Repex modelling 2026-31

Final report for Jemena Electricity Networks

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Report author

Mathew Ditchburn

Brendan Quach

Contact Us

Sydney
Level 40
161 Castlereagh Street
Sydney NSW 2000

Phone: +61 2 8880 4800

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1. Introduction

We have been engaged by Jemena Electricity Networks (JEN) to assess its forecast of replacement capital expenditure (repex) using the Australian Energy Regulator's (AER's) repex model, to support its regulatory proposal to the AER covering the five-year regulatory control period from 1 July 2026 to 30 June 2031.

We have undertaken the assessment consistent with the AER's replacement capital expenditure model outline for electricity distribution determinations.

To support our assessment, we draw upon:

- data reported in sheets 2.2 and 5.2 of JEN's Category Analysis Regulatory Information Notices (RINs) over the current regulatory control period, being from 1 July 2021 to 30 June 2024;
    - we sought additional inputs from JEN to address missing data for staking of wooden poles in its Category Analysis RINs;
- the Consumer Price Index (CPI) as published by the Australian Bureau of Statistics (ABS); and
- benchmark information on median asset lives and unit costs across all Distribution Network Service Providers (DNSPs) in the National Electricity Market (NEM), provided by the AER.

We have calculated the repex model threshold to be $301.9 million ($real 2024). JEN has provided us with its proposed modelled repex for the 2026-31 regulatory control period, which is $237.8 million or 21.2 per cent less than the repex model threshold.

We structure the remainder of this report as follows:

- in section 2, we set out the background behind the AER's repex model, and our assessment approach for applying the repex model; and
- in section 3, we assess JEN's modelled repex, including drivers of differences between the repex model threshold and JEN's proposed modelled repex, and additional sensitivity analysis.

2. Background

In this section, we set out the background behind the AER's repex model, and the methodology we have adopted to populate JEN's 2026-31 repex model.

2.1 Repex model background

The AER's repex model is the default assessment tool used to evaluate a DNSP's repex forecast and reflects a predictive modelling approach to repex. The repex model uses six discrete asset categories to group assets that are relatively homogenous, ie, poles, overhead conductors, underground cables, service lines, transformers and switchgear.[1] Other, less homogenous, asset categories are assessed outside the AER's repex modelling framework.

The repex model forecasts the volume of assets in each category that a DNSP will replace over the upcoming 20-year evaluation period, drawing from DNSPs' RINs as well as benchmarking across other DNSPs in the NEM.[2]

After calibration,[3] the repex model forecasts a DNSP's 20-year repex over four scenarios,[4] ie:

- historical scenario – historical unit costs and historical asset lives;
- costs scenario – NEM benchmark unit costs and historical asset lives;
- lives scenario – historical unit costs and NEM benchmark asset lives; and
- combined scenario – NEM benchmark unit costs and NEM benchmark asset lives.

NEM benchmark unit costs and asset lives feed into more aggressive (ie, lower) repex forecasts, as scenarios using these assume JEN can transition to the NEM median from:

- any unit costs that are greater than the NEM median; and/or
- any average age at replacements that are less than the NEM median.

The repex threshold amount is calculated as the greater of the costs and lives scenarios. This approach considers the inherent interrelationship between the unit cost and expected replacement lives of assets, ie, a DNSP may have greater unit costs than other DNSPs, but correspondingly longer lived assets.[5] The AER's approach assumes the DNSP can transition towards a more efficient repex outcome as compared to the modelled outputs from the historical scenario, but takes the less aggressive scenario outcome out of the costs and lives scenarios.

Since the repex model is predictive and expenditure in electricity distribution infrastructure is often lumpy, the repex model threshold represents JEN's aggregate repex over the five-year regulatory control period. As such, JEN's repex forecast for some asset categories may be above the repex model threshold for those categories, provided this is offset by JEN's repex forecast for other asset categories.

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[1] AER, *AER repex model outline for electricity distribution determinations*, February 2020, p 4.

[2] AER, *AER repex model outline for electricity distribution determinations*, February 2020, pp 4-5.

[3] We discuss the AER's approach to calibration in section 2.2.2.

[4] AER, *AER repex model outline for electricity distribution determinations,* February 2020, p 6.

[5] AER, *AER repex model outline for electricity distribution determinations*, February 2020, pp 6-7.

The AER uses the repex model to determine whether or not a more detailed bottom-up review is required. Further, if a review is undertaken, the AER uses the repex model to focus detailed bottom-up review, and to guide the development of a substitute repex forecast if necessary.[6]

2.2 Our assessment methodology

We discuss below the methodology we use to apply the AER's repex model.

2.2.1 Data

In order to forecast JEN's repex over the 20-year evaluation period, the repex model uses:[7]

- an age profile of current network assets by category;
- an expenditure and replacement volume profile; and
- a probability distribution of asset lives.

