5.13.0

Project justifications for replacement and duty of care programs – Introduction

Ausgrid

Content

1 INTRODUCTION

1.1 Purpose of this document

This document provides a summary of justifications for capital programs categorised as replacement expenditure (repex). These programs form part of Ausgrid's overall proposed standard control capital expenditure (capex) for the 2019-24 regulatory period, however they exclude major asset replacements which are documented separately due to their impact on the network, complexity and the size of investment. Major asset replacements are captured in detail in Attachment 5.14. Ausgrid's forecast repex for the 2019-24 regulatory period is $1,568 million consisting of:

- $435 million in major projects expenditure
- $1,133 million in capital programs.

This excludes an additional $106 million for land purchases, project switching and control activities and subsequent project asset data maintenance to enable delivery of these works. The purpose of this document is to provide the AER, its consultants and consumers with a brief description of the need for these capital programs and the investment timing that results in programs that are efficient and prudent as required by Chapter 6 of the National Electricity Rules (NER). This document sets out the:

- Asset risks to be mitigated
- Options considered to mitigate these risks
- Forecast replacement costs
- Forecast replacement volumes.

These areas meet the capital expenditure objectives defined in clause 6.5.7 of the NER.

1.2 Need for capital progams

Ausgrid invests only when there is clear value to customers. Ausgrid's replacement programs target expenditure on assets to ensure the safety of Ausgrid's staff/customers and to mitigate loss of supply risks. Figure 1 outlines the key objectives Ausgrid's forecast capital programs are aligned to and demonstrates how these objectives contribute to the achievement of both the National Electricity Objectives (NEO) and the capital expenditure objectives defined in the NER.

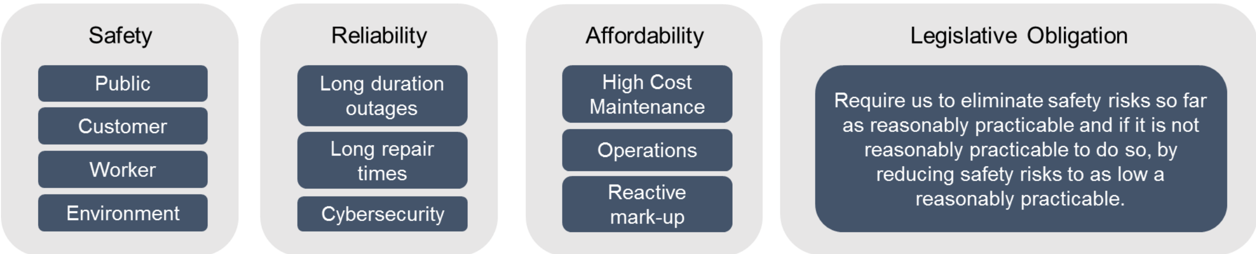
Figure 1. Objectives of Ausgrid's forecast 2019-24 capital program expenditure

Ausgrid's asset management system effectively manages the electricity network and related assets through the full asset life cycle. To achieve its required objectives, Ausgrid employs risk management principles in line with Australian Standards for Risk Management (AS31000) to inform replacement decisions. This provides an appropriate balance between risk, cost and performance for Ausgrid's assets to meet the needs of Ausgrid's customers and stakeholders. Based on these risk management principles, Ausgrid will eliminate safety hazards 'so far as is reasonably practicable' (SFAIRP) however, if it is not reasonably practicable to eliminate safety hazards, they are reduced to an 'as low as reasonably practicable' (ALARP)[1] level in accordance with legislative and regulatory obligations. Other hazards are analysed and evaluated with maintenance strategies to achieve an overall positive balance of risk, cost and performance that meets the needs of Ausgrid's customers and stakeholders and promotes the objectives of the NEO.

1.3 Need for capital progams

In achieving the objectives described above, Ausgrid's replacement program is developed to manage the following key drivers:

Figure 2. Drivers for replacement investment (consequences)



[1] SFAIRP (so far as is reasonably practicable) and ALARP (as low as reasonably practicable) are complementary safety and risk management concepts. Both require that all reasonably practicable measures are taken to eliminate risk. When risk elimination is not possible, both require that all reasonably practicable measures are taken to reduce risk.

In applying a risk based approach, Ausgrid considers the likelihood of these drivers being realised and the consequences which arise from their realisation.

$$Risk = Likelihood \times Consequence$$

It is only through consideration of this that a risk based approach can be adopted in determining optimal replacement needs to meet the objectives. This includes consideration of the lowest sustainable cost approach as outlined in clause 6.2.2 of the NER. Where asset failure does not result in significant risks to our objectives, and where cost effective to do so, Ausgrid will elect to replace assets after failure. Figure 3 shows the key contributors which impact the likelihood of realising these consequences.

