Appendix 1.12: Evoenergy Asset Portfolio Strategy: Ground Assets

Regulatory proposal for the ACT electricity distribution network 2024–29

GROUND ASSETS

ASSET PORTFOLIO STRATEGIES

This **Asset Portfolio Strategy** provides an overview of the asset management strategy for all Ground assets and the risks, needs, opportunities and other considerations used to create this document.

CONTENTS

EXECUTIVE SUMMARY

Evoenergy’s Ground asset portfolio includes a diverse range of electrical assets. It consists of buried linear infrastructure (underground cables), discrete pieces of electrical equipment such as transformers, circuit breakers and Ring Main Units (RMUs) and metallic conductors attached to such electrical assets for protection (earthing). With an exception for underground transmission cables, all energised assets in this portfolio operate at distribution (both High Voltage (HV) and Low Voltage (LV)) voltage levels. Some assets supported by and/or housed within structural infrastructure and associated facilities such as LV pillar enclosures and distribution substation sites/rooms/fencing also form part of this asset portfolio. These assets are installed either on ground surface or buried in ground.

The assets within this portfolio consist of infrastructure that transports electricity underground and also the ‘nodes’ of Evoenergy’s electricity network where distribution voltage levels are stepped down to LV level for downstream reticulation to end consumers. In addition, it also consists of a collection of all earthing items that are attached to all the portfolios of Evoenergy’s electrical network assets.

This Asset Portfolio Strategy summarises the asset management strategies and covers a rolling 10-year period, currently from FY23 to FY32. The following three asset classes are included within this portfolio:

- Ground Distribution Equipment
- Underground Cables
- Distribution Earthing.

Each asset class is broken down further into multiple asset types and sub-types, and this is detailed in Section 2.

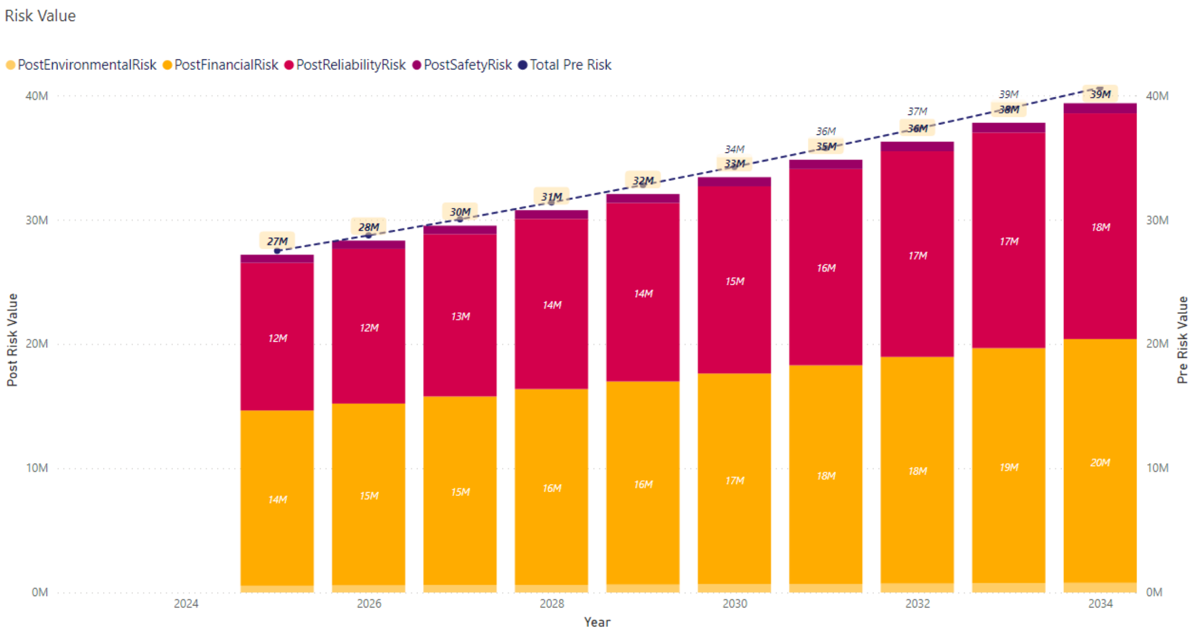
Asset objectives, key risks, and opportunities are explored in this Asset Portfolio Strategy document, drawn from Evoenergy’s Asset Management Policy, Strategic Asset Management Plan, and the Asset Risk Value Framework. This is used to determine the optimal strategy and program of work investment for the assets. In this document, each asset class is described, objectives and issues explored, strategies expounded, expenditure forecast, and resourcing requirement estimated alongside programs of work. Together, these items form a cohesive portfolio strategy for the Ground assets.

The information in this document is presented in the following structure:

- Section 1: Purpose – explains the scope of this document and introduces Evoenergy’s Asset Management System (AMS) and its components at high level. It also presents the hierarchy of the plans within the AMS, where this document sits within the hierarchy, what informs this document, and how the information from this document cascades down.
- Section 2: Portfolio Overview – provides brief information on each of the constituting asset classes.
- Section 3: Asset Portfolio Objectives – provides brief information on Evoenergy’s ongoing and planned business drivers and organisational objectives such as safety, reliability, sustainability, and quality of supply. It describes how this organisational context informs and influences the asset management strategy of this portfolio of assets.
- Section 4: Asset Class Strategies – describes the asset management strategy being proposed for each asset class after considering the management objectives, status of asset and its current characteristics, failure modes, risk level, and available opportunities.
- Section 5: Program of Work – summarises planned program of work including maintenance activities and major replacement and renewal projects across this asset portfolio. Presents a summary of projected expenditure from FY23 to FY32 that is required to fulfil the objectives, address the drivers, and maintain/mitigate the risks to an acceptable level.

Figure 1 demonstrates the comparison between the baseline risk (‘Total Pre Risk’) and the forecasted risk levels over the ensuing 10 year period under the asset strategies as described within this document. The risk is displayed in nominal dollar terms and is an indication of the environmental, direct financial, reliability, and safety risk factors.

FIGURE 1. 10-YEAR FORECAST FOR ASSET PORTFOLIO RISK VALUE

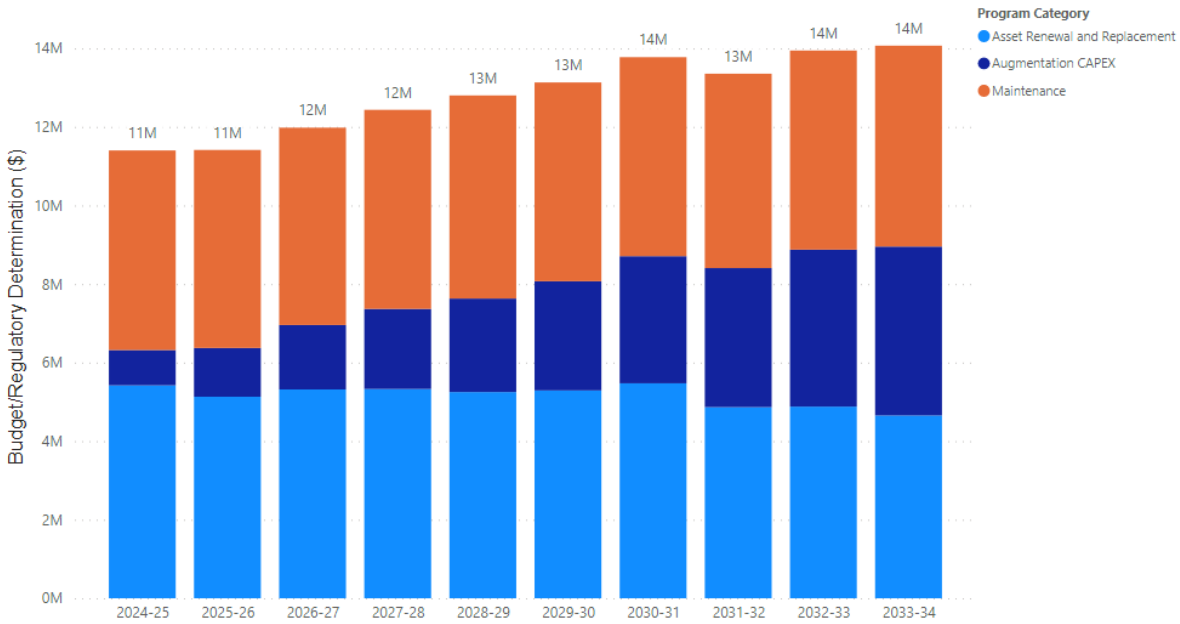


Key components of the program of work include:

- Condition based replacement of distribution pad substations in addition to capacity based upgrades due to Net Zero Carbon Emissions by Year 2045 target (commonly known asNZ45) set by the ACT Government.
- Replacement of high-risk LV cables and pillars to ensure network reliability and public safety
- Condition based replacement of HV and LV boards, panels and circuit breakers
- condition monitoring of various assets to provide suitable data in order to improve the asset modelling.

