ASSET CLASS OVERVIEW

DISTRIBUTION TRANSFORMERS

CP BUS 4.06 – PUBLIC
2026–31 REGULATORY PROPOSAL

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1. Overview

Our distribution transformer replacement program 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, defects and failures of our distribution transformers have been increasing, mainly driven by the deteriorating condition of indoor and kiosk transformers. Further analysis on defect type shows that most of these defects are due to oil leaks.

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. Notably, our forecasts exclude the impacts of additional testing and inspection activities recently introduced.

A summary of our distribution transformer replacement forecast is set out in table 1.

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

EXPENDITURE	FY27	FY28	FY29	FY30	FY31	TOTAL
Defective kiosk transformer replacement	0.8	0.8	0.8	0.8	0.8	**4.2**
Defective ground transformer replacement	0.2	0.2	0.2	0.2	0.2	**1.0**
Defective indoor transformer replacement	1.8	1.8	1.8	1.8	1.8	**9.2**
Other distribution works	0.5	0.5	0.5	0.5	0.5	**2.6**
Total	**3.4**	**3.4**	**3.4**	**3.4**	**3.4**	**17.0**

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 distribution transformers are indoor type. These indoor transformers mainly comprise of 11kV and 6.6kV transformers.

TABLE 2 DISTRIBUTION TRANSFORMER POPULATION

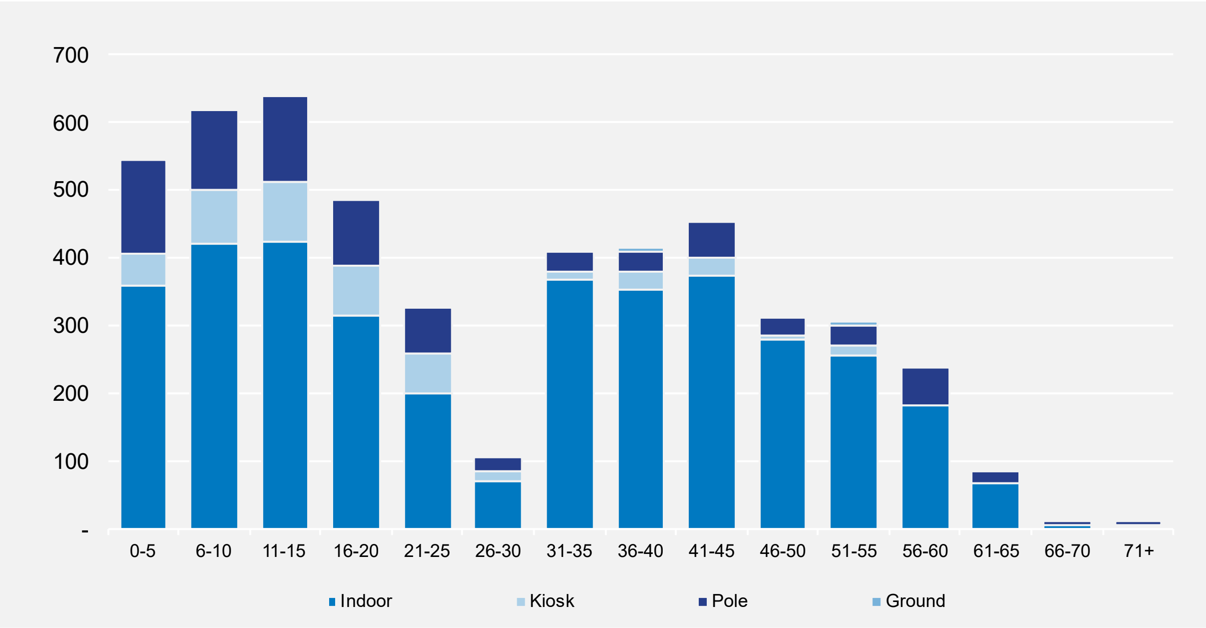
DISTRIBUTION TRANSFORMER TYPE	VOLUME
Pole-mounted	**822**
Kiosk	**447**
Ground	**24**
Indoor	**3,680**
Total	**4,973**

2.3 Asset age profile

The expected service life for our distribution transformers is typically around 60 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.

Figure 1 shows the age profile of our distribution transformers.

