ASSET CLASS OVERVIEW

UNDERGROUND CABLES

PAL BUS 4.04 – PUBLIC

2026–31 REGULATORY PROPOSAL

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1. Overview

Our cable replacement program is critical to our ability to maintain network reliability and minimise safety risk as far as practicable.

Recent evidence shows that observed high-priority defects are increasing in our pits and pillars. Further, our condition assessment modelling shows that in the absence of any intervention by 2031, 60 per cent of our underground cable population (i.e. approximately 1,632km) is forecast to be at high risk of failure.

Given the scale and criticality of our underground cable network, and the evidence of ongoing deterioration in underlying condition, we consider our forecast replacement volumes are modest and represent 'no regrets' investments. In total, we are only proposing to intervene on 0.1 per cent of our cable population.

A summary of our forecast expenditure for underground cable systems for the 2026–31 regulatory period is set out in Table 1.

TABLE 1 UNDERGROUND CABLE SYSTEMS: EXPENDITURE ($M, 2026)

EXPENDITURE	FY27	FY28	FY29	FY30	FY31	TOTAL
Corrective cable: LV	1.4	1.4	1.4	1.4	1.4	7.0
Corrective cable: HV	2.6	2.6	2.6	2.6	2.6	13.2
Risk-based: HV cable	3.3	3.3	3.3	3.3	3.3	16.7
Underground pits and pillars	0.6	0.6	0.6	0.6	0.6	2.9
Defective SWER ISO	1.5	1.5	1.5	1.5	1.5	7.4
Total	**9.4**	**9.4**	**9.4**	**9.4**	**9.4**	**47.2**

Note: Underground cable expenditure included in our reset RIN may not match the above due to the allocation to this asset category of works driven by other projects.

2. Background

Underground cable systems provide the electrical conducting medium to connect low voltage (LV), high voltage (HV) and sub-transmission distribution networks.

The cables themselves are constructed with the conducting medium (i.e. conductor) in the centre of the insulated core and additional layers that provide earthing and mechanical protection. The insulation is a non-conducting material that provides an electrical and physical barrier between the energised conductors in the cable and earth.

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

2.1 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

Our underground cable systems comprise of our underground cables, joint and terminations, cable pits and pillars to provide access points, and the electrolysis cable system (which includes cables and drain boxes).

The volumes associated with each of these assets are set out in table 2 and table 3.

TABLE 2 UNDERGROUND CABLE: POPULATION BY VOLTAGE (KM)

CABLE VOLTAGE	LENGTH
≤ 1kV	5,447
> 1kV and ≤ 11 kV	19
> 11kV and ≤ 22kV	2,757
> 33kV and ≤ 66kV	10
Total	**8,234**