We draw information from JEN's RINs to inform these, published for the three financial years 2021-22 to 2023-24. Specifically, we draw JEN's age profile of assets from sheet 5.2 of the category analysis RIN and calculate JEN's unit costs using expenditure and asset replacement volumes from sheet 2.2 of the category analysis RIN. We also sought additional inputs from JEN to address missing data for staking of wooden poles in its 2022-23 and 2023-24 Category Analysis RINs.

JEN typically reports a larger number of assets moving out of its network, assessed by comparing sheet 5.2 of its category analysis RINs over two adjacent years, than replacement volumes in sheet 2.2 of its category analysis RIN. This is consistent with some assets moving out of its network for reasons other than replacement, such as assets that are not replaced at end of life (which will not have a corresponding replacement item) or asset upgrades.

In addition, JEN's SAP system does not provide sufficient information to ascertain the reason for replacement. As such, it is not possible to determine which assets are replaced due to age or failure, as distinct from customer requested replacements or upgrades, which should not be captured in the average age at replacement calculation.

We conservatively calculate the average age at replacement for each asset category by:

- taking the number of replacements in a given year from sheet 2.2 of the category analysis RIN; and
- assuming that these replacements represent the oldest assets moving out of JEN's network.

By way of example, if JEN reported 20 '<= 1kV wood pole' replacements in sheet 2.2 of the category analysis RIN for 2023-24, but 30 '<= 1kV wood poles' moved out of its network in comparing sheet 5.2 of the category analysis RIN between 2022-23 and 2023-24, we would calculate the average age at replacement as the average age of the 20 oldest wood poles moving out of JEN's network. This is conservative as it will result in a greater average age at replacement relative to a simple average of all assets (or alternative methodology), which will decrease the number of predicted replacements in the repex model.

We adopt NEM median unit costs and asset lives provided by the AER to JEN for DNSPs. Where these data do not have a line item, we substitute the unit cost and asset life from a similar asset category, which we have informed through discussions with JEN.

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[6] AER, *AER repex model outline for electricity distribution determinations*, February 2020, p 4.

[7] AER, *AER repex model outline for electricity distribution determinations*, February 2020, p 5.

As of 1 July 2021, JEN and other Victorian DNSPs moved from reporting on a calendar year basis to a financial year basis. Consequently, we have transformed JEN's historical volumes to a financial year basis by combining half the volumes from the two adjacent calendar years to arrive at a financial year volume.[8]

2.2.2 Calibration

The AER uses a calibration process to estimate the average age at replacement for each asset category using the DNSP's observed historical replacement practices.[9] That is, the AER uses the DNSP's replacement volumes reported in its RINs during the current regulatory control period to derive the average age of assets at replacement.[10]

Consistent with the AER's methodology, we:

- draw information on the average age of assets at replacement from JEN's RINs during the current regulatory control period, where data is available; and
- substitute the average age of assets at replacement from similar asset categories, where data is not available.

We have determined which similar asset categories best represent categories with zero volumes to perform this calibration from discussions with JEN.

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[8] By way of example, we derive financial year 2020 volumes by combining the second half of calendar year 2019 volumes and the first half of calendar year 2020 volumes.

[9] AER, *AER repex model outline for electricity distribution determinations*, February 2020, p 5.

[10] AER, *AER review of repex modelling assumptions*, Explanatory note, December 2019, pp 7-8.

