (i.e. using benchmark input data).

1.3 Summary

This report describes the characteristics of the AER repex model, the step-by-step modelling process, basis for preparing or sourcing the input data for scenario modelling, and outcomes from recent AER determinations using the repex model.

GHD consider that the following six asset groups can be modelled to forecast their repex and hence reviewed using the AER repex model:

- Poles,
- Overhead Conductors,
- Underground Cables,
- Service Lines, and
- Transformers and Switchgear.

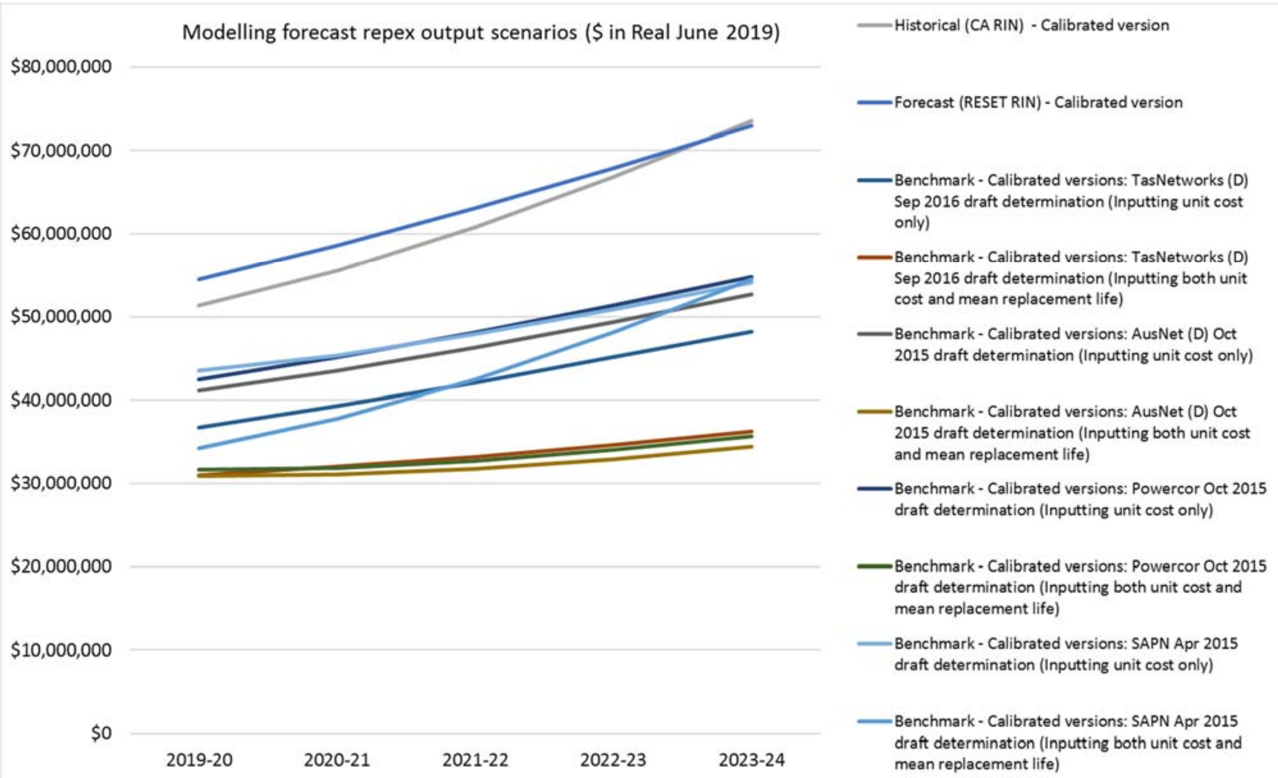
These six asset groups constitute approximately 90 per cent of the total proposed repex forecast.

This modelling will involve producing a number of versions or scenarios of forecast outputs corresponding to different sets of input data. The AER will refer to historical and future asset replacement data reported/proposed by TasNetworks in the Category Analysis RIN and 2019-24 Reset RIN respectively to formulate various sets of input data to perform this modelling. In addition, the NEM benchmark asset replacement data is also utilised as an alternate and efficient set of input data to generate and compare various scenarios of forecast outputs. GHD has referred to TasNetworks (D) September 2016, AusNet (D) October 2015, Powercor October 2015 and SAPN April 2015 determinations for the respective NEM benchmark data due to their currency and relative network similarities with TasNetworks.

Additionally, the AER review process and its determination of likely repex will be influenced by the historical expenditure trend and TasNetworks asset management practices (such as risk management, capacity to deliver, performance analysis, industry direction etc.) should also be considered in reviewing forecast repex spend.

GHD analysis indicates that the likely ‘modelled’ proportion of the repex forecast should be approximately $35m to $40m per year for the 2019-24 period. Figure 1 provides a high level summary of this analysis. This projection is based on a number of benchmark data inputs compiled and used by the AER in its recent determinations of the NEM DNSPs, the historical distribution repex trend of TasNetworks, the age profile of its existing asset portfolio, and its recent asset replacement behaviour.

Figure 1 – Summary of modelled forecast repex output scenarios



The remaining approximately 10 per cent of the total proposed repex forecast cannot be modelled and hence will be reviewed using other techniques such as business cases, engineering review, trend analysis etc. This remaining ‘un-modelled’ repex constitute of the following four asset groups:

- Pole Top Structures,
- Public Lighting,
- SCADA, Network Control and Protection Systems, and

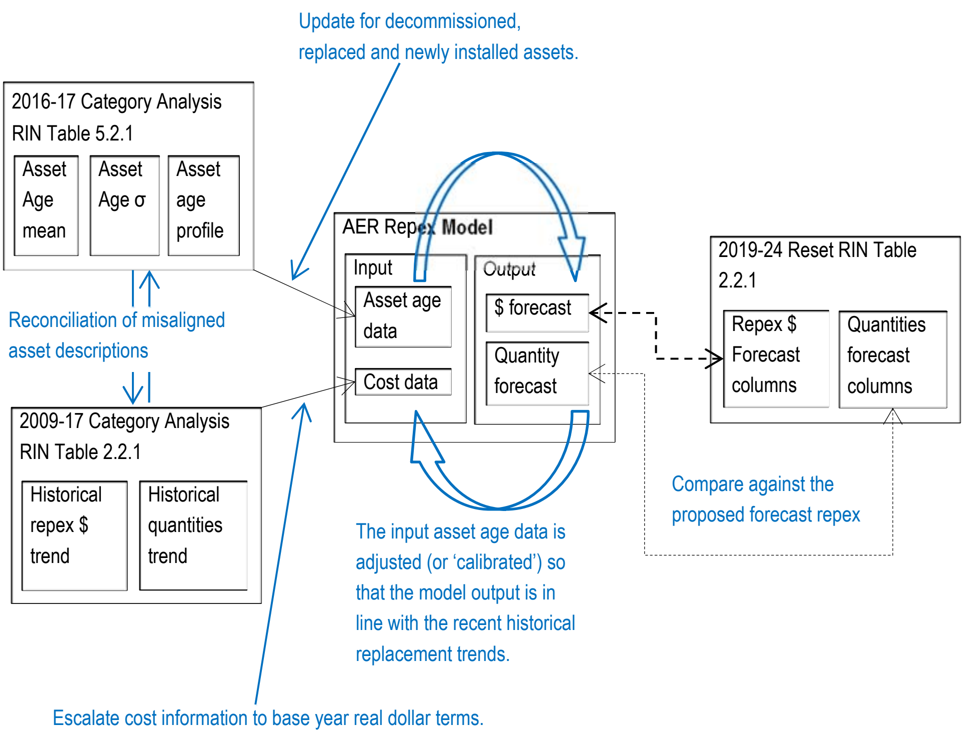
- Other.

2. AER Repex Model

2.1 Overview

The AER has published a tool (repex model) to analyse the DNSPs asset replacement forecast profile based on historical asset information that they have collected using asset age data as a proxy to summarise many factors that drive repex. The model uses historical asset data reported in the Category Analysis Regulatory Information Notice (**RIN**) and produces repex estimates and asset quantities forecast for the upcoming regulatory period. Given the complexity in predicting the need to replace assets, the aim of the model is to simplify the analysis, while maintaining some accuracy at the aggregate level. To achieve this, assets are considered as populations rather than individual items. The key parameter for predicting asset replacement needs across the population is the asset replacement life. This life could be the technical or economic life depending on the circumstances of the particular asset population. An overview of this modelling process is illustrated in Figure 2.

Figure 2 – AER repex modelling process overview



The repex model is designed to predict and benchmark replacement expenditure for DNSPs using a probabilistic replacement model. The probabilistic model predicts future repex as a function of the age of individual network assets, their failure probability distribution characteristics, and replacement cost.

The asset age input data utilised has been sourced from the TasNetworks 2016-17 Category Analysis RIN Table 5.2.1 recently submitted to the AER. The cost input data is derived from the historical asset replacement expenditures and quantities data reported in historic Category Analysis RIN Table 2.2.1. The unit cost information for various asset categories is escalated to the base year real dollar value and averaged across historical period (three or five or more years etc.).

A key part of the model's functionality is the 'calibration' stage, during which the model outputs are 'forced' to aligned to recent past replacement volumes by adjusting input parameters. The calibration process involves manipulating (or goal-seeking) cost input data in the model so that future asset quantity replacement trends form a continuous line with recent replacement quantities. The logic behind this step is to mathematically reflect the organisations asset replacement practices, in contrast to the replacement life being reported in the Category Analysis RIN, in the model.

The process that the AER uses to populate and calibrate the repex model is described in a published document titled 'AER guide to the Repex Model – revised November 2013'. Since then, the AER has released its determinations of all NEM DNSPs which include populated and calibrated repex models based on the respective DNSPs' submissions. These repex models, and the associated commentary and explanations provide insight to the review approach adopted by the AER.

The model review approach involves modelling a number of scenarios to produce alternate repex forecast outputs from the model corresponding to different sets of input data. This enables the AER to form an initial view on repex forecast volume that it may consider reasonable and prudent to meet the National Electricity Rules (NER) capex criteria prior to undertaking a more detailed assessment to account for any other factors.