TABLE 3 CABLE PIT AND PILLAR: POPULATION

ASSET TYPE	VOLUME
HV pits	2
LV pits	312,701
LV pillars	12,863
Total	**325,566**

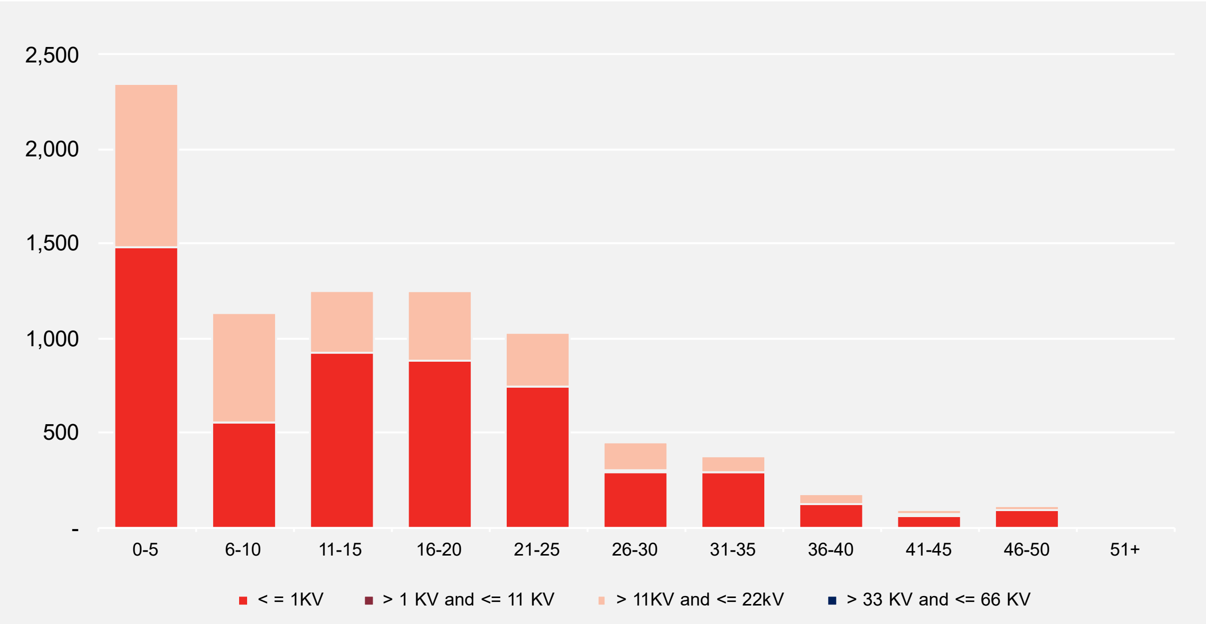
2.3 Asset age profile

The age profile of our underground cable population is shown in figure 1. Much of this cable has been installed as part of recent underground residential developments.

The expected service life for these cables is around 70-years, noting that while we do not replace underground cable based on age, the service life is the expected period of time after which the asset is unlikely to be fit for purpose (typically determined by safety, and technology obsolescence).

We do not have age records for our pits, pillars and electrolysis cable systems.

FIGURE 1 UNDERGROUND CABLE: AGE PROFILE BY MATERIAL TYPE (KM)



Note: Although not visible on the figure due its scale, we have around 22km of aged cable beyond 51 years old.

3. Identified need

The performance of our cable systems may impact our network service level as failures may lead to a loss of supply for customers, pose safety risks to our personnel and the public, start fires (for above ground terminated cables), and/or pollute the environment with an oil leak from oil insulated cable.

The identified need, therefore, is to manage our cable asset class to maintain reliability and minimise safety risks as far as practicable, consistent with our regulatory and legislative obligations.

The large volume of our cable systems population, and its underlying condition and age profile, is also driving the need to consider whether current intervention volumes will allow us to continue to prudently manage deliverability and safety factors over time.

This section outlines the historical performance and condition of our underground cable systems, 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 underground cable assets, we monitor several performance indicators. These include:

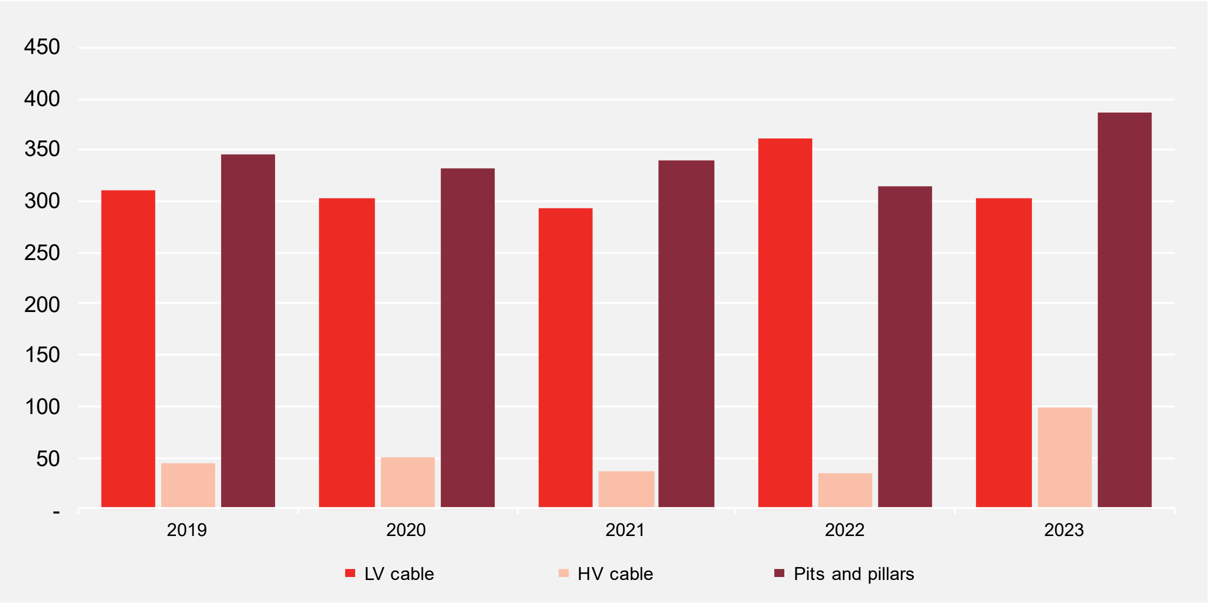
- failures, which are functional failures that occur while the asset is in service
- high priority defects, which can indicate deteriorating asset condition and are leading indicators of future asset failures.

We capture historical asset failures and defects for our LV and HV cables, and pits and pillars.

3.1.1 Historical asset failures

As shown in figure 2, LV and HV cable failures have been relatively stable. However, cable pit and pillar failures increased in 2023.

FIGURE 2 CABLE SYSTEMS: FAILURES BY TYPE



3.1.2 Historical asset defects

Our response to identified defects depends on the nature and severity of the defect. High priority defects that result in intervention are shown in table 4.

TABLE 4 RESPONSE TIMEFRAMES FOR HIGH PRIORITY DEFECTS

PRIORITY	TIMEFRAME FOR INTERVENTION
P1	Make safe within 24 hours of identification (replacements or repairs can occur beyond the initial 24 hours)
P42	Addressed within 42 days of identification
P2	Addressed within 32 weeks of identification

As shown in figure 3, the number of high priority cable system defects has been increasing since 2019. The majority of these are P2 defects.

Figure 4 highlights that the driver of the increase in defects is predominately our pits and pillars defects. This is due to improvements in pits and pillars routine inspection and reporting requirements from 2020. The number of defects is expected to increase from 2024 onwards as the frequency of inspection of pillars in hazardous bushfire risk areas (HBRA) is to increase as directed by Energy Safe Victoria (ESV).