Figure 3. Key contributors impacting the likelihood

The majority of Ausgrid's replacement expenditure arises from the risk of asset failure. Failures of network assets can introduce safety risks to the public, customers and to workers. They can also cause significant outages, damage to the environment and lead to additional costs in business disruption, loss of supply and asset damage. In applying the principles of asset management to develop the maintenance and replacement strategies for Ausgrid's network assets, Ausgrid utilises Failure Mode Effect and Criticality Analysis (FMECA) to assess the risks associated with asset failure. Where the risk of failure is unacceptable, Ausgrid's approach is to prevent failure through the monitoring of asset condition and implement mitigation before the failure is realised, i.e. repair or replacement.

The optimal timing for the majority of Ausgrid's asset class replacements is determined when the likelihood of failure is unacceptable. For example, due to the public interface with overhead assets, Ausgrid applies condition based maintenance to assess the likelihood of pole failures and will replace poles when the likelihood is high as determined by the remaining strength of the poles.

Ausgrid has undertaken in-depth analysis of major network components (major transformers, 11kV switchboards and 132kV fluid filled cables) to assign a specific failure probability distribution to inform replacement decisions. Details of the probabilistic planning method for major projects are captured in Attachment 5.14.

For some asset classes, where the condition is unknown or cannot be determined effectively, age may be used to support the replacement decision. As condition and age both correlate with time, this is an appropriate approach when a condition assessment (maintenance) is not effective or efficient.

The replacement decision for some assets is less reliant on failure characteristics, therefore the optimal timing for asset replacement cannot be solely reliant on condition. As such, Ausgrid has a number of asset replacement programs driven by evolving asset issues unrelated to their condition. These programs target assets with inherent design deficiencies and/or configuration issues. For example, replacement of supervisory control and data acquisition (SCADA) systems, network communications equipment and protection relay are largely driven by the obsolescence of system components and the inability of these systems to continue to support a modern electricity network. The potential for cyber security breaches has also increased the need for a step change in expenditure in this asset category.

A number of replacements are required due to the need to meet safety and environmental compliance obligations. The replacement of these assets forms part of a strategic plan that is unrelated to historical replacement rates and is therefore difficult to model using repex.

This includes upgrades of oil containment systems, security systems or feeder earthing to extend their functional lives.

1.4 Identifying and assessing the options

Once asset risks are understood, Ausgrid must consider the appropriate risk treatment approach which may include capital or operational expenditure. The selection of the treatment approach also considers the evolving network outlook so that Ausgrid does not either over invest in assets which may have reduced utilisation in the foreseeable future or under invest causing an unreasonable step change in future investment requirements or risk exposure.

This is also consistent with recent changes to the NER in regard to the requirement to apply the Regulatory Investment Test for Distribution (RIT-D) for replacement capital expenditure.

Risk treatments as defined in this document include the following treatment options:

- Repairs or modifications
- Life extension (refurbishment or reinforcement)
- Replacing like for like
- Replacing with new technology
- Installation of new assets or upgrade of existing assets which do not fit the definition of 'Augmentation Expenditure' but are required as part of the network, such as installation of new fences, fire and oil containment systems
- Network alternatives.

In determining the appropriate treatment option, Ausgrid considers the cost of each option and evaluates this against the benefits or risk mitigated. For example, when comparing the life extension and costs of refurbishment of steel towers against replacement, it can be seen that refurbishment provides a lower lifecycle cost and therefore better value for customers.

Life extension involves a partial replacement or modification to extend the life of the asset and defer the majority of the capital cost after the asset has been deemed to be conditionally failed. Examples where this treatment is appropriate include staking of a pole or vacuum circuit breaker conversions. The costs of the approach and the condition of the asset are considered to determine if life extension is an effective treatment.

In some cases, like for like replacement is no longer possible as the existing technology being utilised has become obsolete. Improvements in technology can often result in a significant incremental change in benefit when compared to like for like replacement. Examples include insulated overhead conductors (as opposed to bare overhead conductors), SF6 or air insulated equipment (as opposed to oil insulated equipment) and polymeric or epoxy insulators (as opposed to porcelain insulators).

Ausgrid is required to meet the requirements of AS5577-2013, *Electricity network safety management systems*, and must consider all reasonably practicable options in mitigating safety risks. This includes consideration of industry best practice and new and emerging technologies. For example, Ausgrid is replacing oil filled switchgear with newer vacuum and gas technologies due to the combustible and flammable liquid risk which oil switchgear poses. In removing this switchgear, Ausgrid is mitigating the risk of exposure to workers who often carry out operation of these assets. There have been a number of recorded incidents in industry where these assets have led to serious safety outcomes (including fatalities).