2.2 Application

This AER tool is meant to model the non-demand driven network capital expenditure that involves replacing existing assets with modern equivalent assets of similar service levels, where the timing of the need can be directly or implicitly linked to the age of the existing asset. This is illustrated in Table 1.

Table 1 Network capex categories

Capex driver	Activity	
	Replace	Addition
Demand driven: Customer connection	Replacement of assets to facilitate the connection	Development of new network assets to facilitate the connection
Demand driven	Replacement of existing assets with increased capacity (higher service level)	Development of new network assets to increase the capacity
Non-demand driven	*Replacement of existing assets with modern equivalent (similar service level)*	Installation of new assets

Note the distinction with replacement activity driven by demand. Demand driven replacement, by its nature, will require assets of a higher capacity. Non-demand driven replacement should not necessarily require additional capacity, although, additional capacity may result due to replacement with modern equivalent assets and/or asset specification (capacity) standardisation practice.

This is a high level model and it is not meant to be treated as a planning tool, rather as part of the suite of tools used in the forecast review process. The regulatory review process using this tool is intended to account for major drivers of replacement expenditure at an aggregate level and is not designed to process disaggregate level of detail. This tool however can be used to target replacement expenditure areas for further detailed assessment and planning review.

2.3 Suitability

In order to analyse the suitability of the repex modelling process for TasNetworks' transmission business, GHD reviewed the latest regulatory submissions of all Transmission Network Service Providers (TNSPs) in the NEM and their respective determinations. Powerlink in its recent submission used its own revised version of the AER repex modelling approach to propose its expenditure, and the AER did not approve this approach. Other TNSPs in their recent submissions to the AER have proposed their repex using the bottom-up approach (RIT-T or business cases for individual projects/programs) supported by top-down justifications (asset management, risk management, network planning process, performance analysis, etc.). The AER's review approach in all its recent determinations for TNSPs' repex is summarised in the below extract from TransGrid September 2017 draft determination.

> *In transmission decisions, we have not directly used the repex model for estimating a business as usual estimate of repex. This is largely because of the nature of asset replacement in transmission.*
>
> *In distribution, service providers tend to have a relatively more consistent asset replacement profile over time. This more frequent and steady replacement means that historical replacement data over a short period (five years) has been used to make a reasonable estimation of a service provider's replacement needs in the next regulatory control period.*
>
> *Transmission, however, is characterised by fewer assets that are high value in nature, and are replaced in groups, leading to lumpy expenditure over time. This infrequency of replacement and fewer assets means that it is more difficult to use the repex model, given the historical data available is for a short period. We consider that repex modelling of transmission assets will become more viable as our collection of historical replacement information grows in the coming years.*

The scope of this modelling process therefore focussed on distribution business repex only.

2.4 AER Review Process

The AER has published various versions of populated and calibrated repex models along with the associated commentary explaining its approach in recent determinations of respective NEM DNSPs. This has allowed GHD to note that the AER usually produces the following three versions of models, corresponding to alternate repex forecast output scenarios for its review purpose:

- 'Historical-Calibrated' version. The modelled repex forecast output from this version or scenario corresponds to asset age input data from the most recently reported Category Analysis RIN Table 5.2.1, and the asset unit cost input data from the historically reported repex information in previous years Category Analysis RIN Table 2.2.1. It is noted that the AER has been collecting the Category Analysis RIN data from 2008-09 onwards.
- 'Forecast-Calibrated' version. The modelled repex forecast output from this version or scenario corresponds to asset age input data from the most recently reported Category Analysis RIN Table 5.2.1, and the asset unit cost input data from the proposed forecast repex information in the Reset RIN Table 2.2.1.
- 'Benchmark-Calibrated' version. The modelled repex forecast output from this version or scenario corresponds to an input data set (asset unit cost or/and asset age) that the AER considers is the benchmark performance in the NEM. It is noted that the benchmark input data that the AER uses in its review process may differ for each determination. The AER continuously collects Category Analysis RIN from all DNSPs and they regularly update their benchmark input data set. The AER applies different sets of benchmark input data while reviewing different submission on a case-by-case basis.

The benchmark calibrated version retains the asset age profile of the DNSP being reviewed, while utilising the most efficient (i.e. lower) asset unit cost and the most extended asset (i.e. longer) mean replacement life input data from the NEM. As expected, this combination of input data usually produces the most economical repex forecast output scenario. Accordingly, the AER's review process and it determination of repex volume is influenced by this scenario. Additionally, it is also influenced by the historical trend and other consideration of TasNetworks business practices (such as asset management, capacity to deliver, industry direction etc.). It is noted that all these review methods are high level assessment techniques and based on information regularly collected by the AER in a format and manner dictated by the AER.

2.5 Exclusions

The AER in its recent determinations has reviewed the proposed forecast repex of the following asset groups outside the repex model using other assessment approaches (trend analysis, bottom-up estimate, business case etc.).

- Pole top structures
- Public Lighting (which for TasNetworks is classified as an Alternative Control Service)
- SCADA, Network Control and Protection Systems
- Other

These asset groups are deemed not suitable for forecasting repex because of the nature of these assets, their drivers, and the difficulty in establishing an asset boundary in project work. In many cases the replacement timing of assets in these groups may not be a function of their age (e.g. technological obsolescence and lack of market support for after sale services is the case for most secondary system assets). The replacement timing for these assets is therefore driven by various factors other than age related condition, deterioration, operational or maintenance issue, and failure.

In the case of pole top structure asset group, the AER has not collected the asset age profile data in Category Analysis RIN Table 5.2.1.

In other cases, asset items or types may be difficult to group into a particular category, or/and has small population, or/and sparsely distributed age profiles, or/and were relatively new, thereby not incurring replacement in the recent past.

GHD has excluded these asset groups in this engagement also, for similar reasons. It is expected that the proposed forecast repex for these excluded asset groups will likely be reviewed through engineering assessments commissioned by the AER, as this has been the case for each of the NSW and ACT DNSPs in their latest determinations.

2.6 Limitation of the Repex Model

The AER repex model assumes the key factor that predicts replacement is the asset age and thus this model is only suitable to model asset classes where age is a good predictor of the need to replace and timing. Since not all asset groups necessarily fit this pattern (as explained in the previous Section), the AER has split repex assessment into two portions – 'modelled' repex and 'un-modelled' repex. Assets where age is considered a good predictor are classed as 'modelled' repex, whereas those for which it is not, are considered 'un-modelled' repex. Some limitation of the repex model are summarised below.

Limitation regarding the model itself includes the following:

- Age alone is not a sufficient and accurate predictor of replacement.

  While age certainly has predictive value for forecasting asset replacement, replacement also depends on other factors, such as reliability, obsolescence, and condition of assets, which may not correlate exactly with age. The repex model fails to make any allowance for covariates such as these, which must be accounted or corrected for in any accurate assessment. While the repex model is more suitable for forecasting repex for high volume–low value asset categories such as poles, it is not suitable for forecasting low volume–high value asset categories such as power transformers and circuit breakers. The replacements of such assets are dependent on item specific considerations such as condition based risk management which may not correlate directly to asset age. The case for replacing such assets and its expenditure are specific to each project.

- Use of a 'normal' (or standard bell curve) probability distribution of mean asset replacement age.

  The probability distribution of mean ages at which assets require replacement is not necessarily normally distributed. In prevalent asset management or asset life studies a Weibull or exponential function often provides a more accurate fit. While a normal distribution function relies on parameters more commonly produced and understood by businesses, and provides forecasts with predictive value, this approach can introduce inaccuracy in forecast estimates.

Limitation regarding the calibration process includes the following:

- Assumption that the future requirement for long term replacement expenditure can be predicted by looking at recent past expenditure.

  The calibration process involves manipulating model input data so that future replacement quantity trends form a continuous line with recently replaced quantities. This approach fails to recognise where in the investment cycles each asset class sits relative to the expected life of the asset, as well as allowing no provision for one-off major projects requiring replacement of assets.

Limitation regarding the parameters predicted by modelling includes the following:

- The calibration process used by the AER produces economic life mean input data for some asset categories far beyond any technical or feasible range for this parameter. This step is performed to replicate organisational recent asset replacement practices in the model (instead of purely relying on economic life mean data being reported by the DNSP themselves). The 'calibrated' or goal-sought parameter produced by this process is purely an artefact of the model's calibration, and is not related to any real replacement data or technical assessment.

Like most models, this repex model also has some limitations, therefore it is important to consider the results within the context of wider assessment tools. Recognising these limitations is helpful in understanding the nature of the forecast provided by the model and how it compares with the proposed program of works. The AER's draft determination document states "*We further note, as foreshadowed in the Explanatory Statement to our Guideline that we will use the REPEX model as a first pass model, in combination with other techniques. It is not used in isolation, but one of a number of analytical tools*"[1]. This statement suggests that the repex model is designed as a tool to inform decisions on proposed repex and is not suitable to base a regulatory determination on its own.

[1] Page 6-93, Attachment 6: Capital Expenditure | Essential Energy draft decision, AER Nov 2014.

3. Data Inputs

3.1 Unit Cost

3.1.1 Historical – Based on Category Analysis RINs

GHD referred to the historic annual repex and replacement quantities[2] over the previous years' (past regulatory period) to produce a unit cost for each asset category which is used to predict the cost of future replacements in this scenario. It is noted that this information is reported in nominal dollars of June each respective year. GHD escalated this historic information to a real dollar base of June 2019 using the Australian Bureau of Statistics (ABS) published historic data of Consumer Price Index (CPI) specific to Hobart and the Reserve Bank of Australia (RBA) national inflation outlook. The escalation indices used for this conversion is shown in Table 2.

Table 2 Escalation indices

Time period (from, to)	Jun 08	Jun 09	Jun 10	Jun 11	Jun 12	Jun 13	Jun 14	Jun 15	Jun 16	Jun 17
	Jun 19	Jun 19	Jun 19	Jun 19	Jun 19	Jun 19	Jun 19	Jun 19	Jun 19	Jun 19
Cumulative CPI	1.250	1.230	1.194	1.155	1.145	1.125	1.095	1.089	1.075	1.051

The average unit cost can be calculated for individual asset categories in two ways, namely a weighted or an unweighted average unit cost as shown below.