The overall 10-year budget is shown in Figure 2.

FIGURE 2. 10-YEAR PROGRAM BUDGET CHART



1. PURPOSE

The purpose of this document is to detail Evoenergy's Ground asset management strategy and plans, and to provide future expenditure profiles.

The key information presented includes descriptors of each asset class, key issues and objectives, asset class strategies, expenditure forecasts, and a program of work. Together, these form a cohesive portfolio strategy.

1.1. SCOPE

This Asset Portfolio Strategy document covers all three of Evoenergy's Ground asset classes for a rolling ten-year period. The objective of this document is to provide an overview of the asset management strategy for all the asset classes in this portfolio and to discuss their existing and emerging risks, needs, opportunities, and other key considerations.

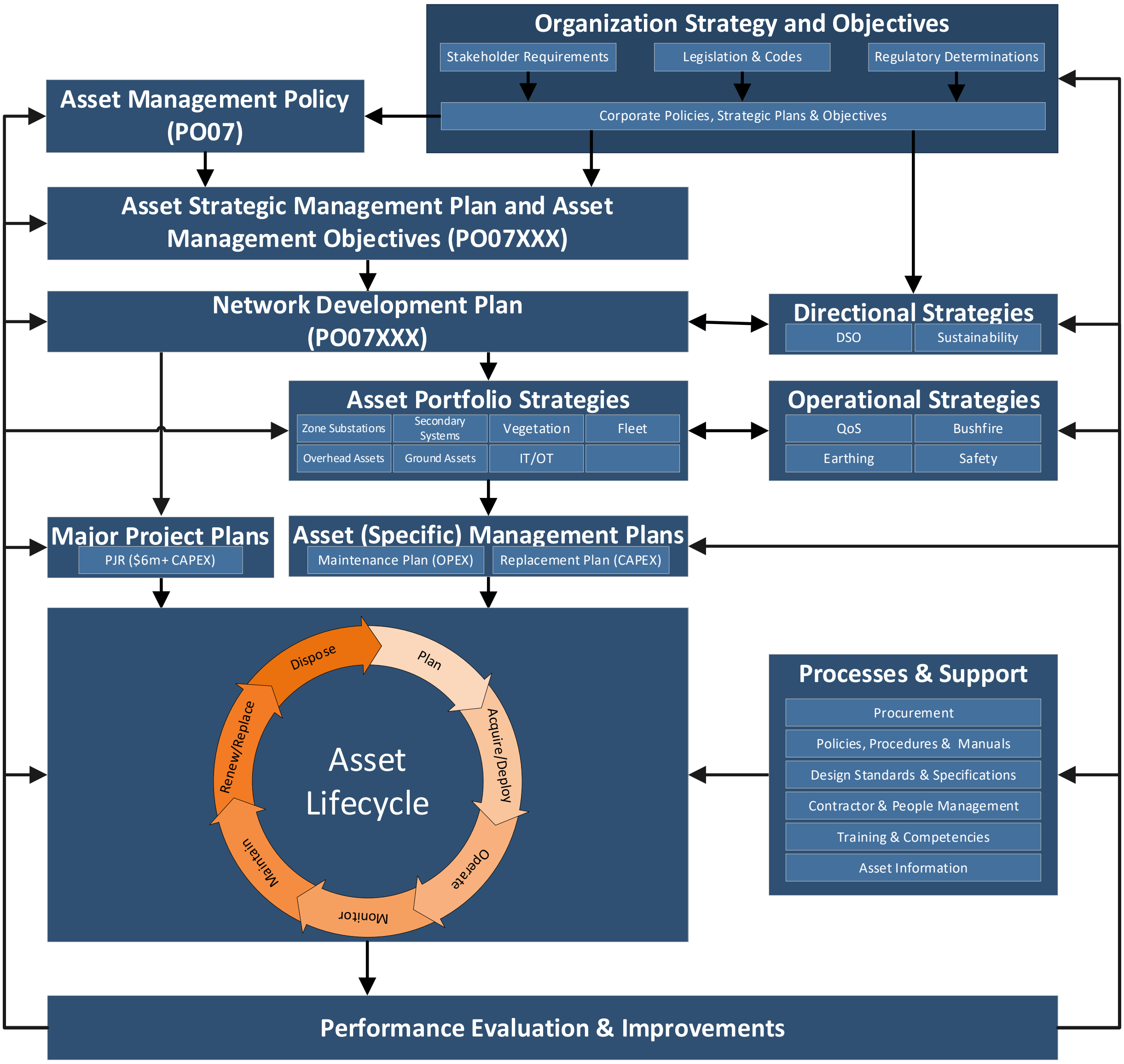
This document links the overarching business objectives and organisational drivers and the low-level operational decisions described in Evoenergy's asset management system.

Figure 3 provides an overview of Evoenergy's Asset Management System.

Figure 4 shows Evoenergy's Asset Management System hierarchy of plans, showing the interrelationship of this document within the overall plans.

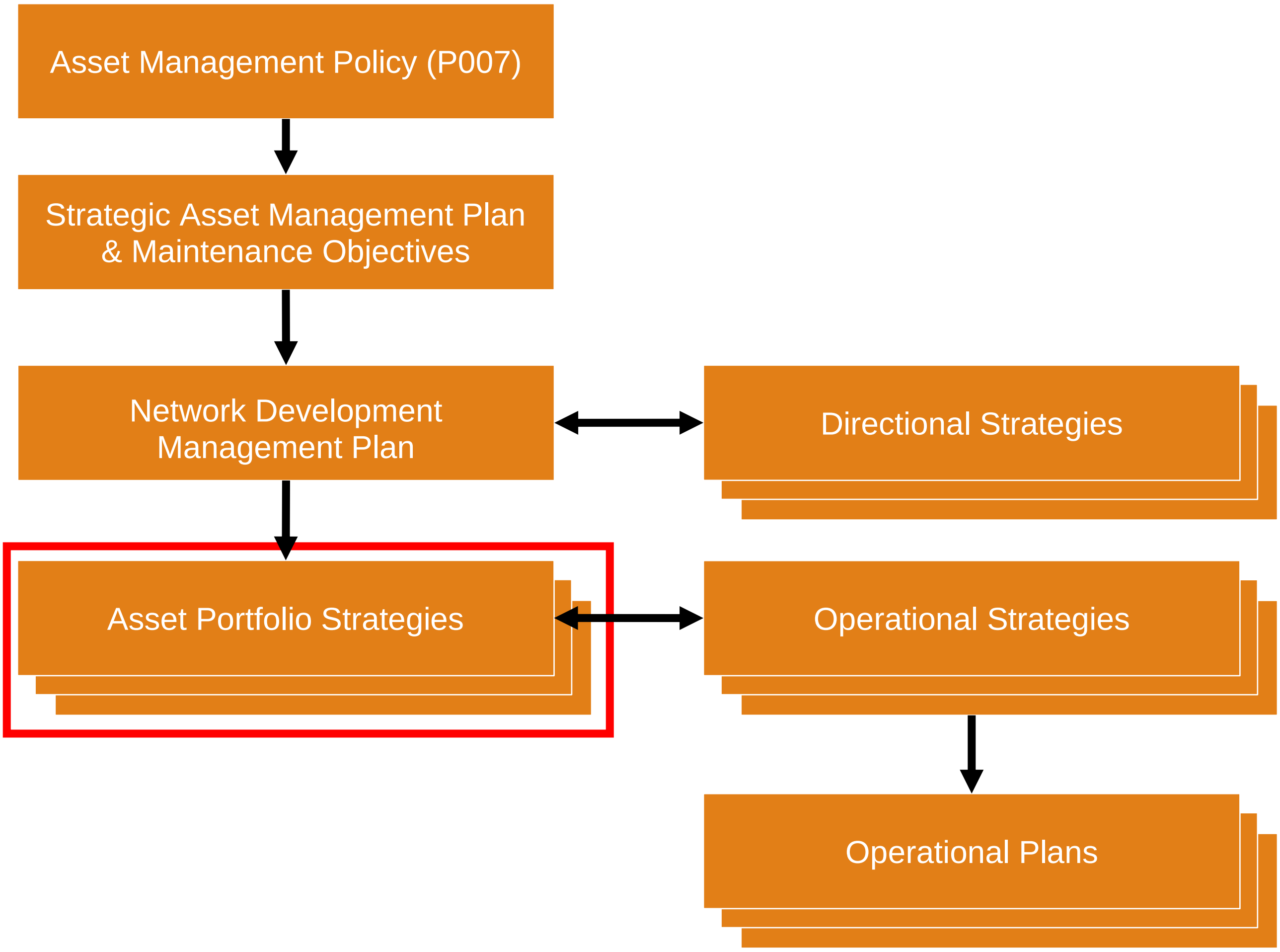
1.2. ASSET MANAGEMENT SYSTEM

FIGURE 3. EVOENERGY'S ASSET MANAGEMENT SYSTEM



1.3. HIERARCHY OF PLANS

FIGURE 4. ASSET MANAGEMENT SYSTEM HIERARCHY OF PLANS (SHOWING THE INTERRELATIONSHIP OF THIS DOCUMENT WITHIN THE OVERALL PLANS)



2. PORTFOLIO OVERVIEW

This section provides an overview of the asset grouping and asset classes contained within this asset portfolio.