FIGURE 3 CABLE SYSTEMS: HIGH PRIORITY DEFECTS

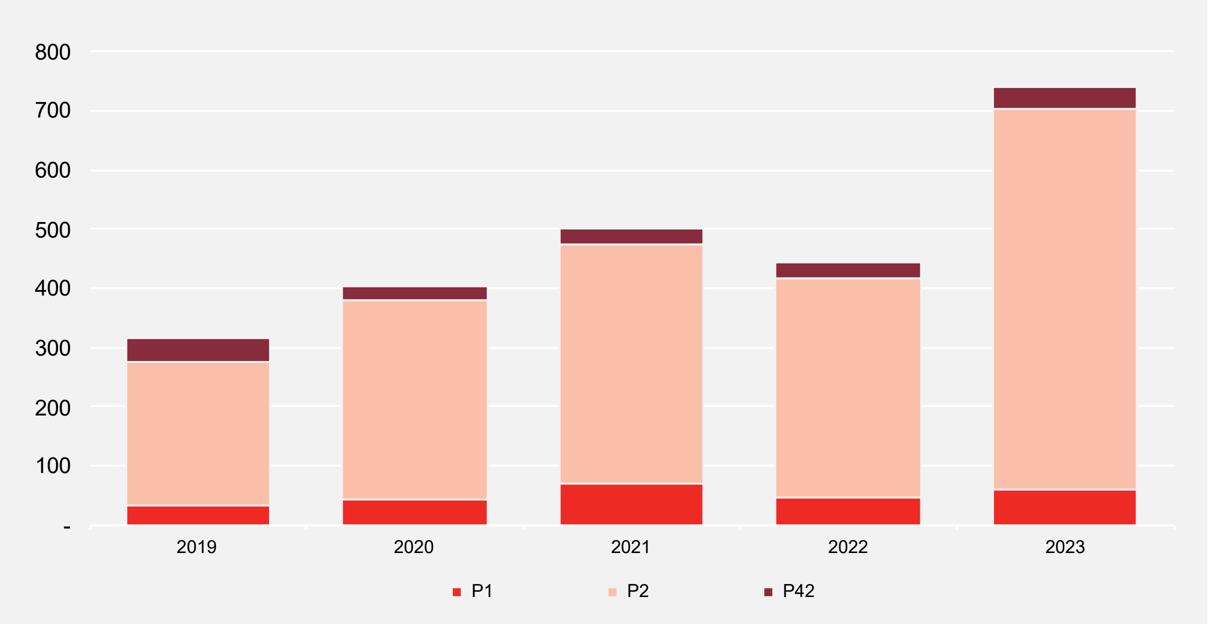
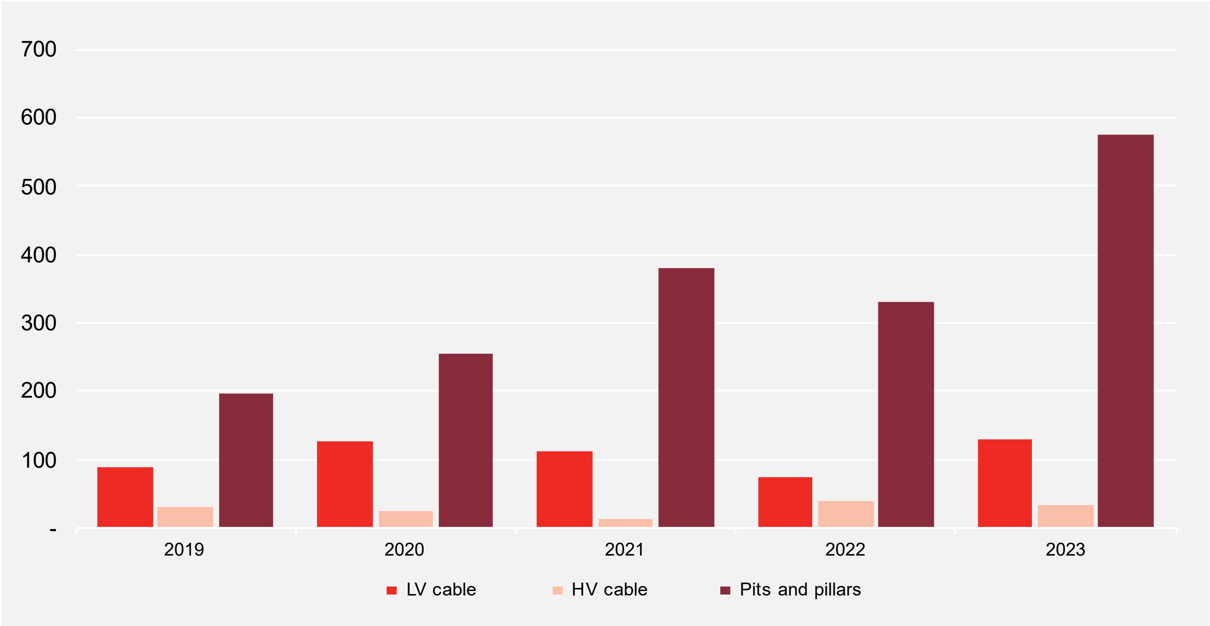