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

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

GHD considers that the weighted average method is more appropriate than the 'average of the average'. The weighted average is the total cost (in real June 2019 dollar terms) of replacement over the past 5 years' period (i.e. 2012-17) divided by the total volume of replacements over the same period[3]. This contrasts with the unweighted method, which calculates a unit cost for each year, and then averages these results.

The advantage of the weighted averaging method is that it better accounts for variable levels of replacement in different years, and better represents outliers. For example, if only a minimal number of assets were replaced in one year, at a relatively high price, we would not want to consider that unit price of equal weight to one derived from a year with a lot of replacements. The average price of an asset should be closer to the

[2] Based on TasNetworks advice GHD only considered asset replacement quantities in this calculation. GHD understand that the asset failure quantities reported in Category Analysis RIN Table 2.2.1 is the count of failure occurrence/event and not the count of failed asset quantities. Therefore, GHD excluded asset failure quantities from calculating the unit cost.

[3] GHD also calculated the weighted average unit cost over the past 3 and 9 years periods to ascertain the variations in each asset category unit costs. GHD concluded that 5 years period to provide a good balance between including many asset categories and also representing recent project delivery cost experience.

replacement cost for the majority of the replaced assets. Also, if only a few assets in a particular category are replaced in one year, economies of scale will not be appropriately represented. Additionally, TasNetworks has not reported the expenditure against the corresponding asset quantities consistently in the past Category Analysis RIN Table 2.2.1, i.e. there are delay or disjointed dollar-quantities reporting. Therefore, GHD used the weighted unit cost calculation method for the repex model data inputs.

Finally the unit cost for a few asset categories could not be determined because TasNetworks has not replaced such assets and thus have not incurred repex in recent times, but these exists in its asset portfolio and has been 'identified' for replacement in the repex model in the near future. To address this data gap and the lack of in-house unit cost estimate information from TasNetworks, GHD independently assumed the following unit cost input data to enable the repex model to perform free of errors as shown in Table 3.

Table 3 Assumption for missing unit cost data (Real June 2019 $)

Asset Groups	Asset Categories	Estimate and Basis of Assumptions
Poles	> 1 kV & < = 11 kV; Concrete	$16.07k [95% of the unit cost of > 11 kV & < = 22 kV; Concrete pole]
	> 22 kV & < = 66 kV; Concrete	$17.76k [105% of the unit cost of > 11 kV & < = 22 kV; Concrete pole]
	> 22 kV & < = 66 kV; Steel	$11.35k [105% of the unit cost of > 11 kV & < = 22 kV; Steel pole]
	Other	$10.06k [There are only 15 poles of this type in the entire asset portfolio. These are likely the 'unknown' poles that TasNetworks knows exist, but for which the category is unknown. Therefore GHD has proportionally weighted the unit costs of all the remaining poles of all categories (less staking) to derive the weighted average unit cost]
Overhead Conductors	> 22 kV & < = 66 kV	$205.46k [Estimating 150% of unit cost of > 11 kV & < = 22 kV ; Multiple-Phase]
Underground Cables	> 22 kV & < = 33 kV	$500k [Estimate]
Transformers	Pole Mounted ; < = 22kV ; > 600 kVA ; Single Phase	$15k [Estimate]
	Ground Outdoor / Indoor Chamber Mounted; < 22 kV ; > 600 kVA ; Single Phase	$35k [Estimate]
	Ground Outdoor / Indoor Chamber Mounted; < 22 kV ; < = 60 kVA ; Multiple Phase	$35k [Estimate]
	Other	$23.09k [There are only 3 of such asset in the entire asset portfolio. These are likely the 'unknown' pole mounted or kiosk mounted

Asset Groups	Asset Categories	Estimate and Basis of Assumptions
		transformer that TasNetworks knows exist, but for which the category is unknown. It is highly unlikely that it will be Ground Mounted/Indoor Chamber type because they are relatively expensive, situated in known address and well known assets. Therefore GHD proportionally weighted the unit costs of all the remaining Pole Mounted and Kiosk transformers to derive the weighted average unit cost]
Switchgear	> 11 kV & < = 22 kV ; Circuit Breaker	$100k [Estimate]
	Other	$4.55k [These are likely the 'unknown' switchgear that TasNetworks knows exist, but for which the category is unknown. Therefore GHD proportionally weighted the unit costs of all the remaining switchgear and derived the weighted average unit cost]

3.1.2 Forecast – Based on 2019-24 Reset RIN

GHD referred to the proposed repex forecast and corresponding replacement quantities during 2019-24 period to produce the weighted average unit cost for each asset category which is used to predict the cost of future replacements in this scenario. It is noted that this information is proposed in real June 2019 dollar values in the 2019-24 Reset RIN and thus does not need monetary reference conversion.

Similar to the historical average unit cost derived from the Category Analysis RINs (explained in Section 3.1.1), GHD calculated the forecast average unit costs by dividing the proposed repex forecast over the 5 years period (i.e. 2019-24) by the proposed replacement quantities forecast over the same period.

The unit cost for few asset categories could not be determined because TasNetworks is not proposing to replace such assets in 2019-24 Reset RIN, but exists in its asset portfolio and has been 'identified' for replacement in the repex model in the near future. To address this data gap and the lack of in-house unit cost estimate information from TasNetworks, GHD independently assumed the following unit cost input data to enable the repex model to perform free of errors as shown in Table 4.

Table 4 Assumption for missing unit cost data (Real June 2019 $)

Asset Groups	Asset Categories	Estimate and Basis of Assumptions
Poles	> 1 kV & < = 11 kV; Steel	$4k [same as average concrete poles]
	> 11 kV & < = 22 kV; Steel	$4k [same as average concrete poles]
	> 22 kV & < = 66 kV; Steel	$4k [same as average concrete poles]
	Other	$4k [There are only 15 poles of this type in the entire asset portfolio. These are likely the 'unknown' poles that TasNetworks knows it exists, but don't know the category. Therefore proportionally weighted the unit costs of all the remaining poles of all categories (less staking) to derive the weighted average unit cost]

Asset Groups	Asset Categories	Estimate and Basis of Assumptions
Overhead Conductors	> 11 kV & < = 22 kV ; Single-Phase	$28.8k [same as the rest of > 11 kV & < = 22 kV overhead conductor]
Underground Cables	> 22 kV & < = 33 kV	$500k [Estimate]
Transformers	Kiosk Mounted ; < = 22kV ; < = 60 kVA ; Multiple Phase	$40k [Estimate]
	Kiosk Mounted ; < = 22kV ; > 60 kVA and < = 600 kVA ; Multiple Phase	$50k [Estimate]
	Kiosk Mounted ; < = 22kV ; > 600 kVA ; Multiple Phase	$60k [Estimate]
	Ground Outdoor / Indoor Chamber Mounted; < 22 kV ; > 600 kVA ; Single Phase	$100k [Estimate]
	Ground Outdoor / Indoor Chamber Mounted; < 22 kV ; < = 60 kVA ; Multiple Phase	$125k [Estimate]
	Other	$132k [There are only 3 of such asset in the entire asset portfolio. These are likely the 'unknown' pole mounted or kiosk mounted transformer that TasNetworks knows exist, but for which the category is unknown. It is highly unlikely that it will be Ground Mounted/Indoor Chamber type because they are relatively expensive, situated in known address and well known assets. Therefore GHD has referred to budget information in TasNetworks internal asset replacement program]
Switchgear	> 11 kV & < = 22 kV ; Switch	$40k [Referring to budget information in TasNetworks internal asset replacement program]
	> 22 kV & < = 33 kV ; Switch	$65k [Referring to budget information in TasNetworks internal asset replacement program]
	Other	$2.5k [Referring to budget information in TasNetworks internal asset replacement program]

3.1.3 NEM Benchmark Unit Costs – TasNetworks Revenue Determination

GHD referred to the repex models published by the AER and included in its draft determination of TasNetworks distribution submission in September 2016. GHD used the NEM benchmark unit costs data used by the AER in its review of TasNetworks repex forecast in 2016. It is noted that the AER continuously collects this data from the NEM and regularly updates their set of benchmark data.

3.1.4 NEM Benchmark Unit Costs – AusNet Revenue Determination

GHD referred to the repex models published by the AER and included in its draft determination of AusNet distribution submission in October 2015. GHD used the NEM benchmark unit costs data used by the AER in its review of AusNet repex forecast in 2015. It is noted that the AER continuously collects this data from the NEM and regularly updates their set of benchmark data.

3.1.5 NEM Benchmark Unit Costs – Powercor Revenue Determination

GHD referred to the repex models published by the AER and included in its draft determination of Powercor submission in October 2015. GHD used the NEM benchmark unit costs data used by the AER in its review of Powercor repex forecast in 2015. It is noted that the AER continuously collects this data from the NEM and regularly updates their set of benchmark data.

3.1.6 NEM Benchmark Unit Costs – SAPN Revenue Determination

GHD referred to the repex models published by the AER and included in its draft determination of SAPN submission in April 2015. GHD used the NEM benchmark unit costs data used by the AER in its review of SAPN repex forecast in 2015. It is noted that the AER continuously collects this data from the NEM and regularly updates their set of benchmark data.

3.2 Blended Unit Cost

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

This particular asset category denotes wooden poles that are staked and therefore have longer asset lives than wooden poles. The proposed replacement economic life for a staked wooden pole is the additional years of life extension of a wooden pole arising from of staking that wooden pole. Staked poles are replaced non-like-for-like asset so the unit cost input data for this asset category will be same as the unit cost of wood pole asset categories.

Consequently, some proportion of wood pole asset categories will be staked instead of being immediately replaced and therefore such replacement unit cost input data will be different for a wood pole that is staked (captured as replacement in the RIN) to wood pole replacement. The unit cost of wooden poles used for repex modelling must therefore account for this non-like-for-like replacement (i.e. staking as opposed to wood pole replacement), and a ‘blended’ unit cost calculated based on the proportion of wood poles that get staked versus the total of wood poles replaced. Based on the AER Repex Model Handbook guideline and recent determinations for NEM DNSPs, the AER will request information from TasNetworks on the proportion of wood poles staked, in order to arrive at this blended unit cost.