Beyond the identification of the most appropriate solution for resolving an asset issue, Ausgrid also considers and forecasts using the method in which replacement program requirements are identified. Ausgrid defines the approach in three broad categories that are utilised to group and enable appropriate forecasts for replacement programs. The approach to selecting the most appropriate category is detailed in the table below:

Table 1. Methods for the identification of replacement needs

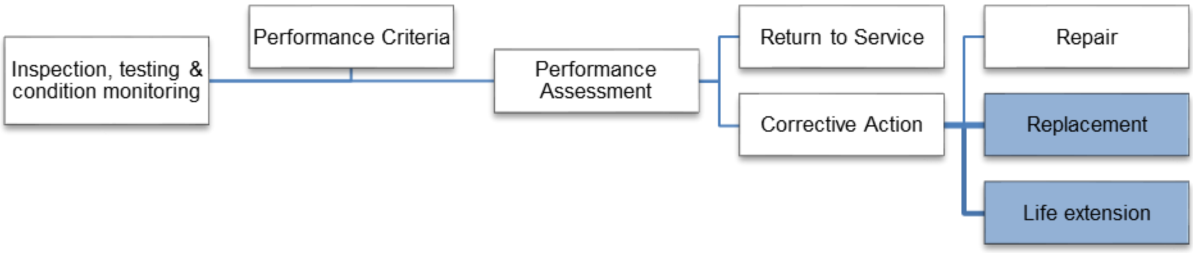
Program need identification	Assessment	Forecast Method
1. Reactive program - generally following asset functional failure	Reactive treatment is suitable when: • Asset criticality is low and asset failure is acceptable, or • The cost in implementing additional controls outweighs the benefit, or • To allow for additional risks which arise during the period and are not forecast in other programs. An example is underground cables, where safety, supply security and reliability can be maintained.	Trending of historical reactive expenditure with step changes applied for expected changes in failure rates or impacts from other investments. Individual replacements are not known until failures occur or risks are realised.
2. Conditional program – assessment of asset condition against acceptable risk criteria	Condition based treatment is suitable when: • The risk mitigation gained (benefits) outweighs the cost, and • Risks can be linked to time or asset condition, and • Condition based maintenance is technically effective and cost effective. An example is poles, where the risks posed may be high, asset deterioration is well understood and can be effectively and efficiently assessed via testing.	Informed by maintenance cycles and forecasted utilising predictive modelling or historical trending. Individual replacements are not known until maintenance is undertaken and evaluated against performance criteria.
3. Planned program - assets with known and already unacceptable condition issues	Planned treatment is suitable when: • The risk mitigation gained (benefits) outweighs the cost, and • Condition based maintenance is not technically effective and cost effective, or • Further monitoring of condition does not add value. An example is the replacement of oil filled circuit breakers, where the risks posed by individual assets are already well understood and unacceptable.	Risk acceptance, constraints and top down evaluation using multiple evaluation methods. Individual replacements are known and prioritised before the start of the regulatory period.

1.5 Alignment with maintenance

Ausgrid's maintenance strategies incorporate inspections, testing and condition monitoring of assets to assess their condition and determine potential asset defects which may require rectification. This Condition Based Maintenance (CBM) approach is used to inform corrective maintenance (repairs) or capital replacement requirements. The decision to replace assets requires deliberate consideration of associated risk levels, costs and therefore the benefits provided to customers.

Figure 4 outlines the maintenance process through to assessment and corrective action (treatment). Asset condition monitoring and testing is performed to understand the current condition of assets and the risk they pose. Corrective action is required where risks are not acceptable, otherwise the asset is returned to service. Corrective action may be in the form of repair, replacement or life extension.

Figure 4. Condition based program approach



In determining the cost effectiveness and timing for planned maintenance, Ausgrid undertakes a Reliability Centred Maintenance (RCM) approach which is considered industry best practice. RCM compares the risk benefits against the cost of performing the maintenance. This comparison utilises cost benefit analysis principles to evaluate whether the maintenance is cost effective to undertake and also determines the optimal timing for this maintenance.

Figure 5 illustrates the linkage between the process for undertaking CBM, treatment options and the stages of the asset lifecycle in which these are applied.