FIGURE 4 CABLE SYSTEMS: HIGH PRIORITY DEFECTS BY TYPE



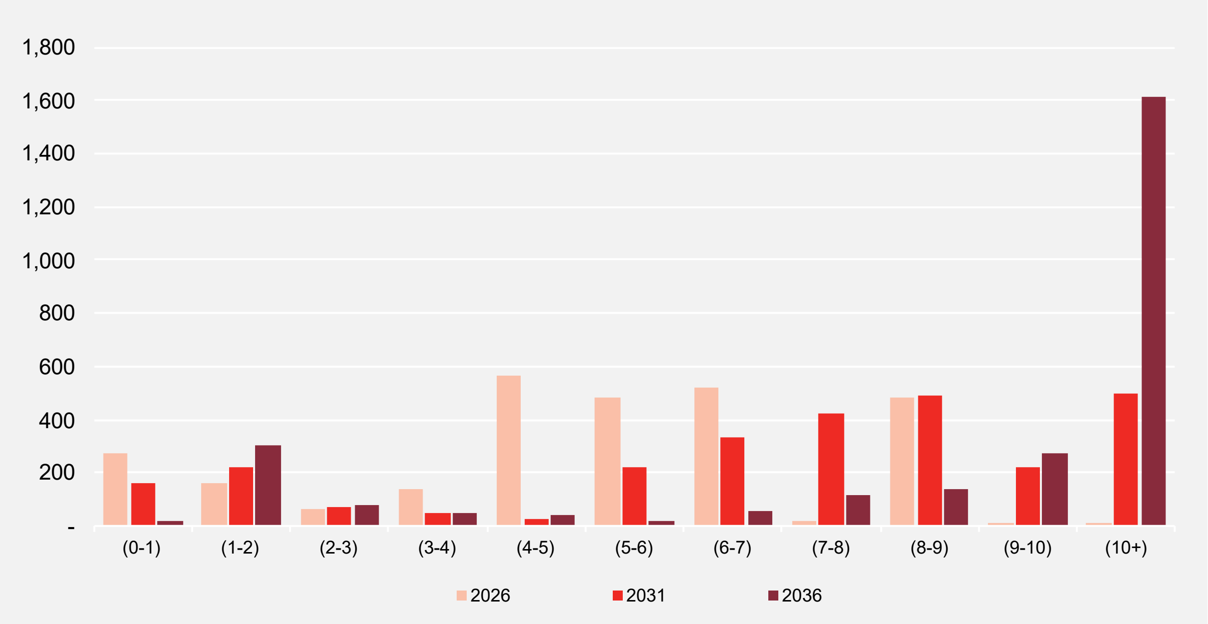
3.2 Asset condition

The condition of our underground cable is also an important factor in considering the extent of the need to maintain the safety and reliability of our network for customers. For our HV cable, condition is represented by the health index derived in our condition-based risk management (CBRM) model.[1]

The predicted health index profile for 2026, 2031 and 2036 is set out in figure 5. A health index of seven or higher is considered higher risk, indicating that the asset has reached a point where there is a high chance of failure.

1 We do not have health indices for of our sub-transmission and LV cables.

FIGURE 5 HV CABLE: HEALTH INDEX PROFILE



As shown in table 5, the proportion of assets with a higher-risk asset condition rating is increasing. This deterioration in condition supports the need to assess the prudency of moving toward more sustainable intervention volumes.

TABLE 5 PROPORTION OF HIGHER-RISK UNDERGROUND CABLE

YEAR	POPULATION (KM)	POPULATION (%)
Higher-risk cable: 2026	514	19%
Higher-risk cable: 2031	1,632	60%
Higher-risk cable: 2036	2,139	79%

3.3 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.