Based on recent years of asset replacement data (as reported in 2009-17 Category Analysis RIN Table 2.2.1 and also supported by data reported in 2016-17 Category Analysis RIN Table 5.2.1), GHD has determined that on average 53% of existing wood poles are staked each year (non-like-for-like replacement) instead of like-for-like replacement. Therefore, using this proportion GHD has calculated the blended unit cost for the wood pole asset categories as shown in Table 5 to apply in the repex modelling in each scenario. The following table illustrate this calculation for deriving the historical unit cost based on internal records, as an example.

Table 5 Blended Unit Cost (Real June 2019 $) – Based on Historical Records (an example)

Asset Group	Asset Categories	Pre-adjustment		Blended Cost	
		Unit Cost	Comments	Unit Cost	Comments
Poles	Staking of wooden pole	$0.90k	Per unit cost of staking (nailing or reinforcing)	$7.13k	All non-like-for-like replacement, thus average of all wood poles. However please refer to population of staking of wooded pole vs population of wood pole asset categories reported in 2016-17 Category Analysis RIN Table 5.2.1. Accordingly, the staking of wooden pole activity has been removed from the repex modelling process, but the 'blended' unit cost is used for the wood pole replacements.
	< = 1 kV; Wood	$6.80k	Per unit cost of a wood pole	$3.97k	Some like-for-like replacement with unit cost of $6.80k and remaining non-like-for-like replacement with unit cost of $0.90k
	> 1 kV & < = 11 kV; Wood	$7.00k	Per unit cost of a wood pole	$3.77k	Some like-for-like replacement with unit cost of $7.00k and remaining non-like-for-like replacement with unit cost of $0.90k
	> 11 kV & < = 22 kV; Wood	$7.20k	Per unit cost of a wood pole	$3.86k	Some like-for-like replacement with unit cost of $7.20k and remaining non-like-for-like replacement with unit cost of $0.90k
	> 22 kV & < = 66 kV; Wood	$7.50k	Per unit cost of a wood pole	$4.00k	Some like-for-like replacement with unit cost of $7.50k and remaining non-like-for-like replacement with unit cost of $0.90k

3.3 Replacement Life Mean

The un-calibrated or base model uses the average age (i.e. replacement life mean) of each asset category as the mean replacement age for all individual assets in that category. The replacement age may refer to either the economic or technical lifetime of the asset, and represents the mean age at which assets in a category are replaced in practice, due to condition or other DNSP asset management practices.

3.3.1 TasNetworks Reported Data

GHD referred to the economic life mean data (reported in years) in the 2016-17 Category Analysis RIN Table 5.2.1 and used them to set-up or populate the un-calibrated or base models for most scenarios.

3.3.2 NEM Benchmark Lives – TasNetworks Revenue Determination

GHD referred to the repex models published by the AER and included in its draft determination of TasNetworks distribution submission in September 2016. GHD used the NEM benchmark lives data used by the AER in its review of TasNetworks repex forecast in 2016. It is noted that the AER continuously collects this data from the NEM and regularly updates their set of benchmark data.

3.3.3 NEM Benchmark Lives – AusNet Revenue Determination

GHD referred to the repex models published by the AER and included in its draft determination of AusNet distribution submission in October 2015. GHD used the NEM benchmark lives data used by the AER in its review of AusNet repex forecast in 2015. It is noted that the AER continuously collects this data from the NEM and regularly updates their set of benchmark data.

3.3.4 NEM Benchmark Lives – Powercor Revenue Determination

GHD referred to the repex models published by the AER and included in its draft determination of Powercor submission in October 2015. GHD used the NEM benchmark lives data used by the AER in its review of Powercor repex forecast in 2015. It is noted that the AER continuously collects this data from the NEM and regularly updates their set of benchmark data.

3.3.5 NEM Benchmark Lives – SAPN Revenue Determination

GHD referred to the repex models published by the AER and included in its draft determination of SAPN submission in April 2015. GHD used the NEM benchmark lives data used by the AER in its review of SAPN repex forecast in 2015. It is noted that the AER continuously collects this data from the NEM and regularly updates their set of benchmark data.

3.4 Replacement Life Standard Deviation

The un-calibrated or base model, along with the replacement life mean data, also uses the standard deviation of age distribution (i.e. replacement life standard deviation) of each asset category as the probability function of asset failure in a normally distributed population for all individual assets in that category.

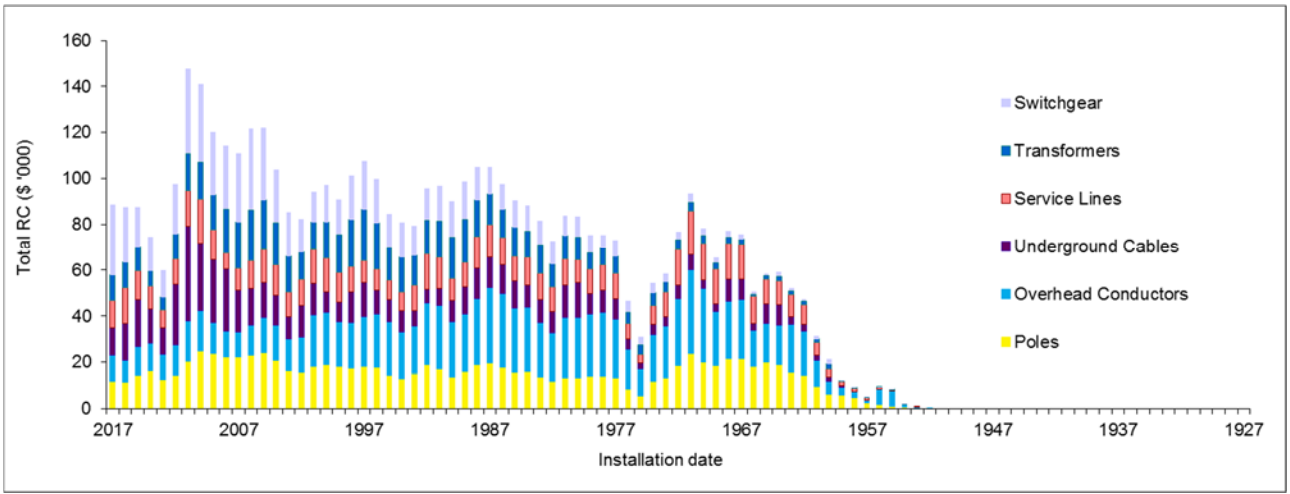
Based on the AER Repex Model Handbook guideline, GHD has assumed the replacement life standard deviation to be the function (square root) of the replacement life mean data for each asset category. This assumption reduces the input variables in repex modelling, and is especially useful for the calibration step where the goal seek calculation reduces to one variable constrain equation.

The resulting replacement life standard deviation is consistent with the reported economic life standard deviation data in TasNetworks' 2016-17 Category Analysis RIN Table 5.2.1, and also with the repex models published by the AER and included in its draft determination of various DNSPs in recent times.

3.5 Asset Age Profile

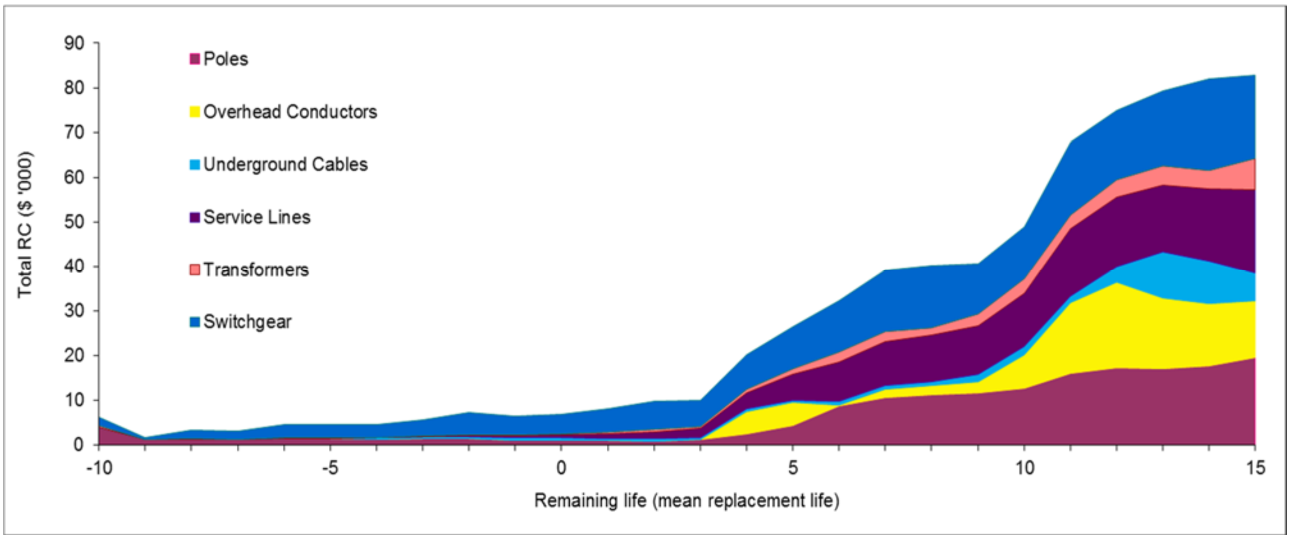
The age profile reflects the age by quantity of all currently installed individual assets. The age profile is populated in the un-calibrated or base model in matrix format with installed quantities against each asset categories and the year of installation. This information for TasNetworks' distribution asset portfolio is reported in 2016-17 Category Analysis RIN Table 5.2.1, and GHD used it to populate the model for all scenarios. This is the only set of input data that remains constant across all the scenario modelling as it reflects the state of TasNetworks' existing distribution asset portfolio. The following figures graph this information for the modelling scenario pertaining to the NEM benchmark unit costs used in TasNetworks (D) September 2016 draft determination, as an example.

Figure 3 – Age profile of TasNetworks distribution asset portfolio (asset quantum pertains to NEM benchmark unit costs used in TasNetworks Sep 2016 draft determination, for example)



The Y axis in this figure shows the quantum of asset volume represented by their values (in real June 2019 $ replacement costs) and the X axis shows the timeline of their installations or existence.