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 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

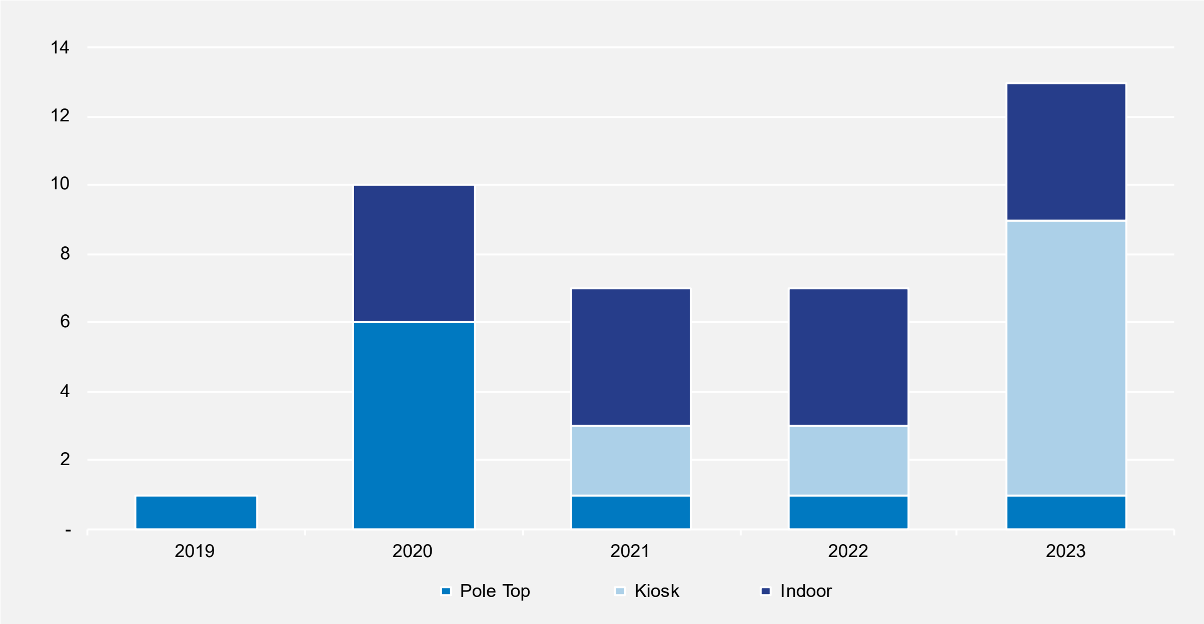
In assessing the need to intervene on our distribution transformers, we monitor several performance indicators, including asset failures, high priority defects, and asset condition. These indicators inform our underlying asset management response—for example:

- 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 Historical asset failures

Figure 2 shows our distribution transformer failures have been increasing, with a shift in the type of distribution transformer failing from predominately pole type transformers (in 2020) to kiosk and indoor transformer failures from 2021 onwards.