Figure 5. Lifecycle for Condition Based Maintenance

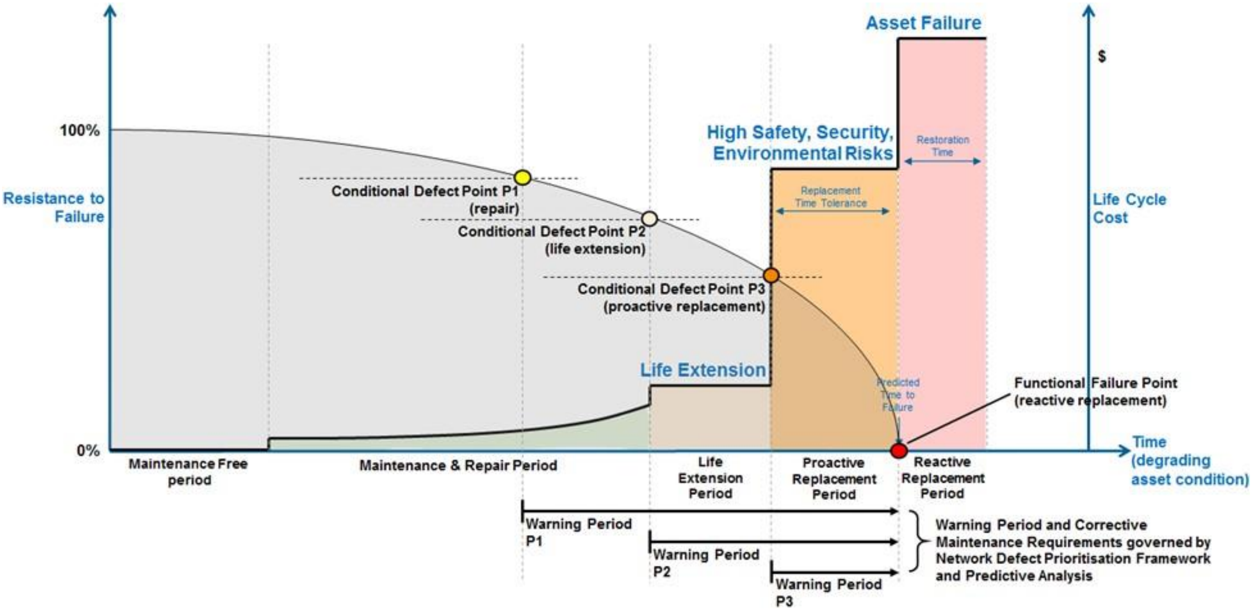


Figure 4 shows that asset performance is assessed against performance criteria. The performance criteria defines the conditional defect points shown in Figure 5. For example, Ausgrid defines the conditional defect point for pole replacement as one to two times the original design strength of the pole. When poles are tested they are evaluated against this strength criteria to inform the need for replacement.

Ausgrid applies a network defect prioritisation framework (NDPF) to determine the appropriate timing of corrective actions based on the likelihood of asset failure from the time of defect identification. This process also provides the timing (and inherently volumes) of asset replacement for condition based and failure related capital programs as shown by the warning periods in Figure 5.

1.6 Top down analysis

Ausgrid has also applied a number of top down approaches in evaluating its portfolio of replacement investment. These include:

- Asset class age analysis
- Asset class replacement volume analysis
- Repex analysis

Attachment 5.01 includes further top down analysis on steady replacement capex by assessing the total replacement value of the asset base assuming asset lives between 55 and 60 years.

For the purposes of this analysis, all replacement (i.e. both programs and major projects) have been included to enable a better alignment to Regulatory Information Notice (RIN) reporting. Ausgrid's analysis has shown prioritised investment in high risk assets over replacement volumes to achieve the appropriate balance of risk and cost that delivers the best overall value to customers. It is therefore expected that those asset classes with a historical step up in their age profile, e.g. poles, will require an investment step change in future years as they age. However, due to the known risks with some asset classes, a higher forecast replacement rate has been applied for these classes only, e.g. low voltage (LV) overhead conductors.

Due to this approach, and when compared to Ausgrid's bottom up forecast, it can be seen that some top down analysis indicates high levels of replacement in a particular asset class and low in others. Ausgrid's analysis has shown these trade-offs to be appropriate in managing the risks on the network and therefore supports the top down evaluation of the program at a portfolio level where these variations can be linked to known asset and network issues.

1.7 Asset class age analysis

Appendix A shows the Ausgrid "State of the Network" which includes the percentage of assets older than the standard life[2] for each major asset class including those where significant investment is forecast. The percentage of assets older than the standard life provides a more meaningful representation of risk over average age as it is not as biased by the volume of new assets installed through other drivers. However, as Ausgrid manages assets on risk rather than age, this approach only provides an indication of the appropriateness of Ausgrid's forecast.

As shown by the information provided, the percentage of assets that are older than the standard life is generally high in comparison to the size of investment proposed representing an overall low rate of replacement. The only exception is for concentric neutral solid aluminium conductor (CONSAC) cable, where only 2.5% of assets are older than the standard life for LV cables. However, Ausgrid's forecast replacement rate is 2.2% per year of the entire population of CONSAC over the 2019 – 2024 regulatory period. This investment is still considered to be appropriate given that the replacement rate is comparable to those assets that are older than standard life. Furthermore, the evidence of accelerated degradation of CONSAC cables leading to known condition issues and increased failures also substantiates the investment rate.

[2] The standard lives are defined NSW Treasury Guidelines 2002 and inform the expected life of each major asset class.