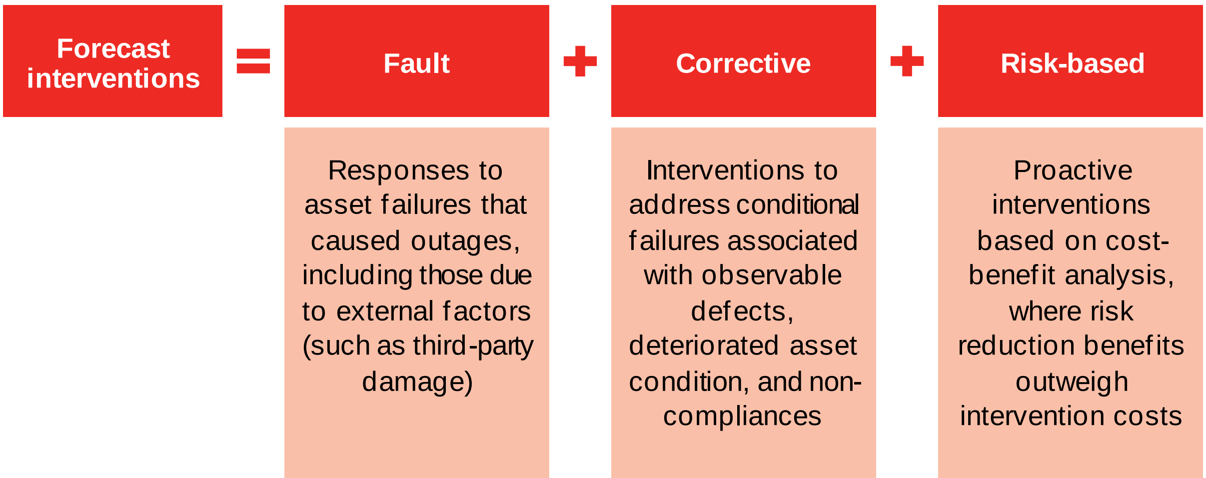
We forecast demand at an asset level. Our risk modelling uses these asset level demand forecasts to accurately evaluate the energy at risk of not being supplied to customers downstream of specific assets.

4. Forecast interventions

Our current asset management approach for underground cable systems includes a balance of condition monitoring (such as online partial discharge monitoring), reactive repairs or replacements, and targeted risk-based replacement programs. For repairs, this typically entails cutting and replacing part of the cable with cable joints. Complete cable replacement, however, will eventually be required due to economic or technical drivers (e.g. where multiple cable sections are deteriorated, it may be prudent and efficient to replace the entire length).

Consistent with this approach, the derivation of forecast interventions for the 2026–31 regulatory period for our underground cable systems is based on three broad categories—faults, corrective and risk-based forecasts. This approach is summarised in figure 6.

FIGURE 6 FORECAST CATEGORIES



4.1 Forecast volumes

For the 2026–31 regulatory period, a summary of forecast volumes for our underground cable systems is shown below. As this asset class comprises a mix of lengths and units, these are shown separately in table 6 and table 7 respectively.

TABLE 6 UNDERGROUND CABLE SYSTEMS: VOLUMES (KM)

VOLUMES	FY27	FY28	FY29	FY30	FY31	TOTAL
Corrective cable: LV	5.1	5.1	5.1	5.1	5.1	25.6
Corrective cable: HV	6.0	6.0	6.0	6.0	6.0	29.8
Risk-based: HV cable	1.5	1.5	1.5	1.5	1.5	7.5
Total	**12.6**	**12.6**	**12.6**	**12.6**	**12.6**	**62.9**

TABLE 7 UNDERGROUND CABLE SYSTEMS: VOLUMES (UNITS)

VOLUMES	FY27	FY28	FY29	FY30	FY31	TOTAL
Defective SWER ISO	132	132	132	132	132	660
Underground pits and pillars	193	193	193	193	193	963
Total	**325**	**325**	**325**	**325**	**325**	**1,623**

4.1.1 Fault and corrective forecasts

Given the random nature of underground cable failures, including the variable length of any corresponding cable replacements, our fault and corrective forecasts for underground cable systems are based on a simple average over the previous five-year period.