3. Outputs of repex model

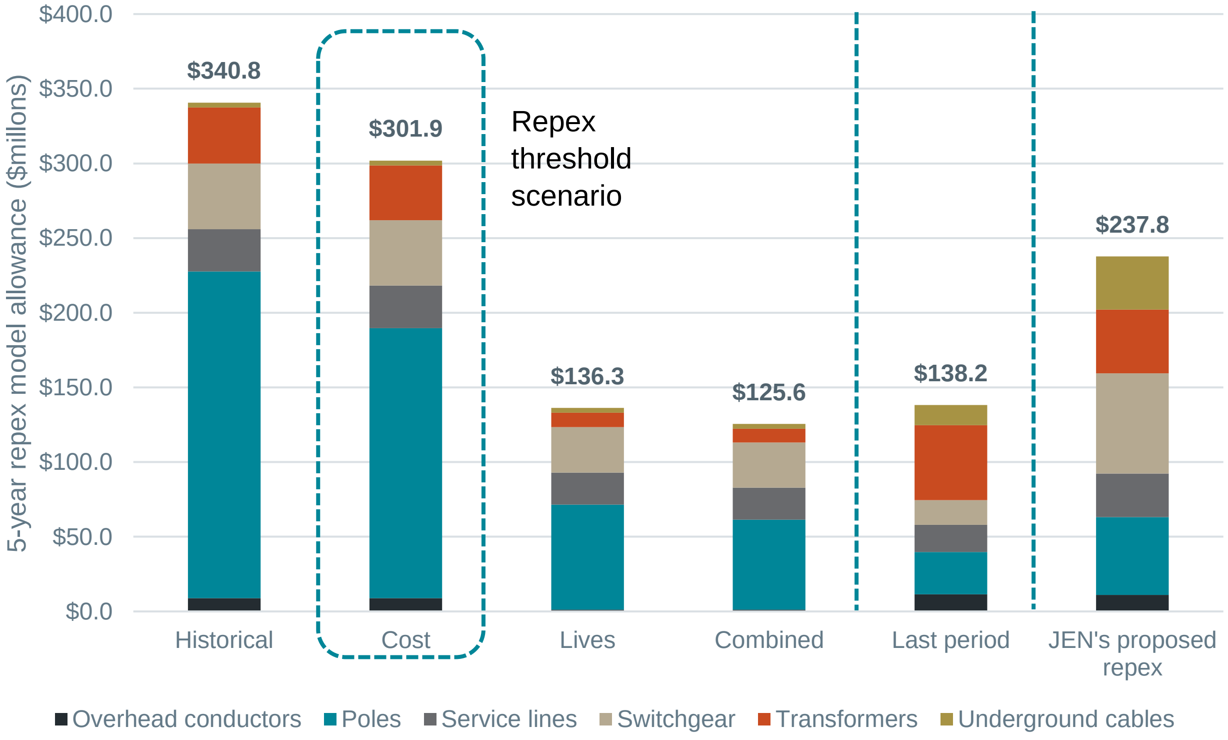
In this section, we set out the outputs of the repex model, including the drivers behind changes in repex forecasts and sensitivity tests of the results. All results are presented in real 2024 dollars unless otherwise stated.

3.1 Repex model outputs

Consistent with the AER's requirements, the predictive repex model sets the costs scenario as the threshold repex forecast, as it is the greater of the costs and lives scenarios. The costs scenario uses NEM benchmark unit costs with JEN's observed average ages at replacement.

The threshold repex forecast is $301.9 million (real $2024), which represents an 118 per cent increase in real terms as compared to the AER's threshold repex forecast for the 2021-26 regulatory control period.[11] We set out the full results of the repex model in figure 3.1 below.

Figure 3.1: Repex model results ($million, real $2024)



Source: HoustonKemp analysis using AER repex model.

We illustrate in figure 3.2 that the main drivers of the increase in predicted repex are:

- a material increase in predicted poles repex, which has increased by $152.4 million or 539 per cent; and
- significant increases in:
  - switchgear which has increased by $27.2 million or 164 per cent; and

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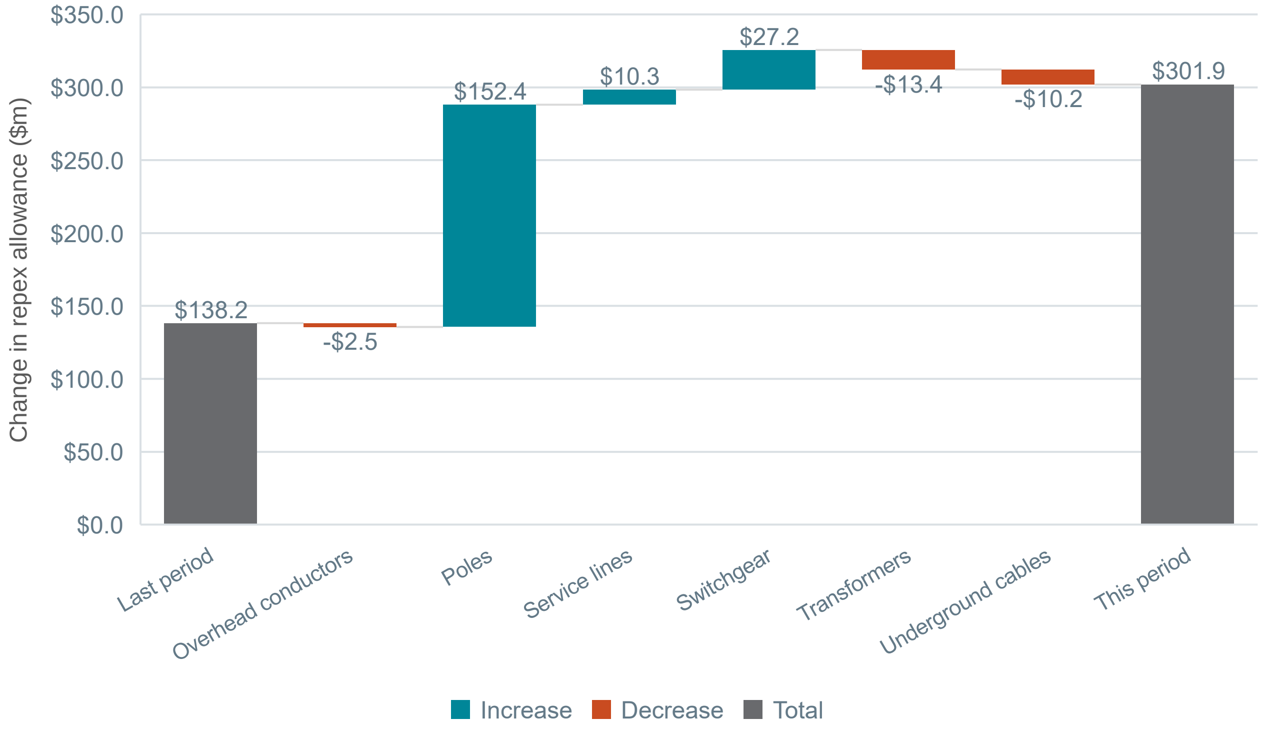
[11] AER, *JEN distribution determination – 2021-26 repex model*, Draft decision, September 2020, sheet "Lives scenario – output".