1.8 Asset class by replacement volume analysis

Appendix B shows the percentage of assets against each asset class forecast to be replaced annually and over the regulatory period. From this Ausgrid is able to determine what the sustainable forecast life from the current level of replacement investment will be. The analysis also includes the annual average expenditure over the last five years (2012/13-2016/17) against the forecast. In determining the forecast replacement lives, this approach assumes the same rate of investment over the long term in each asset class. This, however, is not reflective of current practice as Ausgrid's risk based approach evolves across asset classes as risks arise. This modelling approach provides an indicative view of the relativity of investments at an asset class level to enable an assessment of the appropriateness of variance and to provide an overall guide on the appropriateness of the total portfolio. The analysis shows:

- The volume of **pole** replacement and **pole top structure** replacement is less than 1% of the population, suggesting a forecast replacement life over 100 years. This investment is low relative to the actual replacement life expected for the majority of the assets within these categories, i.e. wooden poles. Ausgrid believes that the condition based approach adopted is appropriate to managing these risks over the regulatory period, despite the relatively small investment in the total population.
- **Staking of wooden poles** is not suitable for this type of analysis as this is a life extension program and does not lead to the installation of a new asset.
- At a replacement rate of 3.6% per year, the forecast replacement life of 28 years for **overhead conductor** is considered to be extremely low. This outcome is dominated by Ausgrid's program to reconfigure the dedicated LV network. Increases of failures and the high penetration of individual photoelectric (PE) controllable streetlights have led to an increase in investment in this area, consistent with some other DNSP's across Australia. Based on current forecast, it is expected that this program will be completed by the end of the FY25-29 regulatory period.
- The forecast replacement rate of 1.6% per year for **underground cables** suggests a forecast replacement life of 64 years. The investment is dominated by 132kV fluid filled, 33kV gas filled and LV CONSAC/high density poly ethylene (HPDE) cables. Due to the sheer population of these assets, these programs are forecast to continue into future regulatory periods. The forecast replacement life of 64 years for this asset class is considered appropriate.
- The annual rate of replacement of **service lines** is 2.7%, suggesting a 37 year replacement life. While bare and poly vinyl chloride (PVC) insulated overhead service lines remain on the network, this is considered an appropriate forecast through targeting high risk locations. Following the complete conversion of service lines to cross-linked polyethylene (XLPE) during the 2020s, it is forecast that the volume of replacement will be reduced further, increasing the replacement life.
- Ausgrid is forecasting to replace 0.5% of its **transformers** population per year under the transformer replacement programs, implying a replacement life of 196 years. Similar to poles, Ausgrid assesses the condition of transformers through condition based maintenance. Lower investment in this asset category over the coming regulatory period has been found to be appropriate based on the transformer condition information and our approach to utilising spare capacity where available to avoid 'like for like' replacement. Lower investment in this asset class allows investment to be diverted to mitigating high risks in other asset classes such as service lines and overhead conductors.
- **Switchgear** has an annual replacement rate of 1.3% and a forecast replacement life of 77 years. The programs within this category include older technology 11kV switchboards, oil filled equipment and also early life replacement of poor condition drop

out fuses. Despite these key areas of increased expenditure, the forecast replacement life of 77 years is still considered high and is driven by the volume of assets within the switchgear category.

- **SCADA, Control & Protection** and **Other** were excluded from this analysis due to the variety in assets, data availability and the appropriateness for this type of analysis.

Overall, Ausgrid analysis considers that the increased replacement volumes in some asset categories relative to their population and the decreases in others to be appropriate, given the risk being managed and the overall volume of investment.

1.9 Repex comparison

In addition to the capital program forecasting process described above, Ausgrid also undertook repex analysis at the ‘Asset Group’ and ‘Asset Category’ level as defined in the AER Reset RIN template ‘2.2 REPEX’. This analysis assists in providing a top down evaluation of the proposed capital replacement. While Ausgrid supports the use of repex in providing a top down evaluation, its application has limitations as:

- Not all replacement needs can be linked to age (or deterioration of asset condition over time)
- The RIN template excludes many asset categories (e.g. non-electrical assets such as fire systems, perimeters and buildings)
- Asset deterioration is rarely linear with age and, while age generally provides a reasonable proxy for condition, in some asset classes (e.g. 11kV fuse switches) inherent design issues, obsolescence and known failure modes result in unacceptable risks which require asset replacement earlier than suggested by age alone.
- The RIN categories used for repex can represent very broad asset groupings with substantial variation in the asset taxonomy such as installation location (overhead or underground) and technology (oil, gas or air insulation).

Based on the items listed above, programs were evaluated to determine which were suitable for repex analysis. Programs were then aligned to the asset groups and asset categories defined in the RIN template to enable consistency and benchmarking.

Replacement programs utilise an average unit cost based on a typical scope for the program. In some cases, a historic trending approach is used to guide the estimate. Ausgrid has included a 10% labour productivity improvement into the forecast unit rates to be achieved by 2024.