Figure 4 – Age profile of TasNetworks distribution asset portfolio (asset quantum pertains to NEM benchmark unit costs used in TasNetworks Sep 2016 draft determination, for example)



The Y axis in this figure shows the quantum of asset volume represented by their values (in real June 2019 $ replacement costs) and the X axis shows the remaining life (i.e. calibrated replacement life – asset age) of asset groups. It can be seen that there are presently some existing switchgear and poles that are past their respective calibrated replacement life. It also shows that there are some existing switchgear and poles that will reach the end of life in the near future. GHD notes that the quantum of this ageing asset volume (represented by their replacement costs) will be different for other scenarios arising from the different set of unit costs data used in the model.

4. Base Models Setup

The un-calibrated or base models requires inputs for each asset categories assessed for forecast repex by the AER. These input data are sourced from various information and the calculation or derivation of each input variables are explained in Section 3 of this report. Multiple versions or scenarios of base model are created corresponding to various combinations of input data. A summary of this population or setup of base models is shown in Table 6.

Table 6 Combination of Input data to populate base models

Scenarios	Data Inputs for each Asset Categories			
	Unit Costs	Replacement Life Mean	Replacement Life Standard Deviation	Age Profile
Historical	Derived from TasNetworks' 2013-17 Category Analysis RIN Table 2.2.1 [See Sections 3.1.1 and 3.2]	As reported in TasNetworks' 2016-17 Category Analysis RIN Table 5.2.1 [See Section 3.3.1]	Square root of replacement life mean [See Section 3.4]	As reported in TasNetworks' 2016-17 Category Analysis RIN 5.2.1 [See Section 3.5]
Forecast	Derived from TasNetworks' 2019-24 Reset RIN Table 2.2.1 [See Sections 3.1.2 and 3.2]			
Benchmark 1a	Referring to NEM benchmark data used during repex forecast review of TasNetworks Sep 2016 draft determination [See Section 3.1.3]			
Benchmark 2a	Referring to NEM benchmark data used during repex forecast review of AusNet Oct 2015 draft determination [See Section 3.1.4]			
Benchmark 3a	Referring to NEM benchmark data used during repex forecast review of Powercor Oct 2015 draft determination [See Section 3.1.5]			
Benchmark 4a	Referring to NEM benchmark data used during repex forecast review of SAPN Apr 2015 draft determination [See Section 3.1.6]			
Benchmark 1b	Referring to NEM benchmark data used during repex forecast review of TasNetworks Sep 2016 draft determination [See Section 3.1.3]	NEM benchmark lives used during repex forecast review of TasNetworks Sep 2016		

Scenarios	Data Inputs for each Asset Categories			
	Unit Costs	Replacement Life Mean	Replacement Life Standard Deviation	Age Profile
		draft determination [See Section 3.3.2]		
Benchmark 2b	Referring to NEM benchmark data used during repex forecast review of AusNet Oct 2015 draft determination [See Section 3.1.4]	NEM benchmark lives used during repex forecast review of AusNet Oct 2015 draft determination [See Section 3.3.3]		
Benchmark 3b	Referring to NEM benchmark data used during repex forecast review of Powercor Oct 2015 draft determination [See Section 3.1.5]	NEM benchmark lives used during repex forecast review of Powercor Oct 2015 draft determination [See Section 3.3.4]		
Benchmark 4b	Referring to NEM benchmark data used during repex forecast review of SAPN Apr 2015 draft determination [See Section 3.1.6]	NEM benchmark lives used during repex forecast review of SAPN Apr 2015 draft determination [See Section 3.3.5]		

5. Model Calibrations

The un-calibrated repex model produces extremely high forecast quantities when populated with replacement life mean input data directly from the Category Analysis RIN Table 5.2.1. This is the case for TasNetworks (and also for other NEM DNSPs). The AER has developed a 'calibration' process whereby the model inputs are adjusted until the forecast replacement quantities match recent historical quantities trend.

5.1 1st Step Calibration

This adjustment is achieved by varying the replacement life mean in the repex model until replacement quantities in the first year of the forecast period match the average replacement quantities in the past regulatory period for each asset category. As explained earlier, the replacement life standard deviation input data of all asset categories is set to the square root of their replacement life mean input data. This reduces the calibration of the repex model to a single variable problem, which can be solved with an iterative algorithm. The process works as follows, for each individual asset category.

- The unit cost and age profile input data remains unchanged during the calibration process.
- The average replacement quantities over the previous regulatory period (reported in previous years Category Analysis RIN Table 2.2.1) are averaged, and this averaged quantity is set as the target of an optimisation function.
- The replacement life mean input data is adjusted or varied, using an optimisation function (such as Microsoft Excel's Goal Seek) until the repex model produces the average historical replacement quantity in the first year of its forecast.

GHD has taken note of all the asset categories which did not incur any repex in the past regulatory period as they require special treatment.

When an asset category has no recent repex, the goal seeking function will attempt to adjust the replacement mean life input data until zero assets are replaced in the first year of the forecast. Because the repex model predicts replacement quantities on a probabilistic basis, and will therefore predict fractional replacement with an extremely high replacement life mean value, the goal seek algorithm in most cases will not be able to find a solution to this problem, or only a solution with an unrealistically high replacement life mean value (for e.g. >100 years in some cases). In such instances, GHD did not perform the calibration step for asset categories with no recent historic repex, and left the 'calibrated' repex model populated with replacement life mean data based on the reported value in 2016-17 Category Analysis RIN Table 5.2.1 for those asset categories.

5.2 2nd step Calibration

Once the 1st step calibration is complete, the repex model will produce forecasts based on individual asset age profiles and historic replacement quantities. However, since the first year of the forecast period is matched to quantities from previous years, the forecast needs to be adjusted to reflect any ongoing trends in replacement quantities. This is based on the assumption that since the model has been calibrated in the first forecast year based on past replacement quantities, it does not account for any trends in replacement requirements.

The forecast replacement quantities output by the repex model from the 1st step calibration are recorded for each asset category and used to determine an annual percentage increase or decrease (i.e. whether the model predicts increasing or decreasing replacement year to year when looking at the future quantities forecast). The annual changes in replacement quantities forecast are then averaged, and the annual trend added to or subtracted from the replacement target of the 1st step calibration. This produces a new target, so that the model predicts ‘next’ year’s replacement rather than the average ‘this’ year quantity. This adjustment is generally a minor one. The model is then recalibrated to match the new target, using the same goal seeking algorithm as during the 1st step calibration.

The annual trend can be derived by averaging the changes in forecast quantities over all the years of the forecast, by considering just the first two forecast years, or considering any number of years in between. The AER Repex Model Handbook document and the recent revenue determination of NEM DNSPs does not clearly explain how this function is calculated, only its purpose i.e. to ‘offset’ the forecasts by one year. GHD has considered the first five years of repex forecast on which to base the 2nd step calibration.

5.3 ‘Calibrated’ Models

Following the calibration process, multiple versions or scenarios of ‘calibrated’ models are created corresponding to the respective un-calibrated or base models. All input data, except for the replacement life mean (and its function, replacement life standard deviation), remains the same for each scenario. The various combination of input data in the multiple scenarios of calibrated model are shown in Table 7.

Table 7 Combination of Input data in the ‘calibrated’ models

<table>
<tr><th rowspan="2">Scenarios</th><th colspan="4">Data Inputs for each Asset Categories</th></tr>
<tr><th>Unit Costs</th><th>Replacement Life Mean</th><th>Replacement Life Standard Deviation</th><th>Age Profile</th></tr>
<tr><td>Historical</td><td>Derived from TasNetworks’ 2013-17 Category Analysis RIN Table 2.2.1 [See Sections 3.1.1 and 3.2]</td><td rowspan="5">New or adjusted values as determined by the optimisation function for those asset categories which incurred recent historical repex [See Sections 5.1 and 5.2].

As reported in TasNetworks’ 2016-17 Category Analysis RIN Table 5.2.1 [See Section 3.3.1] for those asset categories which did not incur any recent historical repex.</td><td rowspan="5">Square root of replacement life mean [See Section 3.4]</td><td rowspan="5">As reported in TasNetworks’ 2016-17 Category Analysis RIN 5.2.1 [See Section 3.5]</td></tr>
<tr><td>Forecast</td><td>Derived from TasNetworks’ 2019-24 Reset RIN Table 2.2.1 [See Sections 3.1.2 and 3.2]</td></tr>
<tr><td>Benchmark 1a</td><td>Referring to NEM benchmark data used during repex forecast review of TasNetworks Sep 2016 draft determination [See Section 3.1.3]</td></tr>
<tr><td>Benchmark 2a</td><td>Referring to NEM benchmark data used during repex forecast review of AusNet Oct 2015 draft determination [See Section 3.1.4]</td></tr>
<tr><td>Benchmark 3a</td><td>Referring to NEM benchmark data used during repex forecast review of Powercor Oct 2015 draft determination [See Section 3.1.5]</td></tr>
</table>

Scenarios	Data Inputs for each Asset Categories			
	Unit Costs	Replacement Life Mean	Replacement Life Standard Deviation	Age Profile
Benchmark 4a	Referring to NEM benchmark data used during repex forecast review of SAPN Apr 2015 draft determination [See Section 3.1.6]			
Benchmark 1b	Referring to NEM benchmark data used during repex forecast review of TasNetworks Sep 2016 draft determination [See Section 3.1.3]	NEM benchmark lives used during repex forecast review of TasNetworks Sep 2016 draft determination [See Section 3.3.2]		
Benchmark 2b	Referring to NEM benchmark data used during repex forecast review of AusNet Oct 2015 draft determination [See Section 3.1.4]	NEM benchmark lives used during repex forecast review of AusNet Oct 2015 draft determination [See Section 3.3.3]		
Benchmark 3b	Referring to NEM benchmark data used during repex forecast review of Powercor Oct 2015 draft determination [See Section 3.1.5]	NEM benchmark lives used during repex forecast review of Powercor Oct 2015 draft determination [See Section 3.3.4]		
Benchmark 4b	Referring to NEM benchmark data used during repex forecast review of SAPN Apr 2015 draft determination [See Section 3.1.6]	NEM benchmark lives used during repex forecast review of SAPN Apr 2015 draft determination [See Section 3.3.5]		

GHD notes that for scenarios (referred as Benchmarks 1b, 2b, 3b and 4b) no calibrations are performed as the replacement life mean input data in those models have already been deemed to be the benchmark lives in the NEM by the AER, and were used to review the DNSPs' proposed repex forecasts in their respective revenue determinations.