- service lines which have increased by $10.3 million or 57 per cent.

However, these increases are offset by modest decreases in modelled repex for:

- transformers which have decreased by $13.4 million or 27 per cent;
- underground cables which have decreased by $10.2 million or 76 per cent; and
- overhead conductors which have decreased by $2.5 million or 22 per cent.

Figure 3.2: Drivers of repex model change ($million, real $2024)



Source: HoustonKemp analysis using AER repex model.

For the 2021-26 regulatory control period, the threshold repex forecast was set by the lives scenario. Under the lives scenario, the repex model adopts JEN's observed historical costs, and the greater of JEN's and NEM median replacement lives.

For the 2026-31 regulatory control period, the threshold repex forecast is now being set by the costs scenario. Under the costs scenario, the repex model adopts JEN's observed historical replacement lives, and the lower of JEN's observed historical costs and NEM median unit costs.

The significant increase in JEN's repex model outcome is principally driven by increased predicted repex for three pole categories – see table 3.1. Increases in modelled repex for these three pole categories drives $127.0 million (83 per cent) of the $152.4 million increase in modelled poles repex, and 78 per cent of the total increase in modelled repex. For these three pole categories:

- the average age at replacement has decreased by between nine and 12 years, due to the change from adopting NEM median asset lives to JEN's asset lives under the cost scenario; and
- the lower of JEN's actual and NEM median unit costs has increased by between 121 per cent and 290 per cent in real terms, relative to JEN's actual unit costs in 2021-26.

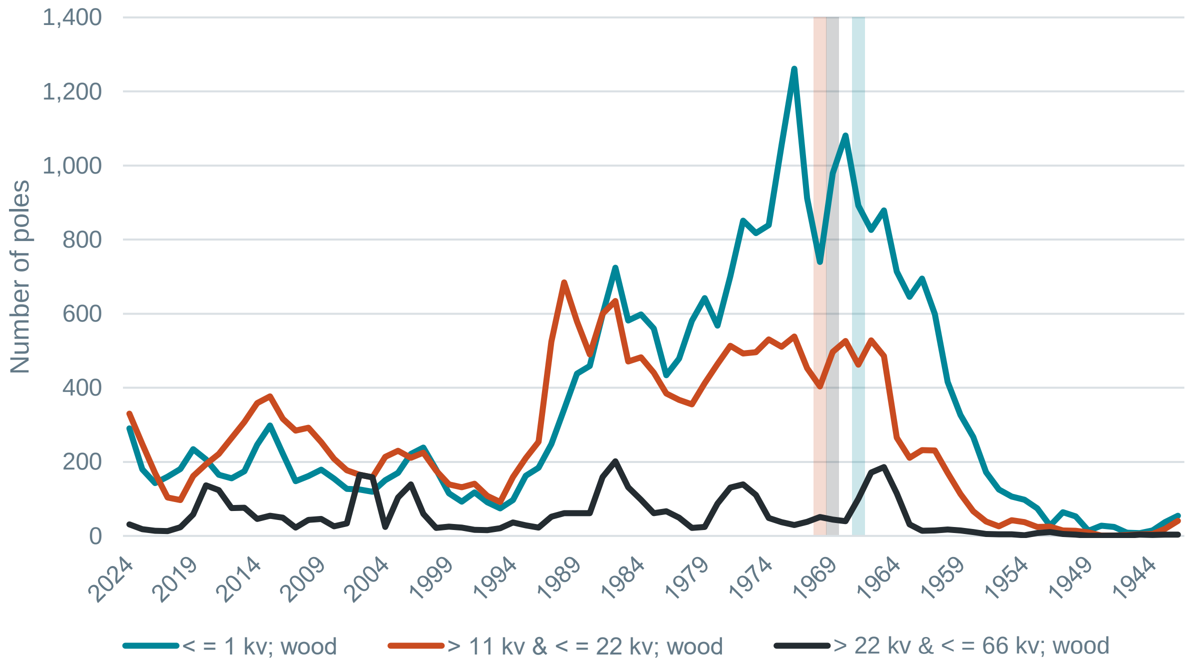
Table 3.1: Main drivers of increase in poles expenditure ($000s, $real 2024)