The Ground asset portfolio is a mix of low-volume but high-value assets (such as underground transmission cables) and high-volume but low-value assets (such as LV pillars). This portfolio is also a diverse mix of assets that are different in nature (linear/discrete), functions (voltage transform/earthing), voltage level (132kV to LV), and location (underground, on-ground).

FIGURE 5. ASSET HIERARCHY (ONLY SHOWING THE ASSET CLASSES WITHIN THE GROUND ASSET PORTFOLIO)

Overhead Assets

Ground Assets

- Ground Distribution Equipment
  - Ground Mounted Transformers
  - Distribution Substation/Switching Station Sites
  - Ring Main Units
  - Distribution HV Switchboard Assembly
  - Distribution LV Switchboard Assembly
  - LV Pillars
  - HV and LV Pits
  - POE Cubicles and Distribution Boxes
- Underground Cables
  - Transmission Cables
  - Underground HV Cables
  - Underground LV Cables
- Distribution Earthing
  - Surge Diverter Earthing
  - Pole Transformer Earthing
  - Overhead Switchgear Earthing
  - Ground Substation Earthing
  - LV Pits and Pillars Earthing
  - Transmission Structure Earthing

Secondary Systems Assets

Zone Substation Assets

Vegetation and Inspection

The Ground asset portfolio constitutes a major network asset category and, together with other asset portfolios, forms Evoenergy's collective network asset system. This portfolio consists of three asset classes as highlighted in Figure 5. Each asset class comprises of multiple asset types and each asset type comprises of multiple asset sub-types.

All these classes have assets that are located on the ground surface or underground. This asset portfolio together with the other asset portfolios ties or connects all the elements of Evoenergy's network systems and allow the safe, reliable, and efficient transportation of electricity from and to its customers. A more comprehensive breakdown of the asset classes and asset types/sub-types is provided in Section 4.

Table 1 offers a count of assets within this portfolio.

TABLE 1. POPULATION OF GROUND ASSETS – SUMMARY

ASSET GROUP	ASSET CLASS	QUANTITY	QUANTITY (UNIT)
Ground Distribution Equipment	Ground Mounted Transformers	3,891	Each
	Distribution Substation/Switching Station Sites	3,770	Lot
	Ring Main Units	3,958	Each
	Distribution HV Switchboard Assembly	604	Lot
	Distribution LV Switchboard Assembly	4,379	Lot
	LV Pillars	19,193	Each
	HV and LV Pits	3911	Each
	Point of Entry (PoE) Cubicles and Distribution Boxes	3,922	Each
Underground Cables	Transmission Cables	6.110	km
	HV Cables	1674	km
	LV Cables (mains)	1542	km
	LV Cables (service)	87,167	Each
Distribution Earthing	Distribution Pole Earth	14,645	Each
	Pole Transformer Earthing	1,385	Each
	Overhead Switchgear Earthing	1,691	Each
	Ground Substation Earthing	3,769	Each
	LV Pillars Earthing	15,295	Each
	Transmission Structure Earthing	1,126	Each/Lot

The assets within the asset portfolio have a functional relationship with the asset classes in Table 2. Further information can be found in their respective Asset Portfolio Strategy documents.

TABLE 2. ASSOCIATED ASSET CLASSES

ASSOCIATED ASSET CLASS	DESCRIPTION OF RELATIONSHIP
Protection Systems	Protection provides the "open" command for circuit breakers to break the circuit when fault conditions occur. Refer to the Secondary Systems Asset Portfolio Strategy for further details.

ASSOCIATED ASSET CLASS	DESCRIPTION OF RELATIONSHIP
Communication Systems	The underground optical fibre cables and pilot cables are installed/housed in the same civil infrastructure (trench, conduits, pits) as the underground cables to communicate the status and condition information and/or control commands. Refer to the Secondary Systems Asset Portfolio Strategy for further details.
Transmission line structure	Transmission structure earthing protects the assets and people and enables protection from fault conditions (insulation breakdown, earth leakage current). Refer to the Overhead Assets Portfolio Strategy for further details.
Overhead distribution equipment and automation	Overhead distribution network plays the same role as the underground network. Instead of being on-ground and underground, it has the electricity lines, transformers and other equipment mounted on support structures (poles). Refer to the Overhead Assets Portfolio Strategy for further details.
Zone substation switchgear and switchboard	The HV underground feeder cables originate from the transmission substation or zone substation switchgear/switchboard. Refer to the Zone Substation Assets Portfolio Strategy for further details.

3. ASSET PORTFOLIO OBJECTIVES

Evoenergy's Asset Management Objectives are documented in the Strategic Asset Management Plan (SAMP) as informed by the Asset Management Policy (P007) and business strategies and plans. This Asset Portfolio Strategy takes the Asset Management Objectives and details specific asset objectives and strategies for the Ground asset portfolio.

This document, therefore, provides alignment to the high-level organisational aspirations, with specific strategies and plans for the asset portfolio for asset replacement and augmentation, and details the maintenance requirements to meet the Asset Management Objectives. The alignment between organisational strategic directions and the day-to-day activities of managing assets is an important aspect of the Asset Management System.

Table 3 provides an overview of the ground asset objectives.

TABLE 3. GROUND ASSET OBJECTIVES

ASSET MANAGEMENT OBJECTIVES	GROUND ASSET OBJECTIVES
Operate and maintain our network safely	• Embed and integrate safety culture, strategies, and initiatives • In conjunction with the requirements of AS5577: ENSMS, the Formal Safety Assessments (FSAs) have identified electricity network hazards, especially pertaining to the Ground asset portfolio that could cause or contribute to an incident • Risk control measures and treatments appropriately identified and evaluated in accordance with methodologies • To operate and maintain the underground network assets coming under Ground assets responsibility to ensure safety of Evoenergy staff and third party staff as well as the general public.

Meet our network reliability targets	• As per NER clauses 4.2; s5.1; s5.1a, provide secure operating state and power system security:
	  ◦ Maintain system security operating within a satisfactory state following a credible contingency event
	  ◦ Operate within a technical envelope
	  ◦ Provide a suitable level of network redundancy, in accordance with submitted annual planning report.
	• As per NER clause 4.3.4 – Network service providers:
	  ◦ Maintain system asset data and ratings in the event that it is requested by AEMO (including expected maximum current flow, at any point).

ASSET MANAGEMENT OBJECTIVES	GROUND ASSET OBJECTIVES
Manage our network for the least total lifecycle cost	• Continue to implement Reliability Centred Maintenance (RCM) in order to maximise reliable service life of assets. This results in improved condition monitoring practices and life-extending refurbishment works. • Total life cycle cost includes procurement, installation, commissioning, operation, condition monitoring, planned and unplanned maintenance, replacement and disposal cost of an asset.
Manage and invest in our network using prudent risk management approaches	• Where the investment is capped, prioritise replacement of the network ground assets having the highest monetised risk
Deliver sustainable and cost-efficient network investments	• Actively planning for the net-zero carbon future • Adopt most cost-efficient replacement solutions when renewing ground assets. Contribute to the procurement process to ensure delivery of sustainable and cost-efficient network components.
Operate an AMS that satisfies the needs of our stakeholders	• Optimise and manage our network asset management strategy to achieve asset longevity, cost reductions, and to maintain network reliability service levels
Manage opportunities and drive continuous improvement	• Make use of opportunities to decommission or replace assets that pose high safety and/or reliability risks e.g., old HV switchgear types, Hazemeyer RMUs, asbestos-containing LV circuit breakers, Henley or Pregnant Column type LV pillars, and CONSAC LV cables

Evoenergy needs to assess its risk exposure, plan its investment to address those risks to as low as reasonably practicable (ALARP), meet market demand and the changing need of energy transformation, and ensure optimal functioning and performance of this asset portfolio to meet these obligations. The subsequent sections in this portfolio document systematically describe Evoenergy's approach pertaining to its Ground asset portfolio in addressing these requirements via its Asset Management System.