6. Scenarios Analysis

6.1 Modelling Outputs

In similar fashion to the AER review, GHD ran a number of scenarios using the repex model to generate alternate or a range of modelled repex forecast outputs. The modelled repex forecast summary results from this modelling are presented in Table 8. This modelled repex forecast includes the six asset groups as stated earlier in this report and constitute approximately 90% of the total proposed repex forecast.

Table 8 Modelled repex forecast summary

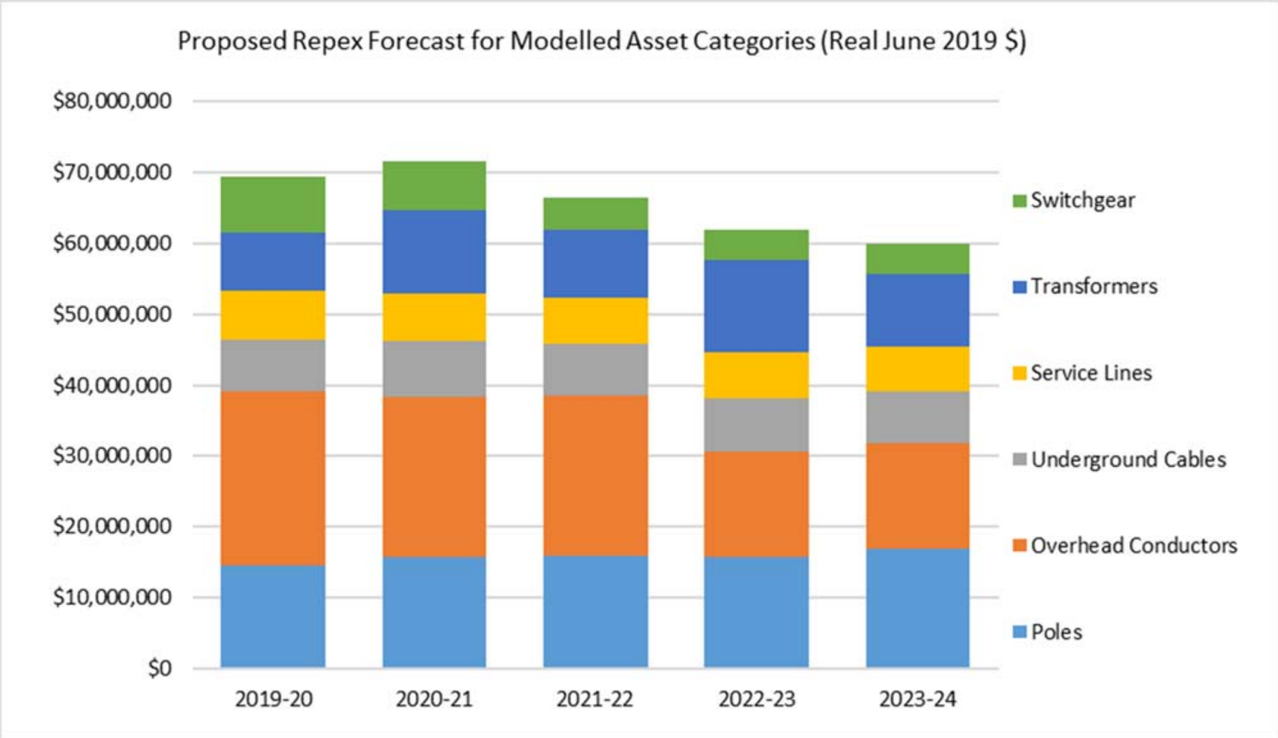
Scenarios	Total 2019-24 Modelled Repex (Real June 2019 $)	Average Annual Modelled Repex (Real June 2019 $)	Comments
Historical	$308m	$61m	
Forecast	$317m	$63m	
Benchmark 1a	$211m	$42m	The modelled repex forecast outputs from these scenarios are partially based on input data that is independent of TasNetworks reporting.
Benchmark 2a	$233m	$47m	
Benchmark 3a	$242m	$48m	
Benchmark 4a	$242m	$48m	
Benchmark 1b	$167m	$33m	The modelled repex forecast outputs from these scenarios are based on input data that is independent of TasNetworks reporting.
Benchmark 2b	$161m	$32m	
Benchmark 3b	$166m	$33m	
Benchmark 4b	$217m	$43m	

The outputs from this modelling in lower level details (i.e. by asset groups and by year) are presented in Appendix A.

6.2 Comparison with Proposed Repex

The total proposed distribution repex by TasNetworks in its 2019-24 Reset RIN Table 2.2.1 for all modelled asset groups (i.e. the six asset groups) equals to $329m for the 2019-24 period with an average annual of $66m. The build-up of this proposed model is illustrated in the following figure.

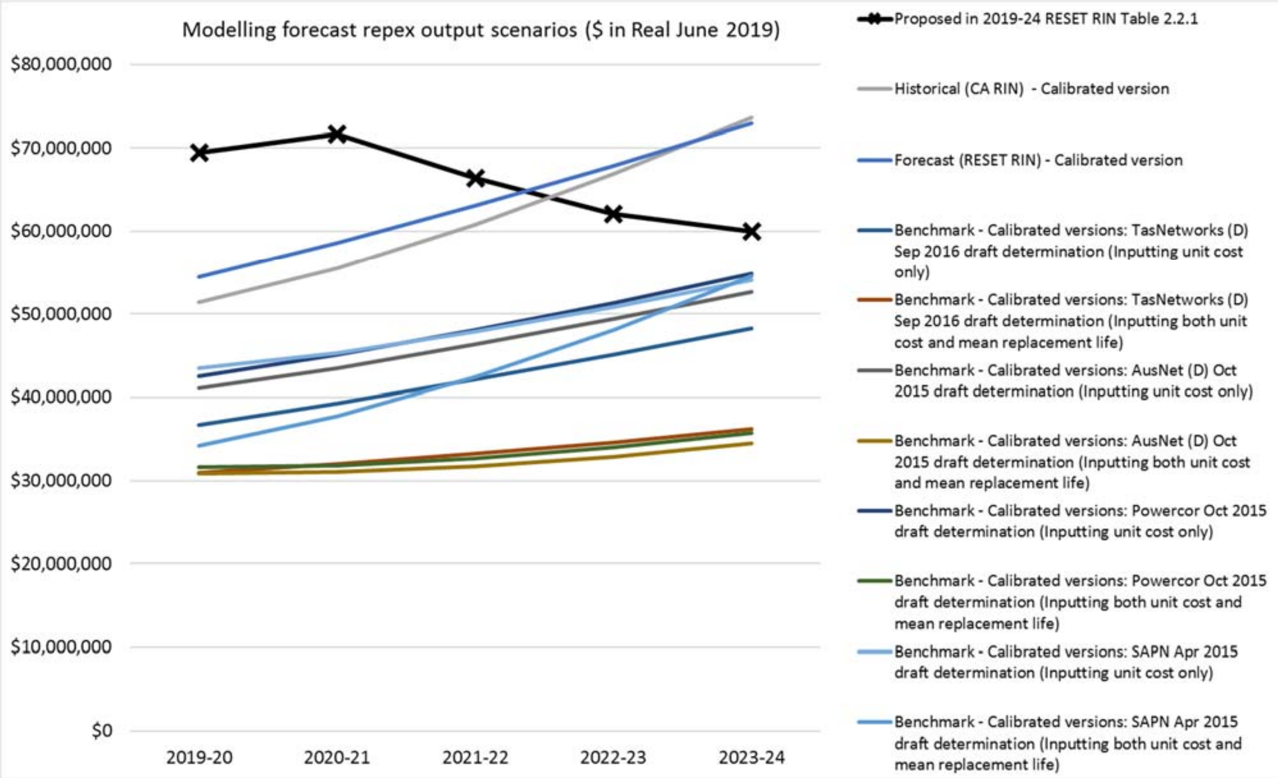
Figure 5 – Proposed distribution 2019-24 repex by TasNetworks



This proposed 2019-24 repex by TasNetworks is front loaded, i.e. more repex is planned to occur in the earlier years with slight tapering down of this repex from 2020-21 onwards. It is understood that TasNetworks plans to balance this expenditure profile by back loading the IT (non-network) capex, i.e. planned to occur in the later years so that the overall capex is delivered uniformly or constantly throughout the 2019-24 period.

This proposed 2019-24 repex by TasNetworks contrast starkly with the modelled repex forecasts of most output scenarios, especially the benchmark scenarios that are independent of TasNetworks reporting and which the AER will use in its review. This comparison is shown in the following figure.

Figure 6 – Comparison between proposed vs modelled repex forecasts



This comparison with further breakdown details (i.e. by asset groups) is presented in Appendix B.

It is noted that the modelled repex forecast output is a function of unit cost, age profile of the existing TasNetworks distribution asset portfolio, and the quantities of old assets determined to be beyond the calibrated replacement life[4]. GHD notes that there are variabilities in the modelled repex forecast outputs within each asset group against the proposed repex and also between the scenario outputs themselves. These are cause by collective combination of the following effects:

- Difference in asset category unit cost.
- Difference in replacement life mean (and also the standard deviation which is assumed to be a function of replacement life mean), and its interaction with the asset age profile for each individual asset categories.

GHD however notes that the purpose of the repex model is to review and analyse repex forecast information at an aggregate level and not at an individual asset category level. The repex model is not designed to analyse granular details. The repex model is a first-pass review tool and it is expected that the AER will use other assessment techniques including review of TasNetworks' asset management practices to supplement its analysis of TasNetworks' distribution proposed repex forecast.

[4] Given it is a probabilistic distribution, it is also dependent on the standard deviation (for normally distributed expenditure profile). But this variable is assumed to the square root of the mean replacement life.

7. Beyond Repex Modelling

GHD understands that TasNetworks various Asset Management Plans provides the status of their existing asset classes, major risks associated with them, business constraints, mitigation or treatment options, and the investment evaluation process to propose solution and the associated costs.

The risk consideration throughout the asset management functions follows TasNetworks' Risk Management Framework thereby following a consistent and structured approach for management of various types of risks. The risk assessment involves the following:

- Identification of the individual risks including how and when they might occur.
- Risk analysis of the effectiveness of the existing controls, the potential consequences from the risk event and the likelihood of these consequences occurring to arrive at the overall level of risk.
- Risk evaluation where risks are prioritised based on their ratings and whether the risk can be treated or managed at the current level.

