ASSET CLASS OVERVIEW

DISTRIBUTION TRANSFORMERS

PAL BUS 4.06 – PUBLIC

2026—31 REGULATORY PROPOSAL

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1. Overview

Our network comprises over 80,000 distribution transformers, meaning our management of these assets is critical to our ability to maintain network reliability, minimise safety risk as far as practicable and reduce the risk of harm to the environment.

In the current regulatory period, the performance of these assets has varied, but defects and failures are generally increasing. This is particularly the case for oil-leaks, consistent with changes in our obligations under the Victorian Environment Protection Act that introduced a new preventative approach to environmental protection (as opposed to the prior reactive approach of managing impacts post incident).

Our distribution transformer replacement forecasts for the 2026–31 regulatory period are mostly based on forecast annual asset defect rates and forecast asset population, consistent with independent statistical analysis on the best fit of our historical data. These are consistent with those completed in the 2021–26 regulatory period.

Additional risk-based replacements of pole-mounted distribution transformer have also been included to maintain our recently established program to address environmental compliance associated with increasing oil leaks. Our forecast volumes for this program reflect replacements undertaken in FY23, and prudently and efficiently avoid future remediation costs.

Overall, our annual forecast replacement rate equates to around one per cent of our population, which means our distribution transformers on average would need to last 105 years before we replace them. This supports a view that our proposed interventions are likely least-regrets.

A summary of forecast expenditure for this asset category is set out in table 1.

TABLE 1 DISTRIBUTION TRANSFORMER: EXPENDITURE ($M, 2026)

EXPENDITURE	FY27	FY28	FY29	FY30	FY31	TOTAL
Defective kiosk transformers	13.8	13.8	13.8	13.8	13.8	68.9
Defective ground transformers	2.0	2.0	2.0	2.0	2.0	9.9
Defective indoor transformers	0.9	0.9	0.9	0.9	0.9	4.6
Environmental compliance	2.0	2.0	1.8	1.3	0.8	7.8
Other distribution works	1.7	1.8	1.8	1.9	1.9	9.2
Total	**20.4**	**20.5**	**20.3**	**19.8**	**19.4**	**100.4**

Note: Our distribution transformer expenditure forecast included in our reset RIN is lower than shown above due to the allocation of some costs to other RIN categories (e.g. replacement of pole mounted distribution transformers typically result in minor associated overhead conductor works).

2. Background

As electricity is delivered from generators to customers, it undergoes several voltage transformations. Transformers perform these voltage transformations, with distribution transformers performing the final transformation step between the high voltage (HV) network and customers.

This section provides an overview of our distribution transformer asset class, including a high-level summary of our compliance obligations, asset population and age profile.

2.1 Our compliance obligations

We operate under a combination of national and state legislation which establish our obligations and the regulatory framework under which we operate.

The National Electricity Rules sets out reliability and safety obligations and the Electricity Distribution Code of Practice include performance requirements. We must also manage our network assets in accordance with the Electricity Safety Act 1998, the Electricity Safety (Management) Regulations 2019, the Electricity Safety (Bushfire Mitigation) Regulations 2023 and the Victorian Environment Protection Act 2017.

These obligations can be summarised as follows:

- Electricity Safety Act 1998 – requires us to minimise safety risk 'as far as practicable' including bushfire danger
- Electricity Distribution Code of Practice – requires us to manage our assets in accordance with principles of good asset management and to minimise the risks associated with the failure or reduced performance of assets
- National Electricity Rules – requires us to forecast expenditure to maintain the quality, reliability and security of supply of our networks and maintain the safety of the distribution system
- Victorian Environment Protection Act (2017) – requires us to reduce the risk of harm from our activities to human health and the environment and from pollution or waste.

In short, we must maintain reliability, minimise safety risk 'as far as practicable' including bushfire danger arising from our network, and reduce the risk of harm to the environment.

2.2 Asset population

As shown in table 2, our distribution transformer population comprises both pole-mounted and non-pole mounted transformers.

The majority of our pole-mounted population are HV (68 per cent) and single wire earth return (23 per cent) transformers. Our non-pole mounted transformers include indoor installations in buildings or underground, installations in kiosks and outdoor ground mounts.