Evoenergy is presently facing several challenges within this asset portfolio, such as:

- About 55km of LV CONSAC cables in service scattered in the network that have a known safety issue of neutral disconnection.
- Certain makes and models of oil insulated switchgear that are high risk due to their condition, lower safety standards to which they have been built, and lack of maintainability and repairability as they are not supported by suppliers/manufacturers.
- Over one thousand (around 33% of the population) Hazemeyer 11kV RMUs in the network that are single phase operated posing a risk of ferro resonance.
- Partial discharge issues associated with HV cable terminations especially associated with Hazemeyer RMUs that lead to catastrophic failures.
- Safety risks associated with old LV pillar types such as Henley pillars and those housed in the base of street light columns (known as 'Pregnant Columns') (see 4.2.2.6 for description).
- Ageing population of underground cables (HV, LV and service cables)
- Old LV Boards in substations that contain exposed live busbars and other components that pose a safety risk including operational risk and also certain makes of circuit breakers that are containing asbestos arc chutes or in poor general condition.
- Lack of data on the population of earthing assets, and hence unknown status of compliance to the current standards.

Overarching key strategies for the Ground asset portfolio have been developed as described in the following sub-sections.

3.1. EARTHING STRATEGY

Evoenergy has recently adopted an inaugural Earthing Strategy (PO07141) that has identified a need to change the deterministic earthing risk decision processes and introduce new risk and value-based investment decision processes. These follow the ALARP principle in keeping with the risk tolerability triangle.

It provides a framework for managing earthing system related risks on the Evoenergy network to meet societally acceptable and tolerable levels and to align with our corporate and asset management risk policies, and regulatory obligations. This framework provides principles for the design, installation, monitoring, maintenance, and ongoing supervision of earthing systems associated with Evoenergy power system assets. Moreover, it proposes actions to address gaps identified with our existing systems and controls and clarifies roles and responsibilities to address them.

The following two objectives of this key driver align with the broader asset management objectives:

- Maintain earthing compliance through efficient investment. The key challenge is that at times projects stall due to over-specified earthing requirements. Evoenergy plans to use a risk-based decision-making process to determine requirements for assets meeting the ALARP principle.
- Proactively identify earthing risks. The key challenge is that the volume of tests on in-service earthing assets needs to be increased to identify emerging risks. Evoenergy plans to improve the routine testing program for earthing assets.

This key driver has introduced several new approaches to Evoenergy's Asset Management System through its interface with the various Asset Portfolio Strategies. The above two objectives will be captured and incorporated into the relevant Asset Portfolio Strategies.

The introduction of this risk-based approach will support asset managers in defining defect thresholds and justifying the need to perform asset interventions such as augmentations where in-service earthing is insufficient to meet performance needs.

Finally, the introduction of a new testing program affects the operations and maintenance stage of the lifecycle for earthing assets. It requires proactive monitoring of risk, and the definition of defect rectification processes where technical deficiencies are identified. Rectification of defects is an exercise having financial implications that will need to be forecast and incorporated into future regulatory submissions.

3.2. CONDITION ASSESSMENT STRATEGY

As Evoenergy's Asset Management System matures, its ability to measure, record, monitor, and rank its assets by smarter health indices at a more granular level especially for low-value but high-volume assets has increased. Condition-based assessments complement the age-based assessment (with age being the proxy for the condition in many cases) to provide more accurate information that enables a better asset management decision. This has allowed Evoenergy to optimise and prioritise its maintenance and asset renewal decisions.

Condition assessment allows for more accurate and precise investigation and intervention actions such as activities aimed at an individual asset level, instead of group or lot or batch or population level. This influences and permits targeted and efficient expenditure. It cuts cost by reducing unnecessary maintenance, identifying faults before they become failures, and enhancing strategic planning for repairs and replacement.

While such condition assessment is traditionally done for high value but low volume asset portfolios, now it is being expanded to the ground asset portfolio asset classes with low value but high volume. Accordingly, Evoenergy's Asset Management System is striving to capture the condition of the following asset classes within this asset portfolio:

- Ground distribution equipment
- Underground cables (e.g., lower value LV cables)
- Distribution earthing.

Advances in technologies such as partial discharge detection and remote monitoring devices have made undertaking asset condition assessment activities more efficient and the gathered information more reliable. It helps Evoenergy in undertaking predictive monitoring and to interrogate failures of ground assets by turning raw data into actionable insights.

4. ASSET CLASS STRATEGIES

4.1. SUMMARY OF CLASS STRATEGIES

This section describes how the major asset classes introduced in Section 2 are managed throughout their respective lifecycles.

The ground assets are part of Evoenergy's transmission and distribution network in the ACT and part of NSW. It consists of network assets installed at ground surface level and underground that supply power to end customers. Overhead assets except earthing are excluded as they are discussed in the Overhead Asset Portfolio Strategy.

Evoenergy's preferred asset management strategy for the Ground asset portfolio is to continue performing routine planned maintenance and to enhance condition monitoring programs where this has a beneficial outcome. For low-risk asset classes, such as underground low-voltage cables, reactive maintenance is performed as required. This balance of strategies continues to enable Evoenergy to operate at the lowest cost to consumers while ensuring the ongoing safe and reliable operation of the distribution network.

4.2. GROUND DISTRIBUTION EQUIPMENT STRATEGY

This asset class is a collection of all Evoenergy assets installed on ground or underground as part of the underground network. It consists of a diverse range of equipment with different functions, characteristics, criticality, asset lives, design requirements, and locations in the network.

4.2.1 Asset Class Summary and Objectives

This asset class consists of many asset types and sub-types and is comprised of equipment installed or located at ground surface which acts like nodes in reticulating the electricity travelling in the underground cable asset class and overhead asset portfolio. The function of this asset class is to transform voltage level to be used down at customer end points, provide switching, protection and circuit breaking, and reticulates electricity downstream. The various asset types for this asset class are described in the following sections.

The ground distribution equipment consists of the following asset types:

- Ground Mounted Transformers
- Distribution Substation/Switching Station Sites
- Ring Main Units
- Distribution High Voltage Switchboard Assemblies
- Distribution Low Voltage Switchboard Assemblies
- Low Voltage Pillars
- High Voltage and Low Voltage Pits
- Point of Entry Cubicles (POE) and Distribution Boxes.

4.2.2 Asset Types

4.2.2.0 Ground Mounted Transformers

Ground mounted transformers are used to step down the high voltages used on the distribution network (predominantly 11kV with a very small proportion of 22kV) to lower voltages (nominally 415V/230V), which are used by customers. They are located in distribution substations such as padmount substations, kiosk substations, stockade substations, and chamber substations. There is one transformer per padmount or kiosk substation, while a stockade or chamber substation typically has two or more transformers.

The capacity of ground mounted transformers in Evoenergy's distribution network ranges from 50kVA up to 6,000kVA. The most common capacities are 250, 315, 500, 750 and 1,000kVA, and are determined by the requirements of the connected loads.

The actual maximum rating of a transformer is determined by the value and duration of the temperature of the inter-winding insulation, which is a function of the transformer load, and other factors such as ambient temperature. Transformers have a high thermal inertia and have the capability to operate above their nameplate rating for some period while the core heats under load.

Ground mounted transformers interface with HV switchgear (RMU or HV switchboard), LV switchgear (circuit breaker, disconnectors, fuses, etc.), the substation earthing system, and the asset or site enclosure.

4.2.2.1 Distribution Substation/Switching Station Sites

This asset type houses the electrical components of the distribution substations. They include the buildings that house the chamber substations, the shells of the padmount and kiosk substations and fences of stockade substations. The doors, door locks, lights, fire extinguishers, signage and safety rails also fall under this asset type.

The integrity of the sites, enclosures, and locking is crucial as unauthorised access to live electrical equipment presents unacceptable safety risks. This asset type provides public safety, prevents unauthorised access to live electrical equipment, provides physical protection to the electrical equipment from exposure to the elements, and also provides safety to authorised personnel who are called upon to work on the assets housed within them.

Distribution substations allow for high voltages transmitted from the transmission network to be converted down into low voltages. Distribution substations will have various components such as switching, control, and protective equipment and transformers to step down the high voltage.

Switching station sites do not have transformers and therefore cannot convert high voltage to low voltage levels, they allow for multiple circuits to be connected through switches.