Pole type	Last period unit cost	NEM median unit cost	Last period average age at replacement	3-year RIN average age at replacement	Last period units replaced	This period units replaced	Last period expenditure	This period expenditure
<=1kV wood	$4.29/unit	**$9.48/unit**	70.81 years	**58.17 years**	1,590	**6,907**	$6,814	**$65,451**
>11kV, <=22kV wood	$5.39/unit	**$15.07/unit**	66.06 years	**55.25 years**	1,136	**4,081**	$6,124	**$61,511**
>22kV, <=66kV wood	$5.36/unit	**$20.89/unit**	64.59 years	**55.73 years**	245	**684**	$1,312	**$14,279**

Source: HoustonKemp analysis using AER repex model.

The large increase in predicted repex for replacing these three categories of poles is consistent with the fact that JEN's poles are increasingly ageing beyond their average age at replacement – see figure 3.3. As such, the repex model will increase the predicted replacement quantity of these assets.

Figure 3.3: Age of poles in commission



Source: HoustonKemp analysis using RIN data and AER repex model.
Note: Vertical bars represent the average age at replacement of the corresponding pole type.

JEN has provided us with its proposed pole replacement program for the 2026-31 regulatory control period, which is $52.1 million or 71 per cent lower than the repex model threshold. JEN's proposed pole replacement expenditure has increased from $28.3 million in 2021-26 to $52.1 million in 2026-31 ($real 2024). We discuss this increase in further detail in section 3.3.

There has also been a large increase in predicted switchgear expenditure, which is driven by decreases in average age at replacement and increases in unit cost for three categories of switchgear – see table 3.2.

Table 3.2: Main drivers of increase in switchgear expenditure ($000s, $real 2024)

Switchgear type	Last period unit cost	NEM median unit cost	Last period average age at replacement	3-year RIN average age at replacement	Last period units replaced	This period units replaced	Last period expenditure	This period expenditure
<=11kV switch	$4.27/unit	$4.29/unit	63.65 years	43.00 years	258	2,605	$1,100	$11,164
>11kV, <=22kV circuit breaker	$95.88/unit	$238.19/unit	53.78 years	56.00 years	52	60	$4,981	$14,187
>11kV, <=22kV switch	$16.21/unit	$14.92/unit	57.09 years	49.53 years	409	1,073	$6,623	$16,015

Source: HoustonKemp analysis using AER repex model.

The repex model has observed very few replacements in the last two years for many transformers, underground cables and overhead conductors, which have modest decreases in predicted repex. We understand this is because replacements in these categories are lumpy, and JEN has not replaced many of these assets in the past three years. In addition, we understand from discussions with JEN that because some of these assets can take multiple years to build, some of JEN’s recent investments have not been reflected in the RINs as of October 2024.

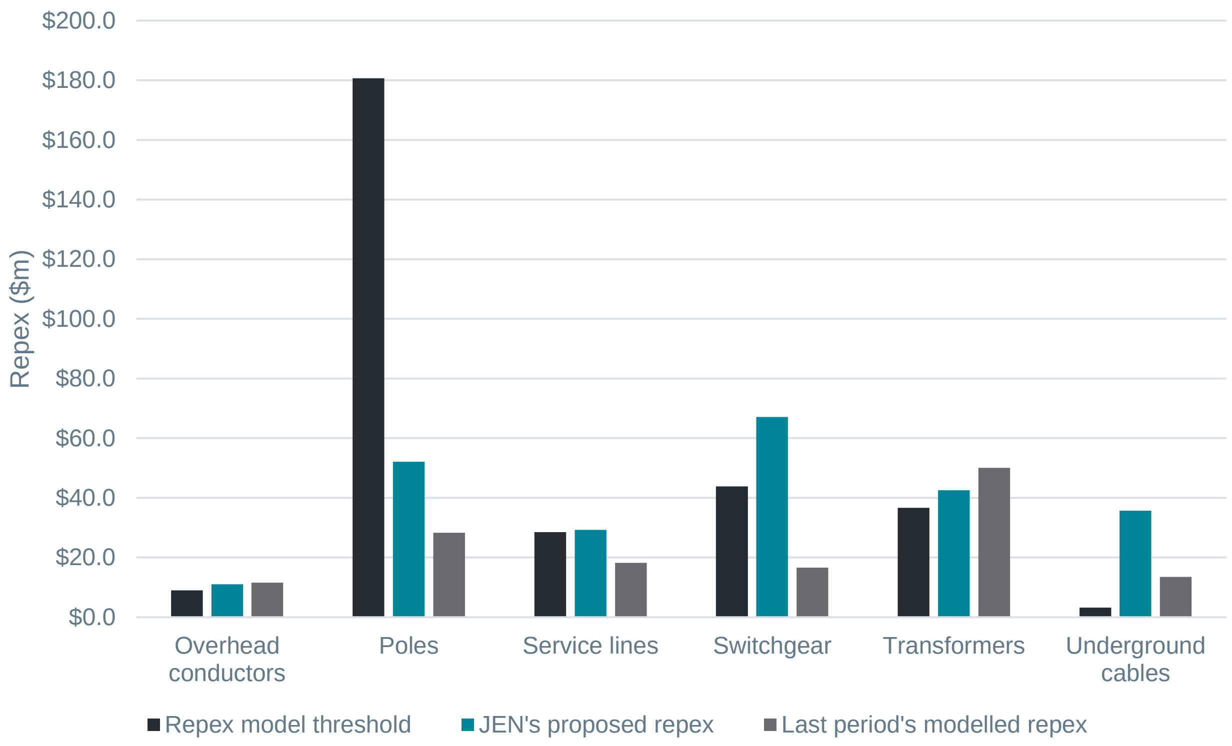
3.2 Drivers of differences between repex threshold and proposed repex