TABLE 2 DISTRIBUTION TRANSFORMER: POPULATION BY TYPE

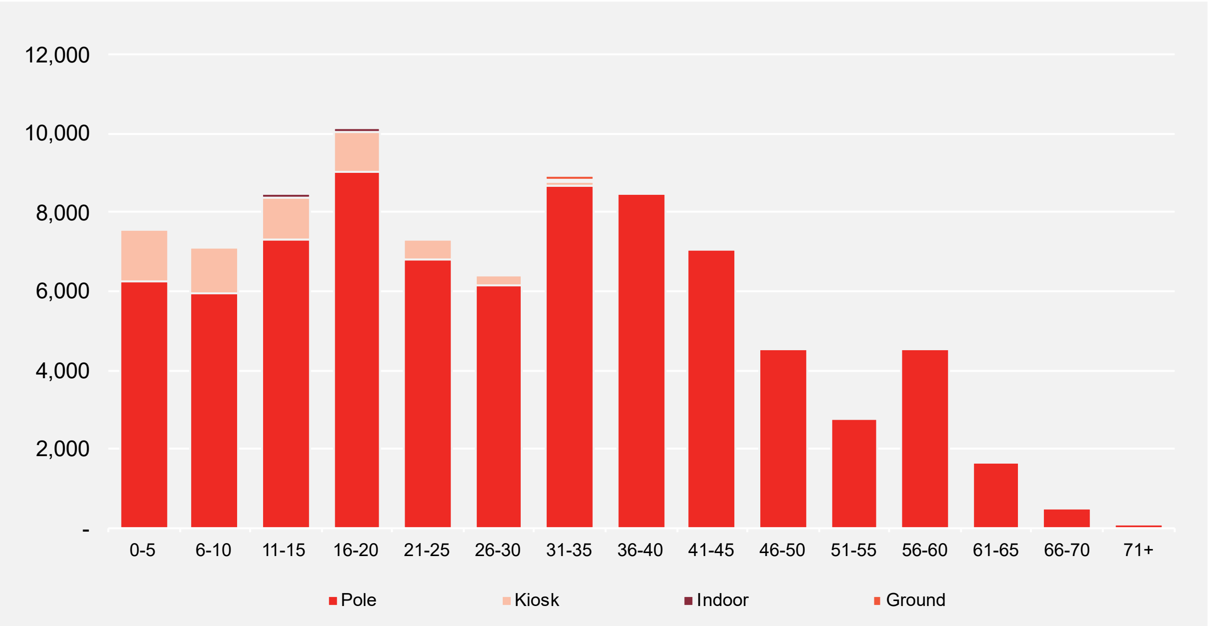
TRANSFORMER TYPE	VOLUME
Pole-mounted	79,643
Kiosk	5,565
Ground	402
Indoor	517
Total	**86,127**

2.3 Asset age profile

The expected service life for our distribution transformers is typically around 55 years. This service life is the expected period of time after which the asset is unlikely to be fit for purpose, typically determined by safety, technology and/or obsolescence.

The age profile of our population is shown in figure 1.

FIGURE 1 DISTRIBUTION TRANSFORMER: AGE PROFILE BY TYPE



3. Identified need

The performance of our distribution transformer asset class may lead to a loss of supply for customers, pose safety risks to our personnel and the public, potential fire starts—including in electric line construction areas (ELCAs) and hazardous bushfire risk areas (HBRA)—and potentially pollute the environment if there is an oil leak.

The identified need, therefore, is to manage our distribution transformer assets to maintain reliability and minimise safety and environmental risks as far as practicable, consistent with our regulatory and legislative obligations.

This section outlines the historical performance of our distribution transformers, which has informed how we assess (and respond, as required to) this identified need.

3.1 Historical asset performance

The historical performance and underlying asset management approach for our distribution transformers differs for pole and non-pole mounted assets. Accordingly, we discuss these separately below.