This asset type consists of the following sub-types and components:

- HV Switching Stations
- Chamber Substations
- Padmount Substations
- Kiosk Substations
- Stockade Substations
- Customer Switchrooms
- Locks.

These components are described in the following paragraphs.

a) HV Switching Stations

Except for the small number of chamber type switching stations, switching station enclosures are typically fibreglass. Switching stations are ground mounted systems used to provide switching for high voltage feeders and supply to high voltage customers.

b) Chamber Substations

Chamber substations are generally found enclosed within a room in a large commercial building, typically with a minimum of two doors for access and emergency escape. Within chamber substations, the provision of lighting, safety signage, and fire extinguishers improves the overall safety of the working environment for authorised personnel. Typically located in areas where there is a high load consumption, these sites include hospitals and apartment complexes. Some chamber substations within Evoenergy's distribution network have monitoring and/or controlling capabilities through the use of the Supervisory Control and Data Acquisition (SCADA) network. All new chamber substations newly installed or upgraded will have SCADA capability.

c) Padmount Substations

All padmount substations on the distribution network have metal or fibreglass enclosures. Padmount substations consist of one ground mounted transformer, HV switchgear, and LV switchgear, usually as one integrated unit. They step down high voltage on the distribution network to low voltage supplied to customers, and supply electricity to both residential and commercial loads.

Padmount substations which have a transformer rating of greater than 1,000kVA will have numerical protection and control devices. Transformers used in padmount substations which have a lower rating use fuses as protection.

d) Kiosk Substations

Kiosk substation enclosures are normally composed of steel (a small quantity are fibreglass) and are a ground mounted substation, comprising of various electrical components such as a transformer and HV switchgear and an LV switchboard. Unlike in the case of padmount substations, kiosk substations have these components detached and therefore they can usually be replaced separately. Kiosk substations are often used in Underground Residential Developments (URDs) to supply electricity to lots for new subdivisions, stepping down the high voltage from the distribution network and providing low voltage to customers. Kiosk substations will therefore have high voltage and low voltage cables running to and from the substation.

e) Stockade Substations

Stockade substations are outdoor substations enclosed by fences with their components detached from each other. Stockade substations operate similarly to padmount and chamber substations, stepping the high voltage from the distribution network to lower voltage levels to supply to customers. There are very few of them (less than 10) that exist in the Evoenergy network.

f) Customer Switchrooms

Customer switchrooms are enclosed areas comprising of various electrical equipment to provide control and protection of the various high voltage and low voltage circuits on the network.

g) Locks

Locks provide the essential dual function of ensuring electrical assets and equipment are not disturbed by unauthorised personnel and also preventing unauthorised access to live components thus ensuring personnel safety. Locks ensure only accredited and authorised personnel can access such assets. That reduces the risk of injuries or fatalities to people, asset damages, and/or outages to the customers.

4.2.2.2 Ring Main Units

An RMU is a cabinet which consists of a range of integrated electrical switchgear connected to a common busbar, and is a typical configuration used on the medium voltage distribution network. It usually consists of one incoming feeder and more than one outgoing feeders. Depending on the network reticulation requirement, this configuration can be expanded to include more incoming and outgoing feeders including to a transformer (in a substation).

This asset type is commonly employed in ring main distribution schemes due to their compact size and modular installation advantage. Depending on the trade-off between space constraints and lifecycle benefits and costs (that takes into account the operational switching requirements, CAPEX and OPEX), RMUs are an alternative for most of the panel type distribution HV switchboards.

RMUs within Evoenergy's network are generally categorised into either Hazemeyer or non-Hazemeyer sub-types considering the major differences in their construction and operation and maintenance requirement

a) Hazemeyer RMUs

Approximately one third of Evoenergy's population of RMUs is of this specific manufacturer/brand. They are relatively compact in size and use Air Insulated Switchgear (AIS) for arc quenching. They are on a routine partial discharge testing program that is on a three-year cycle, and a routine maintenance on an 8 yearly cycle. They are also known as Holec or Magnifix.

b) Non-Hazemeyer RMUs

This is the remainder of all RMUs in Evoenergy network, and consists of various other manufacturers/brands like Lucy, ABB, Schneider, GEC, F&G, EFECE, etc. Presently the non-Hazemeyer RMUs do not have a routine maintenance program and all the maintenance works performed on them during their lifetime are condition monitoring of their HV cable terminations and reactive or corrective maintenance activities. High level inspections are carried out as part of pre-operational checks. That includes visual inspection for oil leaks or SF6 gas pressure.

Both sub-types of RMU are included and visually inspected in the 5-yearly substation inspection program. Additionally, if the RMUs are located within the chamber substation sites they are cleaned during the site cleaning cycle.

4.2.2.3 Distribution High Voltage Switchboard Assemblies

This asset type enables the connection, isolation, earthing and protection of high voltage distributors and transformers in distribution chamber substations and indoor switching stations. The distribution HV switchboard assembly consists of panel type enclosures housing busbars, metering and protection equipment, isolators, and HV circuit breakers.

Most HV switchboards are of single busbar configuration while some large substations have switchboards with a double busbar configuration. Double busbar switchboards have two main busbars usually connected through a bus coupler circuit breaker. The incoming and outgoing circuits can be connected to either busbar for flexible network operating configurations.

Distribution HV switchboard assemblies play an important role within the chamber substations on the distribution network, providing for switching on the network and electrical protection of assets contained in the substation. They allow switching, isolation, and earthing for personnel to safely access the network for operation, condition monitoring, maintenance, and other works. The distribution HV switchboard assembly also provides connection to key components on the distribution network, such as distribution feeders and transformers. It is usually comprised of several HV switchboard panels.

a) Distribution High Voltage Switchboard Panels

Distribution HV switchboard panels are enclosures which house components including busbars, circuit breakers, links, earth switches, metering equipment, and protection equipment. The enclosure provides structural support and operational integrity from environmental influences such as mechanical impacts, dust, and moisture. The HV switchboard panels also provide isolation for human contact against live equipment, thus protecting against electrical shock.

Distribution HV switchboard panels are modular units that when assembled together form a switchboard assembly. They provide connection, isolation, earthing, metering, and protection functionalities to distribution feeders, allowing electricity to be safely transmitted to customers. The key components that form the distribution HV switchboards include:

- HV Busbar – The HV busbars allow for the power from the incoming cables to be transmitted through the HV switchboard to outgoing circuits and the transformers.
- Metering and Protection equipment – These may comprise of energy meters, ammeters, volt meters, protection relays, and HV instrument transformers, namely the Current Transformers (CTs) and Voltage Transformers (VTs).
- Distribution HV Circuit Breakers – HV circuit breakers act as switching devices to provide protection to equipment, people, and the network. Unlike fuses, circuit breakers do not need to be replaced each time they operate. They can be reset, inspected if required, and returned to service once operated. Circuit breakers switch by the opening and closing of moving contacts, receiving control commands (e.g., from protection relays to clear faults on the network). HV circuit breakers provide

protection to the HV distribution network and reduce the impact of damage to equipment and people downstream.

4.2.2.4 Distribution Low Voltage Switchboard Assemblies

Distribution LV switchboard assemblies divide the supply from the LV side of distribution transformers into separate circuits in the LV distribution network and provide some level of protection. They also provide switching and isolation to allow safe access to maintain the network. The distribution LV switchboard assembly consists of enclosures housing busbars, circuit breakers, fuses, and links. They are comprised of the following two electrical and mechanical components:

- Distribution LV switchboards
- Distribution LV circuit breakers.

a) Distribution LV Switchboards

Distribution LV switchboards are enclosed or open systems, which consist of important components such as busbars, circuit breakers, fuses and links to provide protection and switching capabilities. It has the same function as HV switchboards but at low voltage and provides protection to people by preventing electrical shock, injuries or fatalities.

Padmount and kiosk substations will consist of one LV switchboard per substation, while chamber and stockade substations will have up to four LV switchboards per substation. These LV switchboards provide protection to various circuits by having fuses or circuit breakers on them. LV boards in a chamber or stockade sub are usually interconnected through bus couplers.

b) Distribution LV Circuit Breakers

Distribution LV circuit breakers behave in the same way as HV circuit breakers as discussed in the previous section, and it consists of two sub-categories:

- Moulded Case Circuit Breaker (MCCB) – Moulded case circuit breakers have a built-in protection device and have a smaller rating compared to standard circuit breakers.
- Circuit Breaker (CB) – Circuit breakers have greater built-in configurable protection.

4.2.2.5 Low Voltage Pillars

LV pillars are designed to house incoming underground cable terminations and terminations for outgoing service cables to customers' points of entry. As such, LV pillars interface with underground LV cables and underground service cables. LV pillars are equipment within the underground distribution network.