FIGURE 2 DISTRIBUTION TRANSFORMER: FAILURES

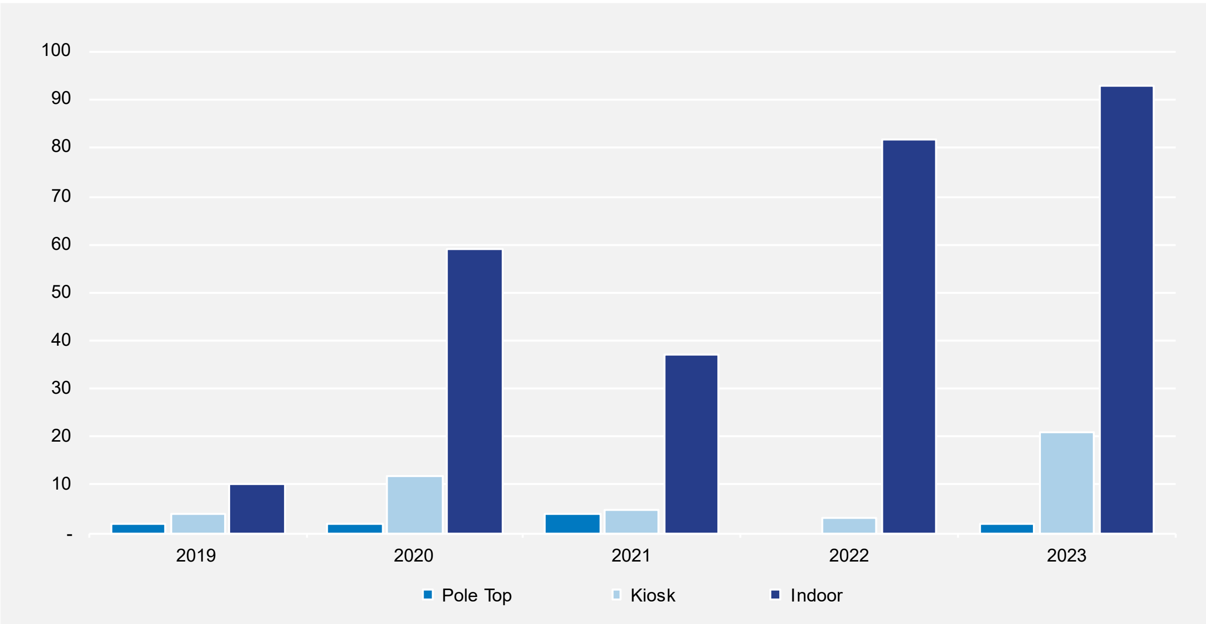


3.1.2 Historical asset defects

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

As shown in figure 3, our distribution transformer defects have been increasing from 2019, driven by indoor distribution transformer defects. This is consistent with deteriorating condition of our indoor transformers. As per our failure history, kiosk defects are increasing as well.

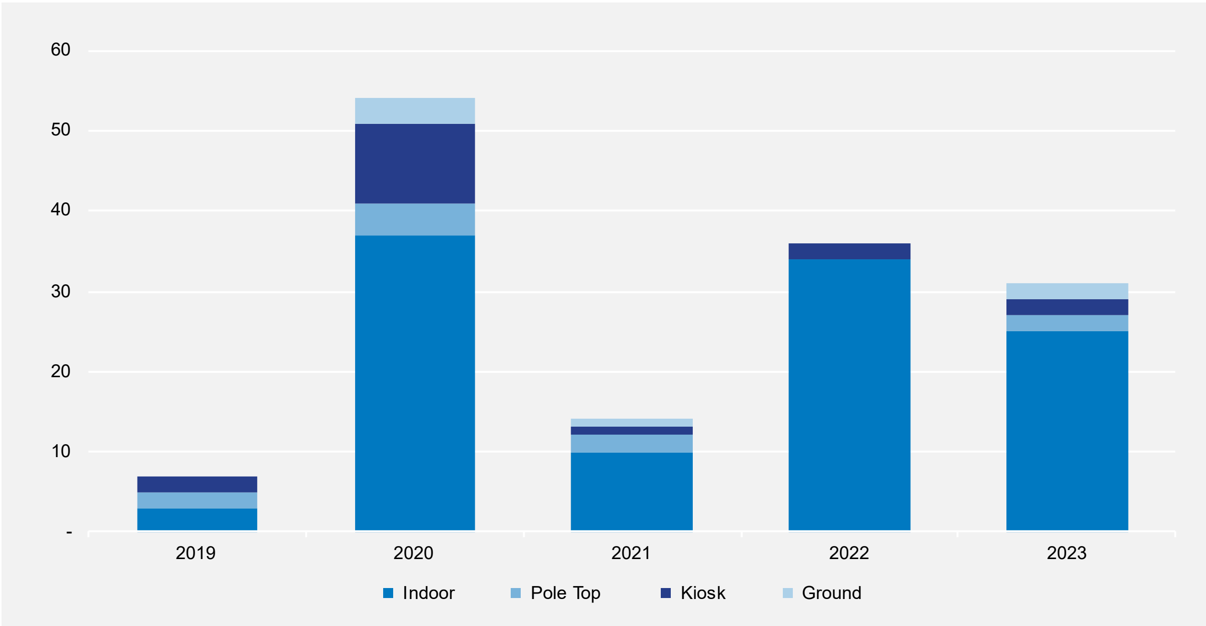
FIGURE 3 DISTRIBUTION TRANSFORMER: TOTAL DEFECTS



Further analysis on defect type also shows that most defects are due to oil leaks. As shown in figure 4, the majority of these oil leak defects are from indoor transformers, which demonstrates the poor condition of our indoor transformers but poses less risk of harm to the environment due to the enclosed environment that enables capture of oil leaks.

Our pole mounted transformer oil leak defects have not increased, however, this is likely due to the longer inspection cycle compared to non-pole transformers. We anticipate pole mounted transformer oil leak defects will increase in future years.