However, for both types of transformers, in assessing the need to intervene we monitor several performance indicators, including asset failures, high priority defects, and asset condition. These indicators inform our underlying asset management response—for example:

- increasing unassisted asset failures indicates a likely need to act immediately and review asset management practices (noting that robust inspection practices and governance over the application of these methods may drive low failure rates, but if the underlying condition of the relevant asset population is poor and/or deteriorating, high and/or increasing intervention volumes may still be prudent and efficient)
- increasing high-priority defects or deteriorating condition (relative to asset management thresholds) indicates a likely need to act soon to increase interventions over time, and/or undertake risk-based assessments.

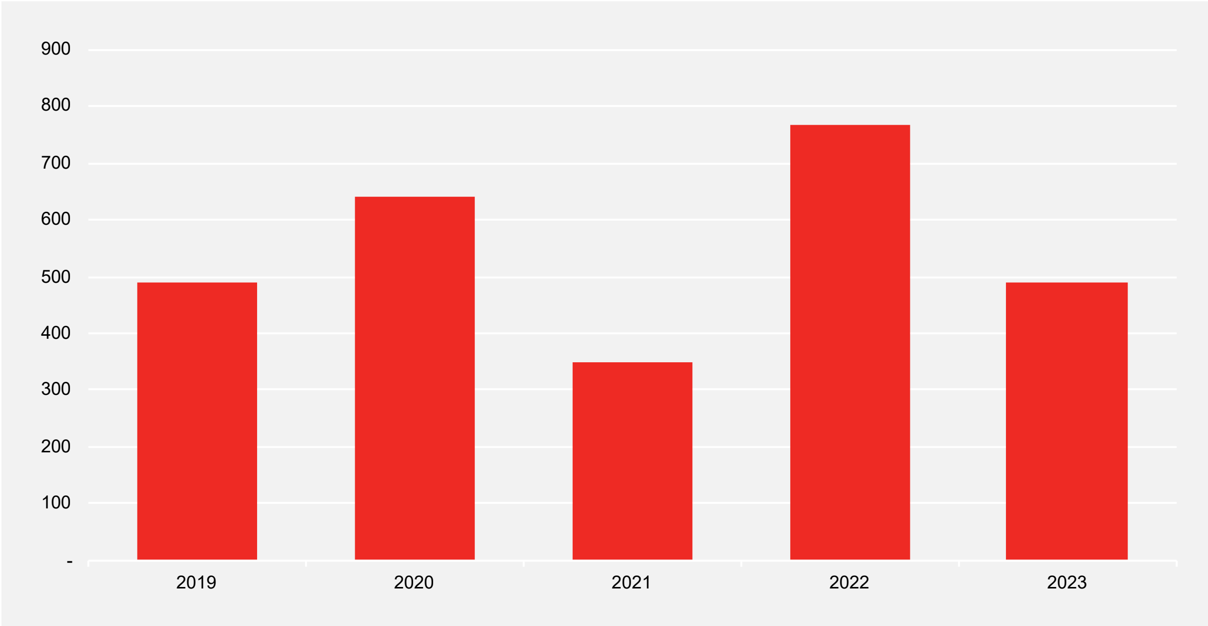
3.1.1 Pole-mounted distribution transformers

Consistent with our regulatory obligations, we inspect our pole-mounted distribution transformers located in HBRA every two to three years and every five years in low bushfire risk area (LBRA). These cyclic inspections provide snapshots in time of the asset condition and identify any defects.

Historical asset failures

As shown in figure 2, pole-mounted distribution transformer failures have fluctuated year-on-year, with a significant spike in 2022.