Historically LV pillars were extensively used in underground reticulated areas till about 2015. With Evoenergy’s introduction of underground LV pits in new developments (greenfield sites), the use of pillars decreased.

LV pillars are located on the road reserve or footpath and serve as a connection point for the underground network from where the electricity at low voltage is safely delivered to the customers. LV pillars allow for switching and reticulation of mains-level power to the customers’ premises at their POE. LV pillars also accommodate incoming and outgoing underground LV mains cable terminations. There are various LV pillars used within Evoenergy’s LV distribution network, including:

- Mini Pillars
- Link Pillars
- Pregnant Columns
- Henley Pillars (named after the brand)
- Micro Pillars.

These components are described below.

a) Mini Pillars

Mini pillars are generally located on road reserves and are typically grey-green or cream coloured fibreglass, plastic, or steel cabinets. Mini pillars are 1-1.5 metres high and are the final stage before electricity is delivered to the customers property. They can accommodate two LV mains cables and up to six three phase customer service cables.

b) Link Pillars

Link pillars allow for cable terminations and provide isolation and switching on the LV network. Generally, link pillars consist of two or three LV mains cables and three or five customer service cables. Some old link pillars on the network can accommodate up to six three phase service cables as well. A new configurable type pillar that is being rolled out provides a replacement solution to such pillars.

c) Pregnant Columns

A pregnant column LV pillar is an electrical panel contained and enclosed within a metallic street light column at its base. It allows for termination of underground mains and service cables, by serving as an interface. The bottom of such street light columns have been made larger to accommodate the electrical panel and thereby giving it its name.

They are known for issues with deteriorated insulation and cable arrangements not compliant to current safety standards. There are also operational issues as the street light column is owned and operated by the TCCS (Transport Canberra and City Services) and the pillar belongs to Evoenergy.

d) Henley Pillars

Henley pillars are a particular brand of metal cabinet type LV pillar used in urban areas to accommodate larger size customer service cables. They usually have several LV mains cables and service cables connected to them. Therefore, the internals are usually congested and have small clearances. Given their age, they often have deteriorated insulation and pose a safety risk.

e) Micro Pillars

Micro pillars typically supply one or two customer service cables only. Applications of micro pillars include supplying bus shelters, traffic lights, and the NBN.

4.2.2.6 High Voltage and Low Voltage Pits

Pits play an important role in allowing for underground cables to distribute electricity to customers along its circuit route. Generally, LV pits are seen on footpaths, or in front of the customer’s property, where often one pit is used to deliver electricity to two households. Pit size is determined by the underground cables contained or passing through it to allow for the bending radius, and also for authorised personnel to access the pit to install and perform maintenance on the underground cables. An improved LV pit with fully submersible internal components was introduced recently as an improvement to the previous design which depended solely on an airtight bell arrangement to keep the internal live components from water ingress.

LV pits are currently being installed in greenfield areas and new suburbs, instead of pillars which were ceased in 2015 and are only used for replacement works currently. There are some HV pits also in service in the Evoenergy network.

4.2.2.7 Point of Entry (POE) and Distribution Boxes

Point of Entry cubicles and distribution boxes are often situated near the loads such as customer premises, traffic lights, streetlights etc. These enclosures are properly sealed to prevent the ingress of surrounding environmental elements and can be accessed by authorised personnel and owners to perform inspection or maintenance activities, including taking electrical measurements.

a) Point of Entry Cubicles

Point of entry cubicles are often installed either free-standing or attached to a customer’s building. All point of entry cubicles on the network including conduits must be appropriately sealed from the ingress of moisture and vermin. Point of entry cubicles require a pre-drilled base plate, in addition to having Polyvinyl Chloride (PVC) insulated cable dividers.

b) Distribution Boxes

Distribution boxes are often mounted on road reserves to control the electricity supply to properties and other LV applications within the area. It is an enclosed box containing electrical equipment such as an ammeter, switches, surge protectors, and fuses. Distribution boxes can be used for a variety of different applications such as providing LV power to streetlights, traffic lights, and speed cameras.

4.2.3 Current Population, Age, and Health Profile

Table 4 summarises the design life, count, average age, and health status of different types and sub-types/components of ground distribution equipment within the Evoenergy network. This provides a high-level view of the population's profile, performance, and potential concerns as highlighted in the Health Category column.

TABLE 4. ASSET POPULATION, AGE, AND HEALTH PROFILES – GROUND DISTRIBUTION EQUIPMENT

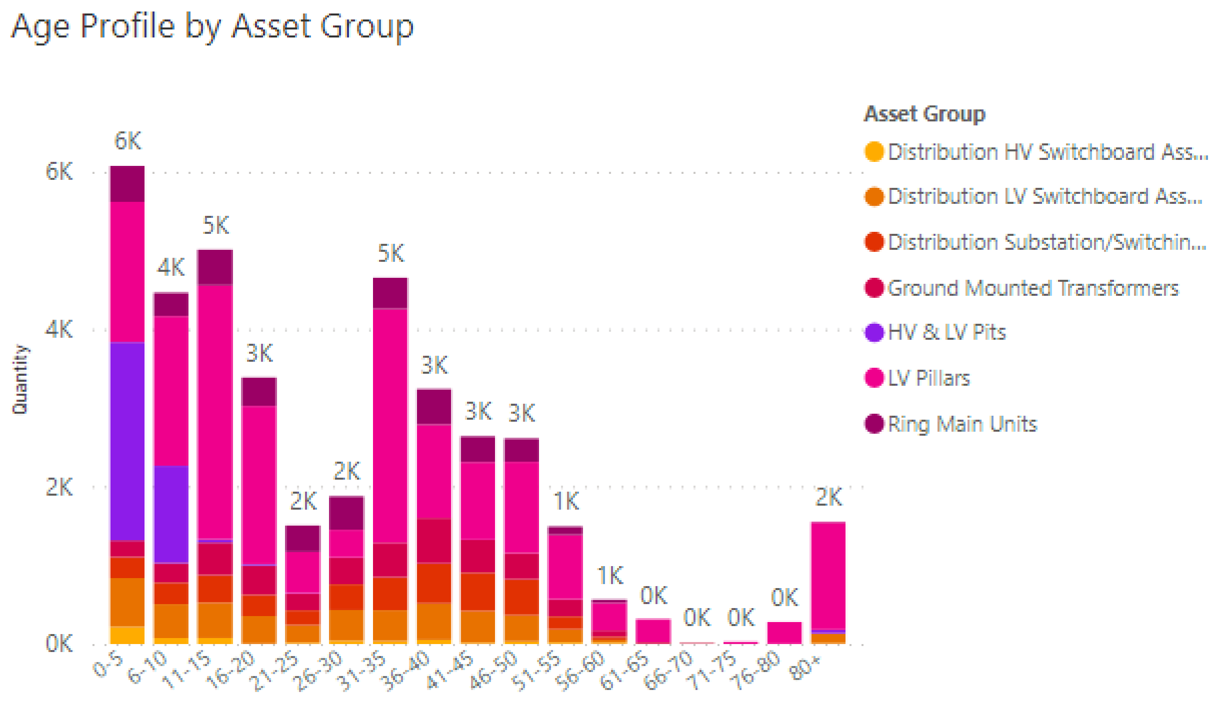
Design Life (yrs), Average Age, Quantity, Critical Health Qty, Unit, Average Health Score, Health Category

BY ASSET SPECIFIC PLAN, ASSET TYPE

Asset Specific Plan	Quantity	Unit	Design Life (yrs)	Average Age	Critical Health Qty	Average Health Score	Health Category
Ground Distribution Equipment	39,682	each	39	28	6,672	73.39	Fair
LV Pit	3,767	each	30	5	1	99.97	Very Good
Micro Pillar	978	each	40	9	43	94.57	Very Good
GroundTransformer	3,890	each	50	30	11	90.56	Very Good
Distribution HV Circuit Breaker	593	each	35	19	25	89.43	Good
Padmount Substation	2,541	each	50	29	15	85.70	Good
Ring Main Unit (Non-Hazemeyer)	2,882	each	25	22	152	84.82	Good
Distribution HV Switchboard	20	each	40	29	2	81.10	Good
Ring Main Unit (Hazemeyer)	1,074	each	25	36	17	79.08	Good
Kiosk Substation	363	each	50	38	17	77.04	Good
Distribution LV Circuit Breaker	1,197	each	25	30	221	74.99	Good
Chamber Substation	503	each	50	28	58	74.47	Good
Distribution LV Switchboard	3,194	each	40	27	393	73.70	Good
Link Pillar	3,454	each	40	26	777	65.08	Good
Mini Pillar	10,488	each	40	28	2,488	62.96	Good
Stockade Substation	6	each	50	36	1	61.17	Good
HV Switching Station	356	each	50	35	73	56.99	Fair
Point of Entry Cubicle	3,547	each	40	53	1,655	51.70	Fair
HV Pit	89	each	30	71	46	46.18	Fair
Distribution Box	396	each	40	71	334	13.27	Very Poor
Pregnant Column	344	each	40	49	343	0.28	Very Poor