The expenditure utilises Ausgrid modelled benchmarked unit rates which are calculated using the RIN categories. These are representative of very broad asset grouping and within these groupings there is a wide spread of unit costs for assets requiring replacement. Using the RIN category data Ausgrid has analysed comparable DNSPs expenditure to benchmark the repex unit rates. Ausgrids forecast unit rate is, in the majority of cases, better than the benchmarked unit rate when compared using the RIN asset categories.

The differences by RIN category from the benchmark and Ausgrid’s expenditure forecast are shown in the figure below:

Figure 6. Difference from the repex benchmark

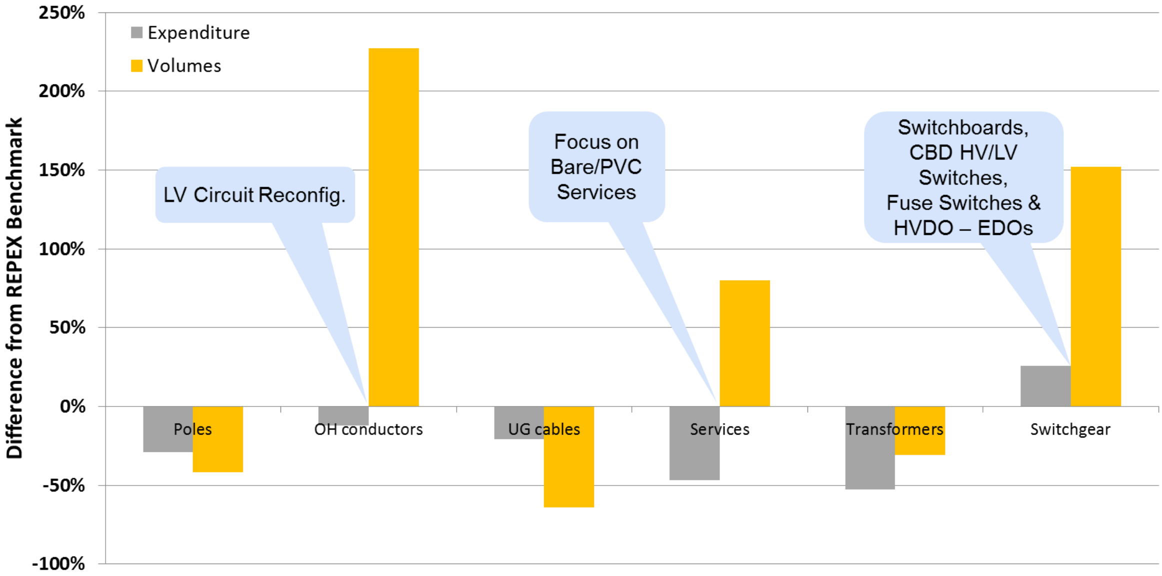


Figure 6 highlights significant differences in volumes in some asset classes relative to the repex benchmark.

- The high replacement volume in **Overhead (OH) conductors** reflects Ausgrid's approach to dedicated LV mains. The low expenditure relative to this high volume is an outcome of the low unit rate in undertaking this work due to the efficiencies that Ausgrid are looking to achieve by undertaking this work in conjunction with alternative control service streetlight upgrade works.
- The low cost and high volume of **OH service lines** is reflective of Ausgrid's efficient unit rate relative to other DNSPs and Ausgrid's focus on replacing all bare and PVC service lines with new XLPE technology. Bare OH services have a higher risk of contact from the public as they are generally attached or in close proximity to residential properties. Due to their smaller cross-sectional area, they also have a higher risk of failure, increasing the risk of contact and bushfires.
- As described in the previous section, Ausgrid has a number of investments driving the volume increase in **switchgear**. These generally relate to lower cost items such as HV air break switches. Due to their poor condition, Ausgrid's central business district (CBD) distribution switchgear is approaching end of life and requires significant replacement volumes. EDO HV drop out fuses have experienced early life failures and require replacement. The high population of these assets is driving the significant volume of replacement.

Ausgrid is managing the expenditure increases in **Poles**, **Underground (UG) cables** and **Transformers** through an off-set with lower volumes and expenditure. Given the known risks in areas of higher investment, the repex approach supports Ausgrid's proposal.

1.10 Structure of the attachments

To enable effective evaluation of the programs, the document has been broken up by the asset groups defined in the AER Reset RIN template '2.2 REPEX'. The asset groups defined in this template are:

- Poles
- Pole top structures

- Overhead conductors
- Underground cables
- Service lines
- Transformers
- Switchgear
- SCADA, network control and protection systems.