FIGURE 2 POLE-MOUNTED DISTRIBUTION TRANSFORMERS: FAILURES

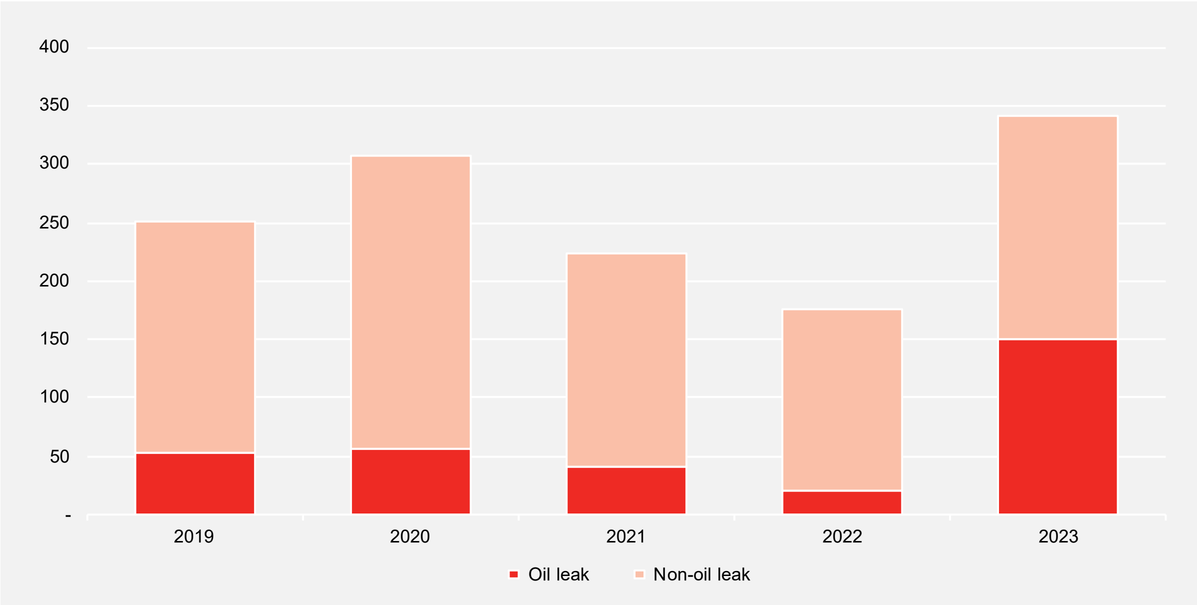


Historical asset defects

Our pole-mounted distribution transformer high-priority defects have also fluctuated year-on-year, but defects as a result of identified oil-leaks have increased in 2023. This reflects amendments to our inspection and maintenance practice to better capture oil leak defects.

Historically, an oil leak from a pole-mounted transformer was recorded as a defect when there was evidence of oil leakage on the ground. However, under revisions to the Victorian Environment Protection Act, any leakage of oil from a transformer is now classed as pollution and hence, classified as a defect. We anticipate this increased level of oil leak defects to continue in the future.

FIGURE 3 POLE-MOUNTED DISTRIBUTION TRANSFORMERS: DEFECTS BY TYPE



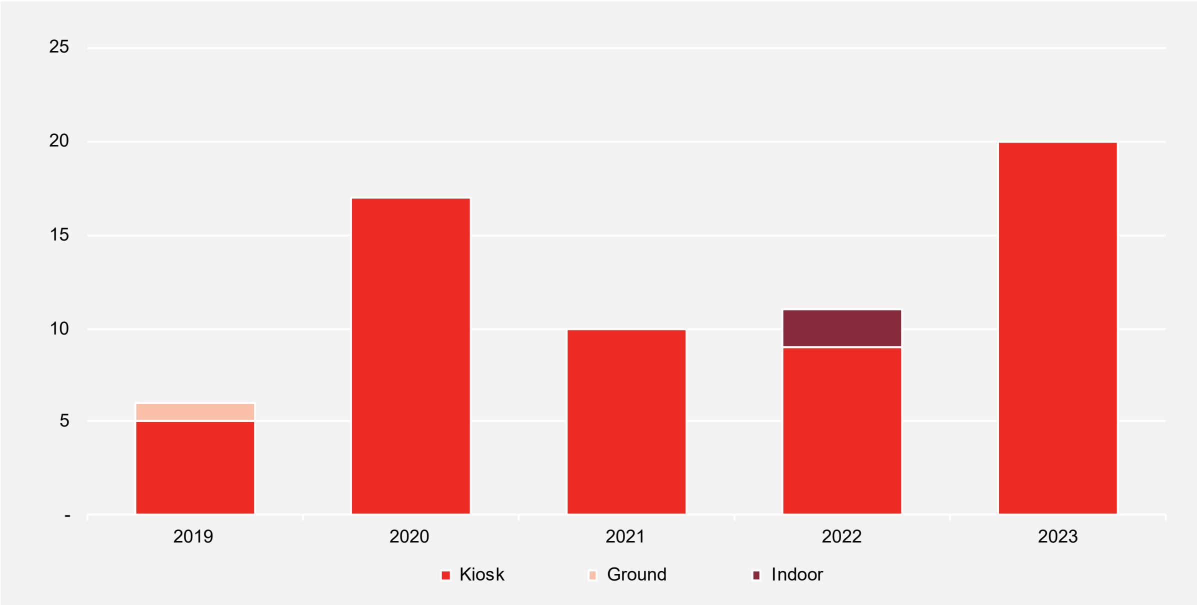
3.1.2 Non pole-mounted distribution transformers