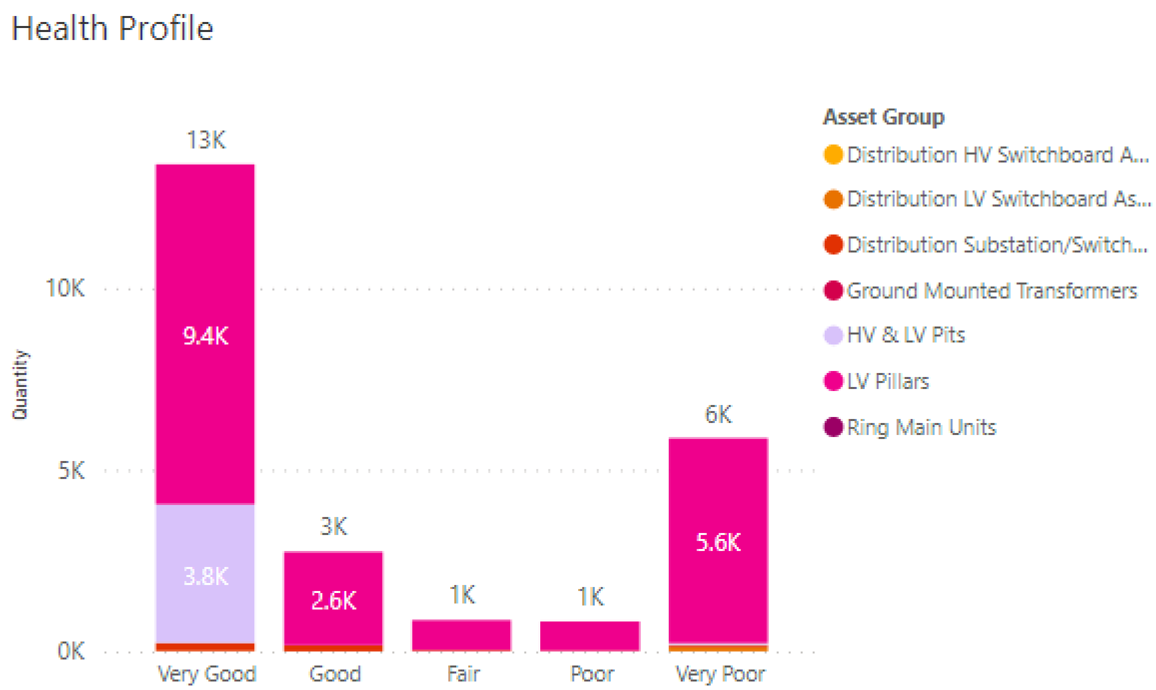
The age profile of existing assets is reflected in Figure 6.

FIGURE 6. ASSET AGE PROFILE CHART (AS AT JULY 2022) – GROUND DISTRIBUTION EQUIPMENT



The asset class health profile is summarised in Figure 7.

FIGURE 7. ASSET HEALTH PROFILE CHART (AS AT JULY 2022) – GROUND DISTRIBUTION EQUIPMENT



The useful life of the ground distribution equipment asset class is largely dependent on the operation (circuit breaking) cycle, overloading instances and duration, and the degree of exposure to and the condition of the local environment that this equipment is installed in.

4.2.3.0 Ground Mounted Transformers

The ground mounted transformers are visually inspected in five-yearly cycles and their current condition is assessed. In addition to the established visual inspection program, issues such as oil leaks are detected at times of visits to substations for other works. Any defects identified are rectified through Evoenergy's defect management process. In addition to the established visual inspection program, issues such as oil leaks are detected at times of visits to substations for other works.

4.2.3.1 Distribution Substation/Switching Station Sites

The distribution substation/switching station sites are visually inspected in five-yearly cycles and their current condition is assessed. Any defects identified are rectified through Evoenergy's defect management process.
Ring Main Units

The RMUs are visually inspected as part of the five-yearly substation inspection and their condition is assessed. Also, the HV cable terminations associated with Hazemeyer RMUs are inspected and tested for partial discharge on a three-yearly cycle. Any defects identified are rectified through Evoenergy's defect management process. Given the age of some of them, it is deemed prudent to test the oil in the oil-filled RMUs such as Lucy after being in service for 20-25 years. Flow-on effects would be oil replacement. Certain other makes and models of RMU have been identified as safety risks considering their condition and the fact that they cannot be maintained due to lack of supplier/manufacturer support for such discontinued old products. No replacement parts are available for them either. Hence, they need to be gradually removed from the network through replacement. Therefore, other than the established inspection program, additional work is deemed necessary over the 2024-29 period to manage their performance.

4.2.3.2 Distribution High Voltage Switchboard Assemblies

The distribution HV switchboard assembly and its constituting components are visually inspected, and the HV circuit breakers are inspected and tested, in five-yearly cycles, and their current condition is assessed. In addition, certain makes and models of circuit breakers have been identified as safety risks considering their condition and the fact that they cannot be maintained due to lack of supplier/manufacturer support for such discontinued old products. No replacement parts are available for them either. Hence, they need to be gradually removed from the network through replacement.

However, as the rest of the components in such switchboards are also close to their end of useful asset life, it is more prudent from an asset management perspective to replace the entire switchboard rather than retrofitting the circuit breakers. Therefore, other than the established inspection program, targeted replacement work is deemed necessary over the 2024-29 period to manage their performance.

4.2.3.3 Distribution Low Voltage Switchboard Assemblies

The distribution LV switchboard assembly and its constituting components are visually inspected and the HV circuit breakers are inspected and tested in five-yearly cycles, and their current condition is assessed. There were some LV boards that contained Capstan Links which posed a high safety risk due to exposed live components and the possibility of phase to phase short circuiting while operating. Such boards have been prioritised for replacement over the years and they will be eliminated from the Evoenergy network in the coming few years. There are other old LV boards that contain exposed live busbars and components. Also, certain makes and models of LV circuit breakers contained within LV boards pose safety and operational risks due to asbestos arc chutes, and/or frequent operational issues due to reaching end of life. Therefore, other than the established inspection program, targeted replacement work is deemed necessary over the 2024-29 period to manage their performance.

4.2.3.4 Low Voltage Pillars

There is no routine inspection or maintenance programme for the LV pillars. Currently the planned replacements are age-based. Unplanned maintenance and replacements are mainly either defect driven or due to third-party damage. Henley pillars and the Pregnant Columns have been identified as posing a high safety risk due to insulation deterioration and congestion of cables with limited clearance. Pregnant Columns are usually associated with CONSAC type LV cables which also have been identified for replacement due to neutral disconnection issues associated with their construction. Currently their replacement is opportunistic.

However, it is deemed a planned replacement programme is required in the 2024-29 period in alignment with the Consac cable replacement mentioned in 4.3.3.3.

4.2.3.5 High Voltage and Low Voltage Pits

The LV pits in Evoenergy's network are relatively new assets. There is no routine inspection or maintenance programme currently in place or deemed necessary. Their maintenance and replacements are driven by defects or third-party damage. When they are replaced, usually the box that is buried in the ground does not require replacement. Evoenergy is now purchasing a newer version of the pit that is slightly different in size, and the internal components are fully submersible in water.

There are 89 HV pits in Evoenergy's network but they are not related to any operational work.

4.2.3.6 Point of Entry Cubicles (PoE) and Distribution Boxes

There is no routine inspection or maintenance programme in place or deemed necessary for the POEs. The POE enclosures belong to the customers and any repair or replacement is the customer's responsibility. Any defects reported on the POE enclosures are informed to their owners to carry out the repairs or replacements in coordination with Evoenergy. The internal components belong to Evoenergy.

4.2.4 Risks and Opportunities

Unlike the other two asset classes in this portfolio, the ground distribution equipment are installed on the ground surface with many of its asset types accessible to members of the public and are exposed to the open environment. This presents the risk of unauthorised access to the inner energised components of the assets, vandalism, and accidental damages (e.g., hit by vehicles) resulting in safety incidents (electric shock, electrocution), reliability incidents (loss of load, inadvertent switching), and/or asset damage incidents. The risk of natural hazards such as bushfires, thunderstorms, and flooding are also applicable for many types of ground distribution equipment, resulting in similar risk incidents.