The risk management provides consistent framework across all the tiers of its asset management practices from the corporate plans and cascading down to area development plans and integrated capital works program which consolidate and optimise the works plans and scheduling. This provides a structured approach to measure, mitigate and reduce the asset risk level to acceptable level determined by TasNetworks management.

The investment evaluation process follows TasNetworks' Gated Investment Framework thereby following a consistent and structured approach to investment governance. The Investment Evaluation Summaries (IES) are used to provide information in support of a project for inclusion in the capital works program. This information provides a record of the project as it progresses from initiation to finalisation and is required to support a request for funding approval.

These Asset Management Plans capture specific asset failure risks that runs along certain make or types of asset categories which may not correlate with the asset age. Such failure risks may be the result of a particular manufacturing batch design or material issues (for e.g. porcelain insulator pins of certain types of air break switch) or a newly discovered environmental phenomenon (for e.g. different fungi communities in relation to carroty rot in wood poles).

The condition based risk management practice considers likelihood and consequence of asset failure to understand the risk profile of specific asset class or type. Likelihood or the probability of asset failure is calculated by deriving the asset health index that incorporates not only the age of the asset, but also its environment, operational duty cycle statistics and asset inspection information. The consequence of asset failure is calculated by considering the adverse effect to safety, environment, repair efforts, replacement difficulty, loss of supply etc. The risk profile determined in this manner then informs the treatment plans to minimise or maintain the risk at a manageable level.

Failure of assets is related to or results in various types of risks. TasNetworks' Asset Management Plan therefore put forward the case to inspect the condition of assets on a regular basis and to replace or reinforce assets in poor condition before they fail. Poor condition assets are identified in maintenance and inspections activities and feed into the list of proposed capital expenditure projects for prioritisation. While poor condition assets are primarily replaced to mitigate risks, there is also an economic advantage as reactive replacements are generally more expensive, incurring overtime, callout penalties and additional repair costs to cables and nearby infrastructure. TasNetworks maintains that by identifying weak spots and defects prior to any asset failure, reactive maintenance can be undertaken with less disruption to customers at lower cost.

Therefore GHD consider it is pragmatic to refer to TasNetworks Asset Management Plans, practices, and the associated analysis to support the proposed repex level, as they incorporate other business drivers.

8. Conclusion

The AER will rely on its repex modelling tool to model various alternative scenarios of the repex forecasts (similar to this report). This process will inform the AER to enable it to establish a likely modelled repex range for TasNetworks' requirement in 2019-24. GHD envisages that the AER will focus more on the benchmark scenarios modelling (rather than the historical and/or forecast scenario modelling), along with historical repex trend analysis, when reviewing TasNetworks distribution repex proposal.

GHD analysis has suggested that the AER's view of 'modelled' proportion of the repex range will likely be approximately $35m to $40m per year (Real June 2019 $) during the 2019-24 period as compared to the proposed $66m annual average in its 2019-24 Reset RIN Table 2.2.1. This is also similar to TasNetworks distribution historic average modelled repex spent ignoring the recent year repex spike. It is noted that this is not the entire repex volume and only corresponds to the six asset groups that have been modelled. There are four asset groups that remains 'un-modelled'.

The modelled benchmark versions or scenario repex forecast are significantly less as compared to the TasNetworks proposal. This is because the benchmark input variables (unit cost, mean replacement life) used in recent AER determinations and in these scenarios, in general, are efficient (i.e. lower cost and longer asset life than assumed by TasNetworks), which the AER considers are the frontier benchmark performance in the NEM. It is noted that the benchmark input data that the AER uses in its review process may differ for each determination. The AER continuously collects Category Analysis RIN from all DNSPs and it regularly updates their benchmark input data set.

Beyond the repex modelling, it is envisage that TasNetworks' Asset Management Plans and associated analysis, business frameworks and practices will also be considered and reviewed to assess the prudency and reasonableness of the proposed repex.

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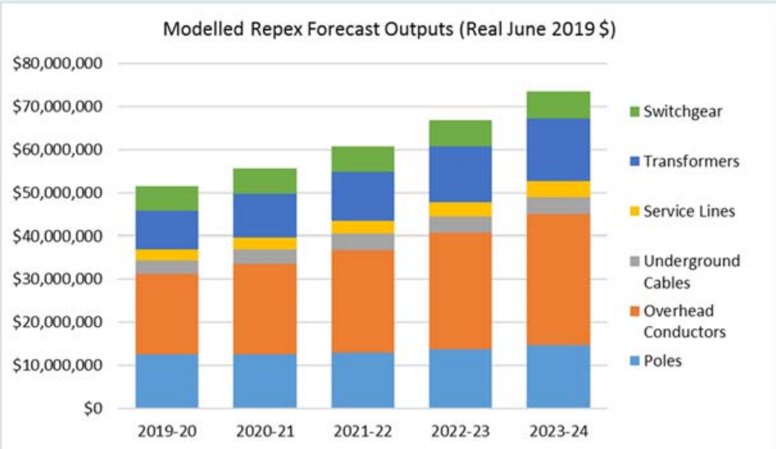
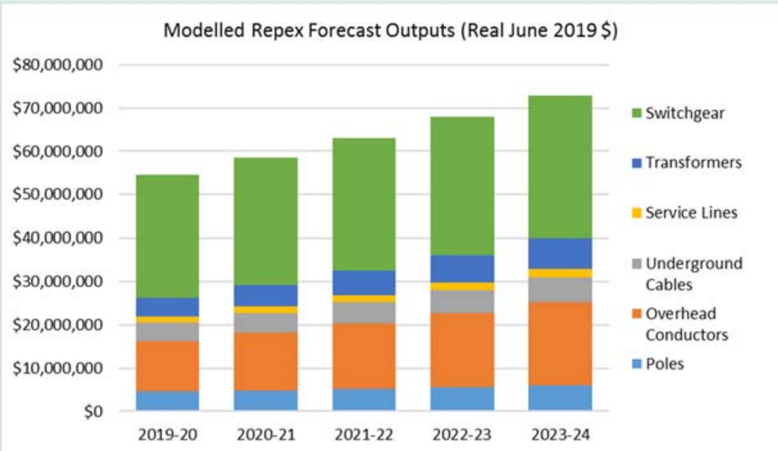
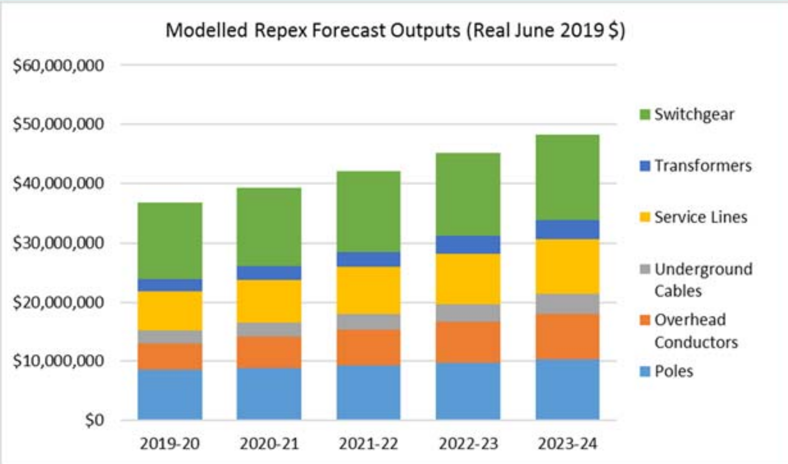
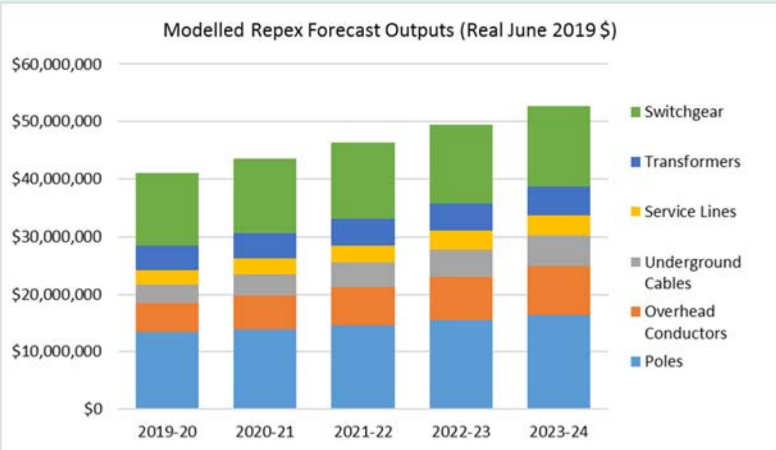
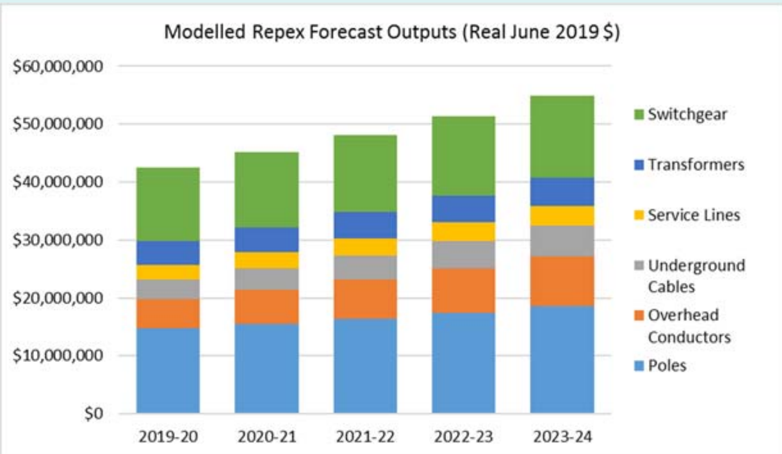
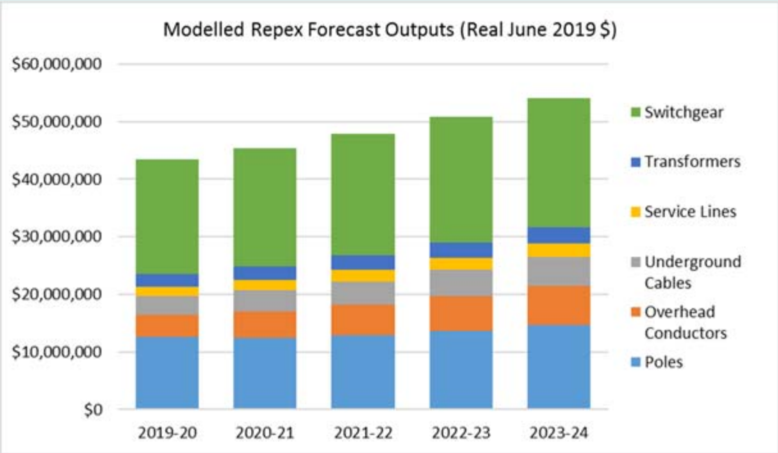
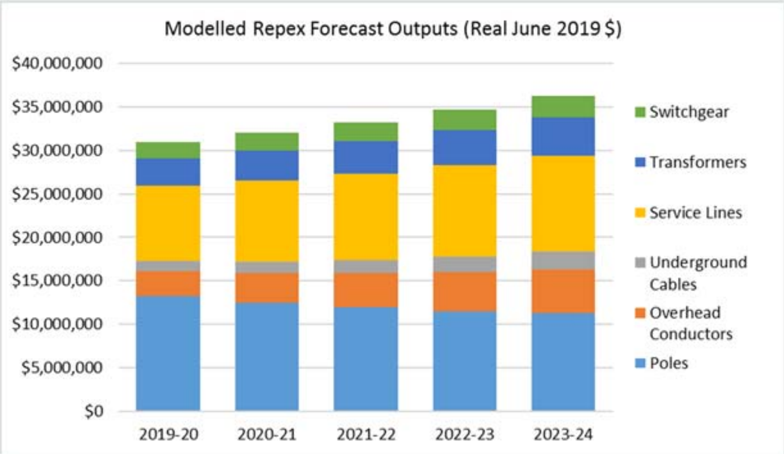
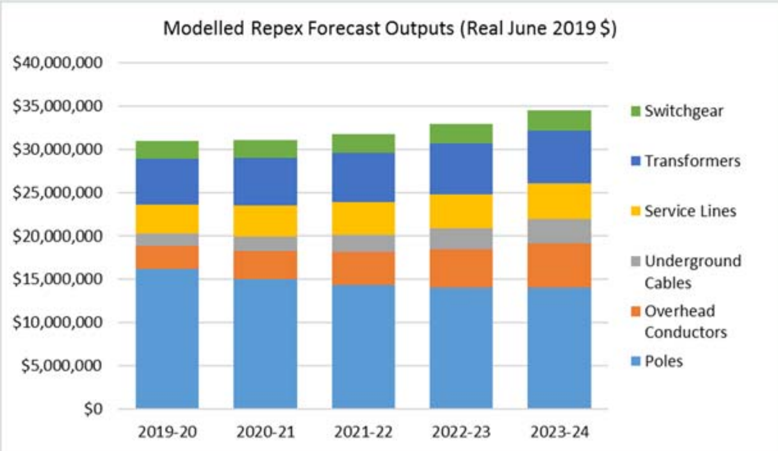
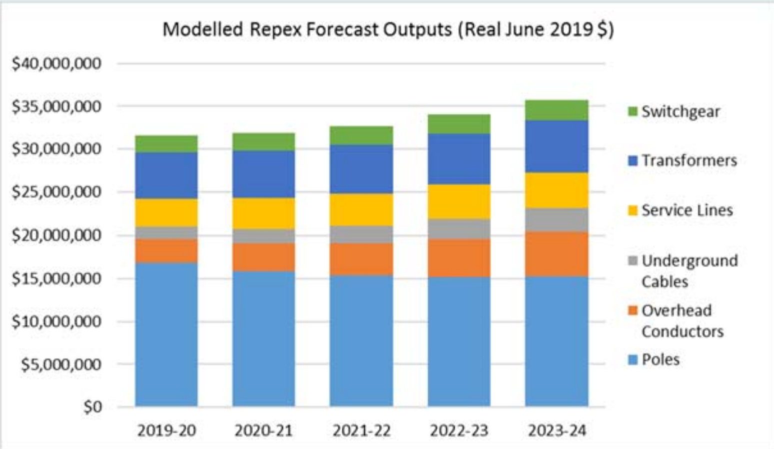
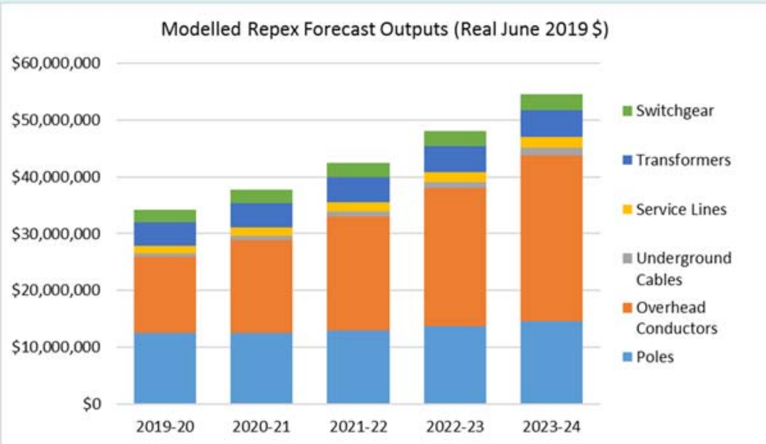
Appendices