We inspect our kiosk and ground type transformers every six months, and our indoor transformers every two years. These cyclic inspections provide an assessment of the underlying condition and identify any defects, including oil leaks.

Historical asset failures

As shown in figure 4, non pole-mounted distribution transformer failures have fluctuated year-on-year, with a general increasing trend, particularly in 2023. The majority of failures are in our kiosk transformers.

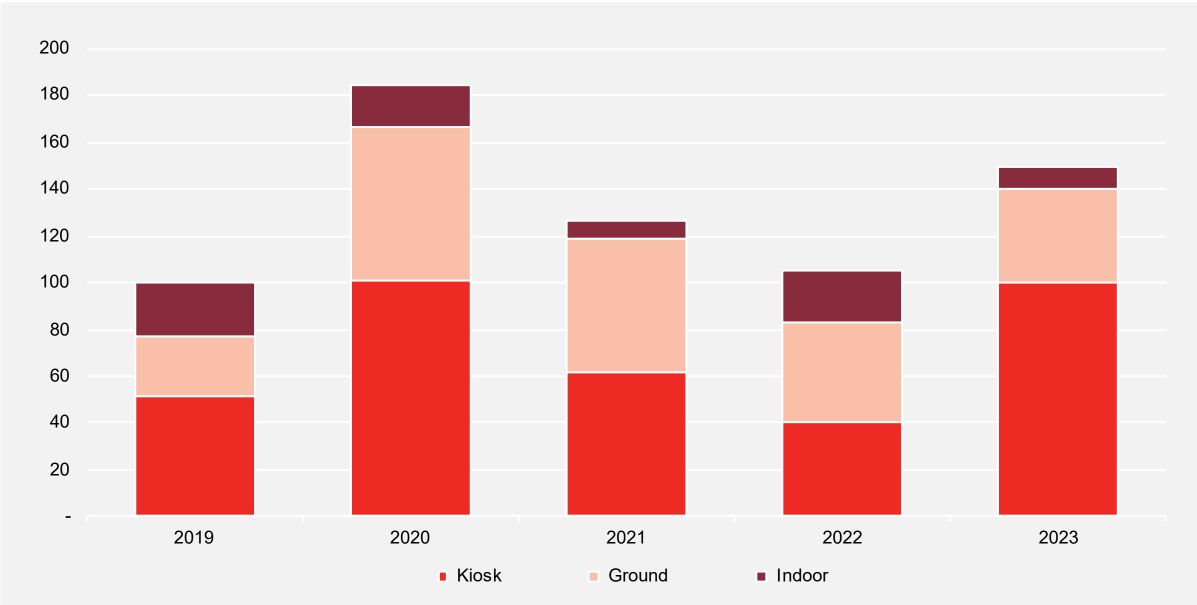
FIGURE 4 NON POLE-MOUNTED DISTRIBUTION TRANSFORMERS: FAILURES



Historical asset defects

As shown in figure 5, our non pole-mounted transformer defects are also increasing. Most of these defects are in our kiosk and ground transformers.

FIGURE 5 NON POLE-MOUNTED DISTRIBUTION TRANSFORMERS: DEFECTS BY TYPE



3.2 Demand growth

By 2031, the electrification of everything from homes to transport, along with ongoing population growth, will require our energy system to evolve.

As recently as December 2024, our network almost surpassed its previous highest peak demand (set in 2014). This near-peak event occurred far earlier in the summer season than previously experienced, and in the same month we also saw new record minimum demands (with our network acting as a net exporter of over 300MW in the middle of the day). These patterns of extremes are expected to grow with the increasing electrification of our customers' homes and businesses

Growth in demand increases the energy that would not be supplied to customers if our distribution transformer assets failed.