4.1.2 Risk-based forecast

Our underground cable systems forecast includes the continuation of our HV cable risk-based program that is underway today, with further detail on set out in appendix A.

Broadly, our risk assessments are underpinned by the monetisation approach shown in figure 7, which is consistent with the AER's asset replacement planning industry practice application note.[2]

The application of this approach compares the replacement costs with the risks of failure for each cable section. Only deteriorated cable sections with positive net present values (NPV), where risk reductions outweigh the costs, are included in our forecast. This ensures we only invest in replacements that are prudent and efficient that provide benefits to customers.

[2] AER, Asset replacement planning industry practice application note, July 2024.

FIGURE 7 RISK MONETISATION APPROACH

Probability of failure

The annual cable section probability of failure was derived from our cable CBRM model. Our CBRM model enables informed asset management decisions by using current asset information and experience to predict future asset condition, performance and risk.

Specifically, the probability of failure is derived from the cable section health index in the CBRM.

Notably, as cable failures typically occur at cable joints, increasing the number of cable joints will introduce additional points of potential failure and hence, increase the cable failure rate.

Consequence of failure

Our approach to monetising risk compares the total cost (including risk) of technically feasible options. The preferred option(s) is that which provides the maximum benefit compared to costs. Figure 8 shows an overview of how we determine the total cost of each option. It identifies the most beneficial solution to manage the cable section, based on the identified failure modes for an asset, and the corresponding likelihoods and consequences of failures.

FIGURE 8 OPTION RISK COST CALCULATION

The determination of these consequences is summarised below:

- network performance risk (energy at risk) is determined based on forecast demand and historical average outage duration for a cable fault. The value of energy at risk is based on the AER's determined value of customer reliability, and the likelihood of energy at risk is 100 per cent upon cable failure (except for ring cable networks, where energy at risk will be avoided as there is alternate supply path)
- safety risks to our staff or member of the public are determined based on the likelihood of a person present when the failure occurs, and the likelihood of an injury or death as a result. These risks are valued using disproportionate factors and the value of a statistical life
- financial risks comprise unplanned replacement and unplanned repair impacts respectively, however, as cable system replacement is typically the only credible response to catastrophic failure (i.e. as the extent of the damage may not be repairable), the likelihood of unplanned cable replacement is typically 100 per cent. Unplanned cable replacement costs are based on historical replacement costs
- environmental risk represents the likelihood of an event whereby the environment is damaged due an event such as the loss of oil, fire, waste and disturbance.

4.1.3 Top-down portfolio review

As part of challenging our underground cable system 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 program. This based program has a targeted identified need, and clear benefit case.

As a further top-down consideration, we assessed our forecast relative to the implied age of replacement. Our annual forecast replacement rate equates to 0.1 per cent of our total cable population. This implies that on average, our underground cables will need to last over 1,200 years before we replace them. While we do not replace cables based on age, this suggests our forecast replacement volumes are likely 'no regrets' investments

4.2 Expenditure forecast

To develop expenditure forecasts for our underground cable systems, we have multiplied the forecast intervention volumes by observed unit rates for different cable types.

Table 8 summarises this expenditure forecast for the 2026–31 regulatory period.

TABLE 8 UNDERGROUND CABLE SYSTEMS: EXPENDITURE ($M, 2026)

EXPENDITURE	FY27	FY28	FY29	FY30	FY31	TOTAL
Corrective cable: LV	1.4	1.4	1.4	1.4	1.4	7.0
Corrective cable: HV	2.6	2.6	2.6	2.6	2.6	13.2
Risk-based: HV cable	3.3	3.3	3.3	3.3	3.3	16.7
Underground pits and pillars	0.6	0.6	0.6	0.6	0.6	2.9
Defective SWER ISO	1.5	1.5	1.5	1.5	1.5	7.4
Total	**9.4**	**9.4**	**9.4**	**9.4**	**9.4**	**47.2**

A Risk-based HV cable replacements

Historically, the majority of our underground cable replacements have been driven solely by interventions following failures or defect. However, in 2021 we established a risk-based program targeting HV cables.