JEN’s proposed repex differs from the repex model threshold for four main categories, ie:

- poles, where JEN’s proposed repex is significantly below the repex model threshold, but above last period’s modelled repex; and
- switchgear, transformers and underground cables, where JEN’s proposed repex exceeds both this period and last period’s repex model threshold.

We discuss each of these categories in the remainder of this section.

Figure 3.4: Difference between repex model threshold and proposed repex ($real 2024)



Source: HoustonKemp analysis using AER repex model.

3.2.1 JEN's pole replacement program

A large number of wooden poles were installed on JEN's network between 1960 and 1975 during a period of rapid network growth.[12] Many of these poles are still in service, and are coming to or exceeding their economic life – see figure 3.3. JEN finds that although overall failures of its wooden poles continue to be very low, pole condemnation rates are trending upward, posing a risk that replacements could increase unexpectedly in the future.[13]

In addition, JEN has previously extended the life of many of their poles using staking. However, we understand from JEN that a large number of staked poles are now crumbling and so also reaching their end of life.

Failures of wooden poles pose a significant bushfire risk for JEN and also result in higher operational costs due to increased frequency of repeat inspections.[14]

As a consequence, JEN has implemented a pole replacement strategy which optimises operational efficiency and safety through its asset management process. JEN states that its pole replacement strategy, where it will undertake proactive replacement of poles with condition issues, will result in increased replacement volumes in the short term, but will bring long term benefits in improved resource allocation.[15] In addition, JEN's pole replacement program with expenditure of $52.1 million is significantly less than the

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[12] JEN, *Pole program strategy paper*, 6 November 2024, p 6.

[13] JEN, *Pole program strategy paper*, 6 November 2024, p 4.

[14] JEN, *Pole program strategy paper*, 6 November 2024, p 5.

[15] JEN, *Pole program strategy paper*, 6 November 2024, p 12.

repex model threshold, being $128.6 million or 71 per cent less than the repex model threshold of $180.7 million.

3.2.2 JEN's switchgear, transformers and underground cables replacement programs

Switchgear, transformers and underground cables replacements represent large, lumpy investments that occur when specific assets reach end of life or face increasing reliability risks. JEN's replacement programs for 2026-31 include several major projects, including works associated with zone substation redevelopments.

We understand that the timing of these replacements is driven by condition assessment outcomes and risk management considerations, rather than following a steady replacement pattern. This leads to periods of increased investment when multiple large assets require replacement within the same regulatory period.

JEN's proposed replacement programs are above their repex model thresholds for these assets, ie:

- switchgear repex of $67.1 million is above the repex model threshold of $43.8 million;
- transformer repex of $42.6 million is above the repex model threshold of $36.7 million; and
- underground cables repex of $35.7 million is above the repex model threshold of $3.3 million.

In addition to routine replacements, JEN's proposed repex is driven by four key factors, ie:

- the requirement to undertake switchgear replacements for compliance with current safety standards at several zone substations;
- the need to replace high-risk transformers approaching end of life at Coburg North zone substation;
- the need to replace legacy oil-filled cables in the sub-transmission network; and
- the imperative to protect assets from increased flood risks.

JEN's switchgear replacement program includes several major zone substation redevelopments, with substantial works planned at Coburg South, North Heidelberg, and Coburg North zone substations. These projects are driven by ageing assets that pose increasing reliability and safety risks. The switchgear at these substations is between 34 and 58 years old, with many assets no longer supported by manufacturers and spare parts becoming unavailable.

At Coburg North zone substation, multiple switchgear assets require replacement due to their age and deteriorating condition. The existing equipment is non-compliant with current standards for electrical arc fault containment, presenting health and safety risks to personnel. Similar issues exist at Coburg South, where the 50-year-old switchgear shows signs of partial discharge and deterioration, indicating risk of failure. North Heidelberg's switchgear also faces comparable age-related degradation affecting reliability, employee safety, and security of supply.