Ausgrid has also created an additional three categories for assets that could not be split across the standard RIN categories:

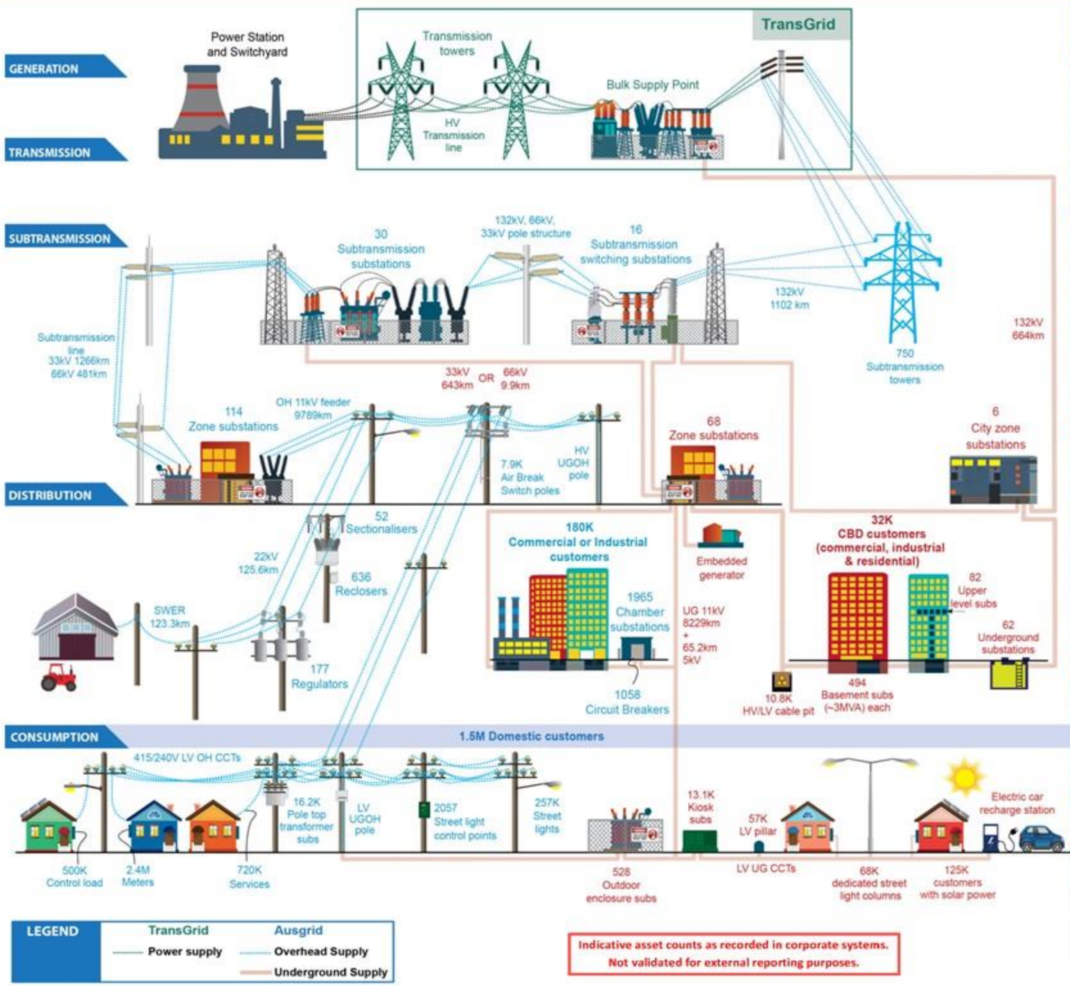
- Substations
- Reactive
- Other.

For the purposes of completing the RIN template, Ausgrid apportions Substation and Reactive asset category counts and associated costs across the standard RIN asset categories. The RIN template ‘Other’ asset category captures all programs where it is not appropriate to apply repex modelling as the drivers are not linked to condition based asset degradation or no RIN category exists. Further detail on our allocation and approach is provided within Schedule 1.