The condition assessment program comprises undertaking on-line partial discharge survey of all sections of a feeder identified as poor performing.

A.1 Identified need

Our underground cable systems asset class comprises over 8,000km of underground cable.

As outlined in section 3.2, the proportion of our underground cable assets with a higher-risk asset condition rating is increasing—in the absence of any intervention by 2031, 60 per cent of our underground cable population (i.e. approximately 1,632km) is forecast to have a health index rating exceeding seven by 2031.

As our cable population continues to deteriorate, and current intervention levels remain low, it is likely that HV cable failures and defects will grow. In this context, the identified need is to prudently and sustainably manage the risks (including reliability and safety) associated with HV cable failure risks.

A.2 Options considered

Table 9 lists all the potential credible options considered to meet the identified need associated with our HV underground cable population. These options include a mix of proactive risk-based replacements of individual cable sections, as well as monitoring high risk sections using partial discharge tests.[3]

To assess these options, we applied the methodology outlined in section 4.1.2 and compared the net benefits of each option relative to the do-nothing base (i.e. option one). Table 10 shows the results of this option evaluation, with further detail in our attached model.[4]

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[3] Partial discharge testing is method used for assessing the insulation condition of HV assets.
[4] PAL MOD 4.14 - HV underground cables - Jan2025 - Public

TABLE 9 POTENTIAL CREDIBLE OPTIONS

OPTION	DESCRIPTION
1	**Do nothing different** Maintain our existing maintenance program with rectification upon asset failure; this would lead to increasing safety and reliability risks
2	**Replace the five highest-risk cable sections** Replacement of the five highest risk cable sections, based on our CBRM
3	**Replace the 10 highest-risk cable sections** Replacement of the 10 highest risk cable sections, based on our CBRM
4	**Monitor the 30 highest-risk cable sections, and replace those with high partial discharge** This option entails installing partial discharge monitoring equipment on the top 30 cable sections with the highest risk reduction. Replacement will only be triggered if there is high partial discharge showing significant cable degradation.
5	**Replace the five highest-risk cable sections, and monitor the next 10 highest-risk cable sections** This option entails the replacement of the top five cable sections with the highest risk reduction and installation of partial discharge equipment on the next top 10 cable sections with the highest risk reduction.

TABLE 10 OPTION EVALUATION: RELATIVE TO BASE CASE ($M, 2026)

OPTION		PV COST	PV BENEFITS	NET BENEFITS
2	Replace the five highest-risk cable sections	(3.8)	15.6	11.8
3	Replace the 10 highest-risk cable sections	(7.8)	26.8	19.0
4	Monitor and replace those with high partial discharge	(7.5)	18.0	10.5
5	Replace and further monitor for partial discharge	(5.8)	22.1	16.2

A.3 Preferred option

Consistent with our economic modelling, the preferred option is to replace the 10 highest-risk cable sections based on our CBRM (i.e. option three). This option meets the identified need, and provides the highest net economic benefits to our customers.

Sensitivity analysis was also used to test the robustness of our preferred option to potential downside scenarios (e.g. higher costs and/or lower benefits). Our preferred option remained economic under these sensitivities.

A summary of the proposed costs for the preferred option are set out in table 11.

TABLE 11 PREFERRED OPTION: EXPENDITURE ($M, 2026)

EXPENDITURE	FY27	FY28	FY29	FY30	FY31	TOTAL
Risk-based: HV cable	3.3	3.3	3.3	3.3	3.3	16.7

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