At Coburg North zone substation, both transformers are also approaching end of life at nearly 60 years of service. These assets are showing serious signs of deterioration, with very high moisture and acid levels. One transformer is experiencing significant oil leaks, increasing the risk of catastrophic failure. JEN's condition monitoring shows these transformers have a health index above 7, indicating an elevated probability of failure in the next regulatory period.

The modelled repex component of these three zone substation projects is approximately $70.0 million. We understand that JEN has a business case for each of these zone substation redevelopments. While these investments are substantial, they represent discrete projects that cannot be smoothed across regulatory periods without compromising network reliability and safety outcomes.

JEN's underground cable replacement program includes replacing legacy oil-filled cables in the sub-transmission network. These cables, installed between the mid-1960s and early 1970s, are approaching end of life and present increasing safety, environmental and reliability risks. The existing cables face multiple critical issues, including:

- supply interruptions and single contingency network operations, driven by an increasing trend of failures and defects due to asset age and condition;
- technological obsolescence, with limited manufacturer support and requiring specialised resources and bespoke materials;
- inefficient maintenance and repair times compared to modern alternatives; and
- environmental risks posed by oil leaks from cable failures.

The modelled repex component of this non-routine asset replacement is approximately $22.7 million. We understand that JEN has a business case for this project.

A further driver is the need to relocate transformers and underground cables from areas newly classified as high flood-risk zones. Following the 2022 Maribyrnong river floods, Melbourne Water reclassified many of the communities JEN serves as 'high-flood risk zones'. This has led to a program to relocate critical assets to higher ground outside the flood plain.

The modelled repex component of the proactive relocation is estimated at $16.6 million, and will reduce the risk of flood damage that could cause outages, hinder restoration efforts, and lead to premature asset replacement.

3.3 Sensitivities

Alternative unit costs

We test the repex model outcomes using the costs scenario with unit costs observed from the last three years of RINs against:

- unit costs from the latest year of RIN data only;
- JEN’s actual unit costs; and
- unit costs from the AER’s 2021-26 repex model, escalated by CPI.

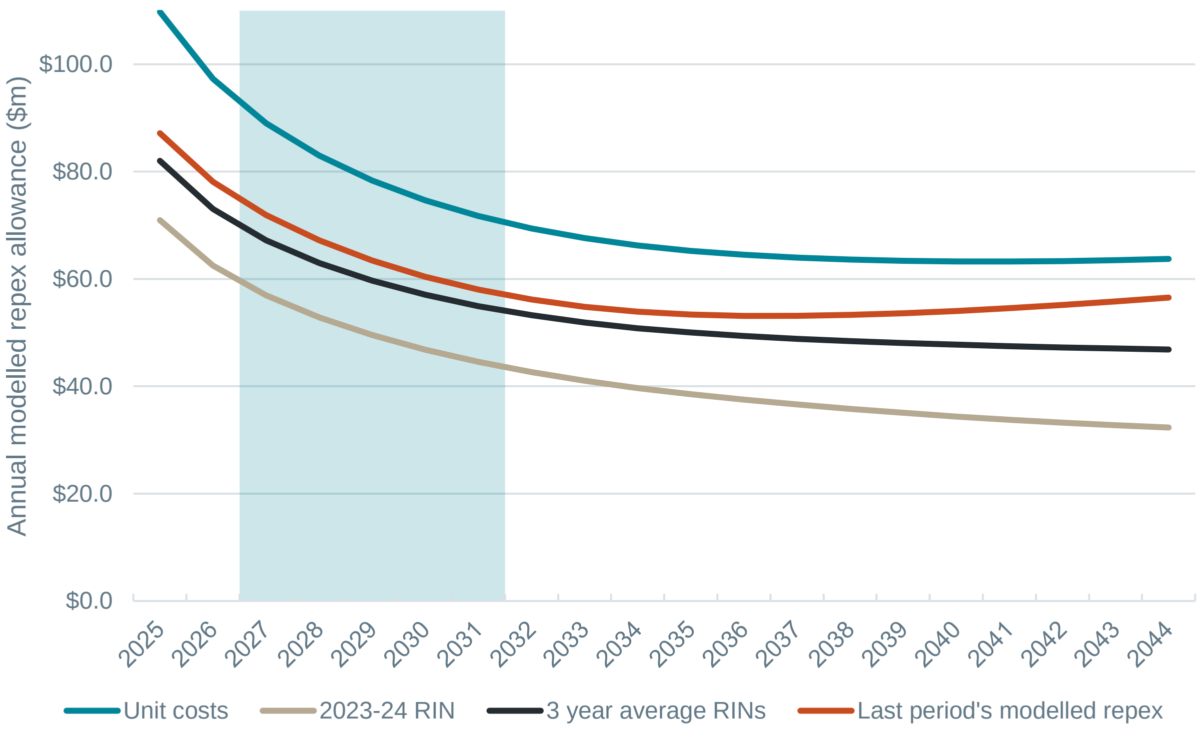
The outputs demonstrate that using the unit costs from the last year of the RIN only results in a lower repex threshold. This is principally because there are less replacements of large, lumpy assets observed in the latest year of RIN data, and so more calibration (ie, substitution with similar (and lower cost) asset categories) is required. This both reduces the repex threshold and makes the repex model less reliable.