Appendix A – Detail Modelling Outputs

Scenarios	Calibrated Repex Model Outputs	Total 2019-24 Modelled Repex (Real June 2019 $)	Average Annual Modelled Repex (Real June 2019)
Historical [Based on Category Analysis RINs]	 	$308m	$61m
Forecast [Based on 2019-24 Reset RIN]	 	$317m	$63m

Scenarios	Calibrated Repex Model Outputs	Total 2019-24 Modelled Repex (Real June 2019 $)	Average Annual Modelled Repex (Real June 2019)
Benchmark 1a [Based on TasNetworks Sep 2016 draft determination – unit cost only]		$211m	$42m
Benchmark 2a [Based on AusNet Oct 2015 draft determination – unit cost only]		$233m	$47m
Benchmark 3a [Based on Powercor Oct 2015 draft determination – unit cost only]		$242m	$48m

Scenarios	Calibrated Repex Model Outputs	Total 2019-24 Modelled Repex (Real June 2019 $)	Average Annual Modelled Repex (Real June 2019)
Benchmark 4a [Based on SAPN Apr 2015 draft determination – unit cost only]		$242m	$48m
Benchmark 1b [Based on TasNetworks Sep 2016 draft determination – both unit cost and mean life]		$167m	$33m
Benchmark 2b [Based on AusNet Oct 2015 draft determination – both unit cost and mean life]		$161m	$32m

Scenarios	Calibrated Repex Model Outputs	Total 2019-24 Modelled Repex (Real June 2019 $)	Average Annual Modelled Repex (Real June 2019)
Benchmark 3b [Based on Powercor Oct 2015 draft determination – both unit cost and mean life]		$166m	$33m
Benchmark 4b [Based on SAPN Apr 2015 draft determination – both unit cost and mean life]		$217m	$43m

Appendix B – Comparison between Proposed vs Modelled Forecasts

Asset Groups	Proposed by TasNetworks in 2019-24 RESET RIN Table 2.2.1		Modelled Repex Forecast Scenario Outputs									
			Historical 1	Forecast 1	Benchmark 1a	Benchmark 2a	Benchmark 3a	Benchmark 4a	Benchmark 1b	Benchmark 2b	Benchmark 3b	Benchmark 4b
			Based on Category Analysis RINs	Based on 2019-24 Reset RIN	TasNetworks (D) Sep 2016 draft determination	AusNet (D) Oct 2015 draft determination	Powercor Oct 2015 draft determination	SAPN Apr 2015 determination	TasNetworks (D) Sep 2016 draft determination	AusNet (D) Oct 2015 draft determination	Powercor Oct 2015 draft determination	SAPN Apr 2015 determination
					Inputting unit cost only	Inputting unit cost only	Inputting unit cost only	Inputting unit cost only	Inputting both unit cost and mean replacement life	Inputting both unit cost and mean replacement life	Inputting both unit cost and mean replacement life	Inputting both unit cost and mean replacement life
	2019-24		**2019-24**	**2019-24**	**2019-24**	**2019-24**	**2019-24**	**2019-24**	**2019-24**	**2019-24**	**2019-24**	**2019-24**
Poles	$78,824,431		$66,230,195	$26,166,996	$46,932,103	$73,748,921	$82,771,004	$66,230,194	$60,426,802	$73,731,660	$78,553,064	$66,173,662
Overhead Conductors	$99,654,585	**VS**	$121,007,543	$76,505,860	$30,195,008	$33,707,028	$33,707,032	$26,527,632	$19,860,036	$19,151,476	$19,151,476	$103,463,343
Underground Cables	$37,205,139		$17,895,000	$25,132,156	$13,512,171	$21,339,609	$21,339,602	$20,690,641	$7,791,613	$10,034,330	$10,034,330	$4,596,555
Service Lines	$33,114,214		$15,381,888	$8,036,268	$39,630,427	$14,784,763	$14,784,763	$9,703,611	$49,244,867	$18,792,176	$18,792,176	$8,142,876
Transformers	$52,918,985		$57,897,869	$28,243,174	$13,095,855	$22,811,638	$22,806,563	$12,616,643	$19,035,449	$28,613,936	$28,610,696	$22,087,356
Switchgear	$27,770,766		$29,747,032	$152,929,682	$68,125,959	$66,594,005	$66,574,706	$105,956,173	$10,783,942	$10,814,215	$10,829,953	$12,593,149
5 years total modelled repex	**$329,488,119**		**$308,159,526**	**$317,014,135**	**$211,491,522**	**$232,985,963**	**$241,983,670**	**$241,724,893**	**$167,142,708**	**$161,137,793**	**$165,971,695**	**$217,056,940**
Average per annum	$65,897,624		$61,631,905	$63,402,827	$42,298,304	$46,597,193	$48,396,734	$48,344,979	$33,428,542	$32,227,559	$33,194,339	$43,411,388

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