Appendix A – State of The Network

State of the Network

February 2018



Asset Category	Average Age	Std Life	% over Std Life	Qty	Units of M	Bushfire %
Overhead						
132 kV OH ccts	↑ 37.1	45	46.8%	1,102	km	66%
33 & 66 kV OH ccts	↑ 34.4	45	43.7%	1,716	km	56%
11/22 kV OH ccts	↑ 35.1	45	39.8%	10,038	km	61%
- Steel/ACSR/Quince	↓ 41.0	45	47.1%	2,211	km	73%
LV OH ccts	↑ 43.4	45	59.0%	13,074	km	21%
LV OH dedicated ccts - lighting	↑ 51.9	45	79.7%	6,081	km	11%
Poles	↑ 36.2	45	42.3%	446,505	No	27%
Services Overhead	↓ 28.4	35	40.2%	720,016	No	17%
Underground						
132 kV UG ccts - oil	↔ 43.7	45	36.4%	359	km	5%
132 kV UG ccts - other	↓ 7.7	45	3.7%	305	km	4%
66 kV UG ccts	↓ 4.0	45	1.1%	10	km	57%
33 kV UG ccts - gas	↑ 51.0	45	81.9%	108	km	1%
33 kV UG ccts - other	↓ 40.9	45	53.1%	535	km	9%
5/11 kV UG ccts	↑ 32.3	60	9.7%	8,294	km	14%
LV UG ccts	↑ 27.6	60	4.6%	6,163	km	22%
- CONSAC	↓ 43.6	60	2.5%	712	km	10%
- HDPE	↓ 53.3	60	18.6%	139	km	4%
LV UG dedicated ccts - lighting	↑ 47.5	60	57.9%	1,270	km	13%
LV pillars	↑ 23.4	60	0.0%	57,383	No	34%
Services Underground	↓ 29.2	60	5.7%	232,057	No	32%
Substations - ZN & TS						
Sub-transmission Substation	↑ 42.7	60	15.2%	46	No	33%
Zone(ZN) Substation	↑ 38.1	60	14.3%	182	No	30%
City ZN Substation	↑ 28.9	60	0.0%	6	No	0%
132 kV CBs ZN & TS	↑ 8.6	45	1.2%	603	No	19%
66 kV CBs ZN & TS	↑ 7.7	45	0.0%	139	No	32%
33 kV CBs ZN & TS	↓ 23.9	45	30.6%	924	No	24%
5/11 kV CBs ZN	↓ 15.5	45	11.1%	4,003	No	17%
5/11 kV Switchboards ZN	↓ 30.7	45	34.8%	5,425	No	17%
Sub-transmission Transformers	↓ 29.3	50	6.7%	85	No	21%
132/11 kV ZN Transformers	↓ 16.5	50	8.5%	180	No	17%
66/11 kV ZN Transformers	↑ 25.8	50	10.0%	44	No	32%
33/11 kV ZN Transformers	↑ 32.1	50	27.1%	260	No	26%
Other (incl. Asset Intangibles)	- 0.0	-		-	-	0%
Distribution Centres - DC						
- Pole Substation	↑ 31.0	40	32.1%	16,222	No	56%
- Kiosk Substation	↑ 22.5	40	18.5%	13,128	No	15%
- Outdoor Enclosure Substations	↑ 40.9	40	54.1%	528	No	6%
- Chamber Substations	↓ 34.8	40	39.1%	2,603	No	3%
5/11 kV CBs DC	↓ 29.9	45	26.3%	2,460	No	3%
5/11 kV Switchboards DC	↑ 55.0	45	65.5%	847	No	0%
Distribution Centre Transformers	↑ 25.2	45	14.4%	34,110	No	32%
Meters						
Three Phase Meters (Types 5 & 6)	↑ 11.0	25	-	210,178	No	-
Single Phase Meters (Types 5 & 6)	↑ 26.5	25	-	2.123M	No	-
Streetlights						
Lights & Brackets (Incl. Connections)	↑ 35.9	20	16.2%	257,678	No	16%
Light Poles & Columns	↑ 28.7	45	29.7%	65,225	No	22%

Notes

1. Average Age from Asset Investment Outcomes (AIO) Dashboard and GIS extracts as at early February 2018.
2. Standard Life from NSW Treasury Guidelines 2002.
3. Distribution Substation numbers include control points.
4. Zone Substation supply is nominated as overhead if one or more supply feeders is overhead.
5. STS and ZN Transformers extract from AIO Dashboard as at early February 2018.

Appendix B – Asset class program replacements by volume

Asset Category	% of Asset Category Volume	% of Asset Category Expenditure	FY13-FY17 Annual Volumes	FY20-24 Annual Volumes	Total Population	FY20-24 (% per year)	FY20-24 (% over period)	Forecast Replacement Lives
Poles	8%	9%	3,105	4,091	447,280	0.9%	4.6%	109
Staking Wooden Poles	2%	0.4%	1,758	1,107	406,240	0.3%	1.4%	n/a
Pole Top Structures	5%	2%	274	2,247	447,280	0.5%	2.5%	199
OH Conductor	2%	7%	302	937	25,927*	3.6%	18.1%	28
UG Cables	1%	28%	314	247	15,794	1.6%	7.8%	64
Service Lines	56%	3%	18,838	25,599	952,073	2.7%	13.4%	37
Transformers	0%	7%	178	184	36,018	0.5%	2.5%	196
Switchgear	4%	13%	1,343	1,867	143,545	1.3%	6.5%	77
SCADA, Control & Protection	5%	11%						
OTHER	16%	19%						

* The total population for overhead conductors excludes dedicated low voltage mains. As the retirement of these assets is included in the forecast volumes, the misalignment is not reflective of the true investment for the asset class. When dedicated low voltage mains are included in the total population (an additional 6,081km) the annual replacement percentage for FY20-24 reduces to 2.9%.