FIGURE 4 DISTRIBUTION TRANSFORMER: OIL LEAK DEFECTS



3.2 Demand growth

The electrification of everything from homes to transport, along with ongoing population growth, will require our energy system to evolve. By 2031, for example, we are forecasting a 26 per cent increase in annual consumption and 7 per cent growth in peak demand.

Growth in demand increases the energy that would not be supplied to customers if our distribution switchgear 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

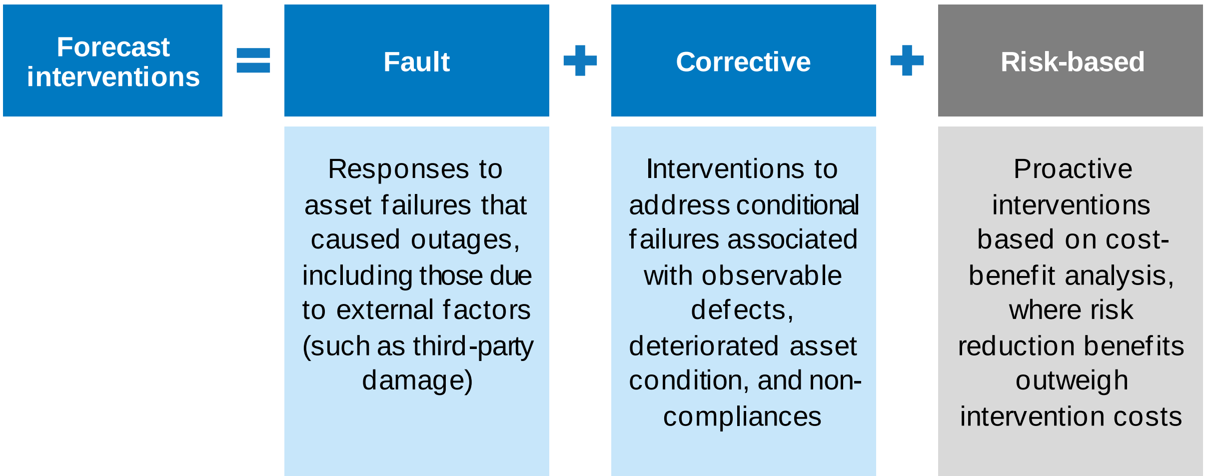
Our current asset management approach for distribution transformers includes cyclic inspections and interventions, where required, to meet service levels consistent with our compliance obligations and stakeholder expectations.

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 two broad categories—faults and corrective forecasts. We are not proposing any risk-based forecasts. This approach is summarised in figure 5.

FIGURE 5 FORECAST CATEGORIES



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.

TABLE 3 DISTRIBUTION TRANSFORMER: VOLUMES

VOLUMES	FY27	FY28	FY29	FY30	FY31	TOTAL
Defective kiosk transformers	5	5	5	5	5	25
Defective ground transformers	1	1	1	1	1	6
Defective indoor transformers	18	18	18	18	18	90
Other distribution works	2	2	2	2	2	10
Total	**26**	**26**	**26**	**26**	**26**	**131**

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

4.1.1 Fault replacement forecast

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 forecasts

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 0.90 to 0.97—which demonstrates the linear regression model is a very good fit).[1]

[1] CP ATT 4.02 – Simon Holcombe (Melbourne University) - EDPR defect forecasting methodology – Aug2024 – Public, p. 24.

4.1.3 Top-down portfolio review

At a high-level, our annual forecast replacement rate equates to around 0.5 per cent of our population, which means our distribution transformers on average would need to last 214 years before we replace them. This supports a view that our proposed interventions are likely least-regrets.

Further, our forecast volumes are likely to be conservative as we anticipate this increasing defect trends will continue in the future because of the commencement of two additional testing regimes. Specifically:

- in 2024, we trialled the use of handheld partial discharge devices by HV operators. These identify switchgear and transformer cable box defects prior to switching and hence, increases operator safety. However, as we are currently rolling out the deployment of these devices, we have excluded impacts until more data is available
- in 2024, we introduced a new oil testing regime for larger transformers (greater or equal to 1,000kVA). This testing will provide condition information and enable the identification of transformers with poor oil quality. Transformers with poor oil quality will likely require replacement as it impacts insulation and could lead to transformer failure. However, we have again excluded any impacts from this testing in our forecast until more data is available.

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

TABLE 4 FORECAST DISTRIBUTION TRANSFORMER EXPENDITURE ($M, 2026)

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