The repex model also shows using JEN’s actual unit costs or those unit costs from the AER’s 2021-26 repex model escalated by CPI results in a greater repex threshold – see figure 3.5 below.

The total repex over the period from the repex model under these sensitivities is:

- $301.9 million for the core result;
- $250.7 million using the unit costs from the latest year of RIN only;
- $321.0 million using unit costs from the AER’s 2021-26 repex model, escalated by CPI; and
- $396.7 million adopting JEN’s actual unit costs.

Figure 3.5: Sensitivities – costs scenario ($million, real $2024)

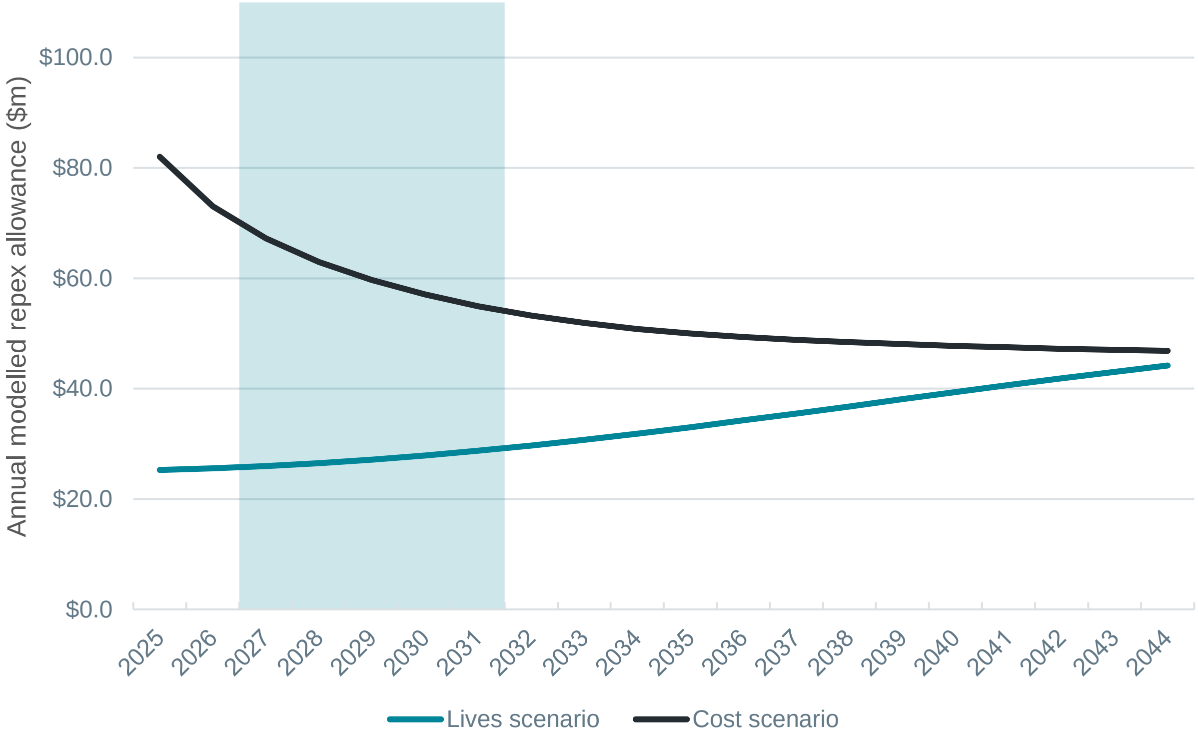


Note: the shaded area represents the 2026-31 regulatory control period.

Lives scenario

We also test the sensitivity of using the lives scenario, which has an upwards profile. The lives scenario gives a significantly lower repex threshold value ($136.3 million over the 2026-31 period), driven by the significantly higher average age at replacement for the three main pole categories (and other categories in the repex model). We explain in section 3.2 that adopting NEM median average ages at replacement for JEN’s poles is not appropriate. The lives scenario gives a lower repex allowance for close years, increasing to a greater repex allowance in future years.

Figure 3.6: Sensitivities – lives scenario ($million, real $2024)



Note: the shaded area represents the 2026-31 regulatory control period.

Sydney
Level 40
161 Castlereagh Street
Sydney NSW 2000

Phone: +61 2 8880 4800