We forecast demand at an asset level. Our risk modelling uses these asset level demand forecasts to accurately evaluate the energy at risk of not being supplied to customers downstream of specific assets.

4. Forecast interventions

Our current asset management approach for distribution transformers includes cyclic inspections and interventions, where required, to meet service levels consistent with our compliance obligations and stakeholder expectations.

Typically, replacement of distribution transformers is the only credible response to major defects and failures, as there is no viable repair option and additional inspection and maintenance will not address the underlying asset condition. For example:

- for pole-mounted transformers, these cannot be repaired in-situ and removal and repair in the workshop would be more costly than replacement
- for non pole-mounted transformers, repairs can address minor defects (such as minor oil leaks) by tightening seals or applying patching compounds, however, major defects and failures (such as major oil leaks) will require replacement.

The derivation of our forecast interventions for the 2026–31 regulatory period, for our high-volume assets such as distribution transformers, are based on three broad categories—faults, corrective and risk-based forecasts. This approach is summarised in figure 6.

FIGURE 6 FORECAST CATEGORIES

Forecast interventions	=	Fault	+	Corrective	+	Risk-based
		Responses to asset failures that caused outages, including those due to external factors (such as third-party damage)		Interventions to address conditional failures associated with observable defects, deteriorated asset condition, and non-compliances		Proactive interventions based on cost-benefit analysis, where risk reduction benefits outweigh intervention costs

4.1 Forecast volumes

For the 2026–31 regulatory period, a summary of our forecast intervention volumes for distribution transformers is shown in table 3. These volumes are mostly consistent with those completed in the 2021–26 regulatory period, with the exception of a risk-based uplift to address environmental compliance associated with increasing oil leaks.

TABLE 3 DISTRIBUTION TRANSFORMER: VOLUMES

VOLUMES	FY27	FY28	FY29	FY30	FY31	TOTAL
Defective kiosk transformers	673	674	674	675	675	3,369
Defective ground transformers	12	12	12	12	12	60
Defective indoor transformers	7	7	7	7	7	35
Environmental compliance	165	165	148	105	66	649
Other distribution works	7	7	7	7	7	35
Total	**864**	**865**	**848**	**806**	**767**	**4,148**

Note: Volumes associated with faults are consolidated into the defective categories above

4.1.1 Fault replacements

Faults on our distribution transformer assets occur somewhat randomly across our network, and accordingly, our fault-based distribution transformer forecast is based on a simple average over the previous five-year period.

4.1.2 Corrective replacements

Our corrective forecasts for distribution transformer replacements are based on forecast annual asset defect rates and forecast asset population, consistent with independent statistical analysis on the best fit of our historical data. Specifically:

- the annual asset defect rate is the number of annual defects found per total asset population, and reflects the different cyclic inspection intervals for various transformer types. These defect rates are based on our historical data from 2017 to 2022 as changes in our environmental obligations are reflected in our data from 2023 onwards
- historical asset defect rates for each transformer type were analysed independently, and further disaggregated into oil leak defects and total defects (given the significance of oil leak defects). Simple historical averages were found to best fit the underlying data (i.e. historical asset defect rates yielded a very low root mean square error for all transformer types, which demonstrates low error and hence more robust predictions)
- forecast asset population is determined using linear regression based on our historical asset population growth for each transformer type. Independent assessment of our historical asset population growth over time found they exhibited a linear trend, and a linear regression prediction model was found to be the best fit of our historical asset population (i.e. these yielded consistently

high R-square values—ranging from 0.94 to 0.99—which demonstrates the linear regression model is a very good fit).[1]

4.1.3 Risk-based replacements

Our distribution transformer intervention forecast includes a risk-based program to address environmental issues associated with increasing oil leaks in our pole-mounted transformers.

In 2021, amendments to the Environmental Protection Act came into effect that introduced the requirement to minimise the risks of harm to human health or the environment from pollution or waste so far as reasonably practicable. In effect, this mandated a shift from a reactive to a proactive management approach associated with oil leaks from our assets (such as pole-mounted transformers).

Identified need

Our response to these changes has included amendments to our inspection and maintenance practice for pole-mounted transformers to better capture oil leak defects and prioritise oil leak rectification. Historically oil leaks from a pole-mounted transformer were recorded as a high-priority defect only when there was evidence of oil leakage on the ground. Under the Act, however, we are now required to assess the risk reduction benefits from intervening earlier (e.g. replacing the transformer following identification of visible oil markings, but before oil leaks to the ground).

In 2023, an inspection of over 30,000 of our pole-mounted transformers identified 511 lower priority (i.e. P3) defects. Once extrapolated to our entire population, this suggests over 1,300 P3 defects exist today.

We have since replaced 151 of these P3 defects, based on the value of the avoided benefits from soil remediation and unplanned replacement costs. The value of avoided soil remediation reflects the weighted average of historical notifiable and non-notifiable clean-up costs, and actual replacement costs.

Options considered

We considered two separate options to manage this population of P3 defects:

- option one: do-nothing – that is, cease our existing intervention program and instead, revert to managing lower priority defects reactively
- option two: maintain our existing intervention program – under this option, we would maintain the P3 replacement volumes completed in FY24 throughout the 2026–31 regulatory period.

Our assessment of these options is set out in our attached risk model.[2]

Under the do-nothing option, our modelling assumes that our P3 will transition over time and eventually become high-priority defects (i.e. oil leaking onto the ground) that require replacement and soil remediation. Based on our historical data, we have assumed an eight-year transition period, from thereafter 60 per cent of these P3 defects will fail each year. These assumptions are considered highly conservative, as it is much more likely the transition period to failure will happen much earlier.

1 PAL ATT 4.02 – Simon Holcombe (Melbourne University) - EDPR defect forecasting methodology – Aug2024 – Public, p. 24.
2 PAL MOD 4.15 - Pole mounted transformer uplift - Jan2025 – Public.

This option is also likely to be non-compliant under our general environment duties.

Under option two, we would maintain our existing program throughout the 2026–31 regulatory period. Our modelling assumes, however, than after a five-year period our early intervention program will begin to replace some P3 defects that would otherwise have themselves transitioned to a higher priority defect (which are reflected in our historical defect forecast). This has the effect of reducing our overall replacement program over time.

Table 4 shows the benefits of option two relative to a do-nothing approach. Consistent with this outcome, maintaining our current program will deliver material benefits to our customers over time, and is therefore our preferred option.

TABLE 4 OPTION EVALUATION: RELATIVE TO BASE CASE ($M, 2026)

OPTION		PV COST	PV BENEFITS	NET BENEFITS
1	Do-nothing: reactive replacements only	-	-	-
2	Maintain existing proactive replacement volumes, with an assumed reduction over time	(5.0)	23.7	18.7

4.1.4 Top-down portfolio review

As part of challenging our distribution transformer intervention forecast, we considered the overall driver of our forecast interventions. The primary uplift relative to historical performance is the impact from our risk-based environmental compliance program, which has a targeted identified need and clear benefits case, and is consistent with our recent history of asset failures and defects associated with oil leaks.

Further, at a high-level, our annual forecast replacement rate equates to around one per cent of our population, which means our distribution transformers on average would need to last 105 years before we replace them. This supports a view that our proposed interventions are likely least-regrets.

4.2 Expenditure forecast

To develop expenditure forecasts for our distribution transformers, we have multiplied the forecast intervention volumes by observed unit rates for different transformer types.

Table 5 summarises this expenditure forecast for the 2026–31 regulatory period.

TABLE 5 DISTRIBUTION TRANSFORMERS: EXPENDITURE ($M, 2026)

EXPENDITURE	FY27	FY28	FY29	FY30	FY31	TOTAL
Defective kiosk transformers	13.1	13.1	13.1	13.1	13.1	65.6
Defective ground transformers	1.8	1.8	1.8	1.8	1.8	8.9
Defective indoor transformers	0.9	0.9	0.9	0.9	0.9	4.4
Environmental compliance	1.8	1.8	1.6	1.2	0.7	7.2
Other distribution works	1.6	1.7	1.7	1.8	1.8	8.6
Total	**19.2**	**19.3**	**19.1**	**18.7**	**18.3**	**94.6**

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