The ground distribution equipment asset types identified as needing capital projects to mitigate the risks due to the poor condition and performance, and due to heightened risk because of their location as described above, can be rationalised. This opportunity to rationalise such capital projects will be on a risk basis by considering the asset type/sub-type, its criticality in the network and to the load, and safety exposure.

4.2.5 Planned Projects, Replacements and Retirements

During the current regulatory period Evoenergy has delivered and commissioned a number of ground distribution equipment replacement and augmentation projects. Most of these capital works were undertaken as part of on-going programs of work targeting certain makes and models of asset classes on Evoenergy's network. Customer-initiated projects and Evoenergy's network planning function will determine the augmentation of this asset class during the upcoming 2024-29 regulatory period. Please refer to the Annual Planning Reports to identify the timeline, asset types and the volume of such network augmentation projects.

During the upcoming 2024-29 regulatory period Evoenergy plans to replace some of the existing assets from this asset class population by delivering the following projects:

- Replacement program of padmount and kiosk type distribution substations
- Replacement program of distribution HV and LV switchboard assemblies in chamber substations
- Replacement program of the Henley and Pregnant Column type LV pillars
- Replacement program of HV and LV circuit breakers (this will be associated with the HV and LV board replacement program).

Customer-initiated projects, defects, asset failures, and the need for network augmentation or re-configuration as identified by Evoenergy's network planning function will also determine the decommissioning or retirement of this asset class during the upcoming 2024-29 regulatory period. Please refer to the Annual Planning Report to identify the timeline, asset types, and the volume of such asset retirement and network re-configuration projects.

Evoenergy's Network Reliability Strategy guides investment in the ground assets portfolio. In addition to good practice asset management outlined in this strategy, reliability risk management is achieved by increasing network responsiveness in the restoration of unplanned outages through remote control switching and automation. The 2024-29 regulatory period has a budget for the installation of remote-controlled switchgear (including asset replacement) in switching stations and distribution substations.The ACT government has mandated a net zero carbon emission target for the ACT by 2045. This target is expected to increase the demand on the electrical network. The increase of electrical demand will be experienced across the existing network and will result in upgrades in parts of the network. The next regulatory period has included an allowance for padmount substation upgrades to cater for the network capacity uplift.

4.2.6 Asset Management Strategy

The preferred asset management strategy for this asset class in general is to continue with the current strategy, i.e., condition monitoring, routine planned and defect-driven maintenance, and risk-based and defect-driven replacement. This is achieved through periodic inspection, assessing asset age, fault history, reliability performance, and safety incidents to determine and identify deteriorating asset conditions. This is applicable for relatively higher value and more critical asset types such as pad and kiosk substations, ground mounted transformers, and HV and LV switchboards. The expenditure strategy for lower value and less critical asset types is to run to end of life, and reactive or planned replacement depending on the criticality of the asset to the network. There are some asset replacements that are warranted by safety issues (e.g., operating mechanism replacement of a certain make of RMUs, nylon bolt replacement on LV boards, solid transformer link replacement with fused links, etc.)

4.3. UNDERGROUND CABLES STRATEGY

This asset class consists of all Evoenergy assets buried underground such as varieties of cables, joints and their on-ground terminations, operating at different voltage levels (132kV to low voltage) and with different construction/build methods.

4.3.1 Asset Class Summary and Objectives

Underground cables are insulated conductors and typically installed underground to transmit electricity. All new sub-divisions in the ACT utilise an underground distribution network. The underground cable asset class is managed and categorised mainly by the voltage level and their use and then by insulation type and the type of cable construction.

The underground cable asset class consists of the following asset types:

- Transmission cables
- HV cables
- LV mains cables
- LV service cables.

4.3.2 Asset Types

4.3.2.0 Transmission Cables

All Evoenergy's transmission cables are copper cables with Cross-linked Polyethylene (XLPE) insulation, 3 phase, (one core/phase) with each core housed in a separate conduit underground.

Evoenergy's transmission network is mostly overhead, with a very limited amount of it underground. Evoenergy operates just over 6 km of 132kV underground transmission cables into East Lake zone substation and between Causeway substation and Telopea Park Zone substation.

There could be opportunities and requirements in the future to underground some of the 132kV and 66kV overhead lines and decommission the overhead transmission assets . The initial costs associated with an underground transmission network are much higher compared to that of an overhead network. There are benefits of using an underground transmission network, such as faults being less likely to occur and resilience for weather events such as bushfires, storms, and lightning strikes.

4.3.2.1 Underground High Voltage Cables

Evoenergy's HV cables are a mix of copper or aluminium cables with various construction and insulation types, either three-core (for 3 phase) or single core (for each phase) and either in conduit or direct buried underground.

Underground HV cables in Evoenergy's network transmit electricity between two termination points at voltages of 11kV or 22kV. The underground HV cable assets include the following components:

- HV Cables
- Underground Joints
- Cable Terminations
- High Voltage Feeders.

These components are described in the following sections.

a) High Voltage Cables

HV cables are generally of three-core construction and the conductor material is either stranded aluminium or copper. The HV cables usually consist of the following two types:

- Paper Insulated Lead Covered (PILC) cables – Evoenergy's older network consist of 11kV cables that are mostly PILC cables. PILC cables are insulated by paper, using a metallic sheath to cover the paper insulation. These cables have a steel wire or tape to protect the layers of bitumen compounded hessian tape, to provide mechanical protection.
- Polymeric (XLPE or PVC) insulated cables – Evoenergy's new network has followed the industry practice by using XLPE insulated cables. The cables' metallic sheath is composed of either aluminium sheath, lead sheath, or copper screen wires. The protection used for the metallic sheath consists of PVC and High-Density Polyethylene (HDPE).

b) Underground Joints

Underground joints connect two different cable sections together. Due to handling capability constraints, cables usually come in drums of 500 m or less. Therefore, longer distances require cable joints to maintain continuity. Cable fault repairs also require joints. Also, connection to new substations and switching stations may require joints to be made to existing cables.

Underground joints will consist of ferrules to connect the conductors from the two cable sections, insulation to restore the insulation for the exposed conductor and connecting ferrules, electrical stress control tubing, and mechanical and environmental protection. A well-constructed joint should maintain the electrical performance of the cable and last till the end of life of the cable. High quality workmanship is of paramount importance for an effective and long-lasting joint.

c) Cable Terminations

Cable terminations provide insulation and electrical and mechanical protection to the point of connection of the cable end to other electrical equipment, including switchgear, overhead lines, and transformers to which the cable is connected. The following types of cable terminations exist in the Evoenergy network:

- Taped and porcelain/cast iron – Taped and porcelain/cast iron cable terminations were used in the past. They consisted of PILC cables which had a paper taped stress cone with either porcelain or cast iron as its insulator. Safety issues prompted Evoenergy to replace all cast iron HV cable terminations installed on overhead poles and most of them in ground substations, with heat shrink cable terminations.
- Heat shrink applied with a blow torch – Heat shrink type cable terminations are used in new HV and LV outdoor cable terminations, as they provide good stress control on the cables and provide mechanical and environmental protection.
- Elbow separable connector, cold shrink and cold applied – Elbow separable connector, cold shrink and cold applied cable terminations are being used in installations since the 1990s, serving to connect cables to equipment such as transformers and switchgear.

d) High Voltage Feeders

Evoenergy's zone substations supply HV distribution feeders of 11kV and 22kV, providing electricity to over 200,000 customers. The HV underground feeders are usually a mixture of underground network portions and overhead network portions. The total cable circuit lengths of each of these underground feeders can go up to 20 km.

4.3.2.2 Underground Low Voltage Cables

Evoenergy's LV cables are a mix of aluminium and copper cables with various construction and insulation types, four-core, two-core or single core. They are either in conduit or directly buried underground.

The underground LV cables are used to transmit electricity from the step-down distribution transformers to the customer's premises. Underground LV cables can be classified into the following two categories:

- Low voltage mains cables
- Service cables.

a) Low Voltage Mains Cables

LV mains cables supply electricity at 415V/230V level from ground substations to LV pillars or LV pits on the street.

b) Service Cables

Underground service cables are used to supply either single or three phase electricity to customers, linking the power from the distribution network pillars or pits on the street to the customer's connection point commonly known as the POE.

4.3.3 Current Population, Age, and Health Profile

Table 5 summarises the design life, count, average age, and health status of different types and sub-types/components of underground cables within the Evoenergy network. This provides a high-level view of the population's profile, performance, and potential concerns as highlighted in the Health Category column.

TABLE 5. ASSET POPULATION, AGE, AND HEALTH PROFILE – UNDERGROUND CABLES (QUANTITY IN METRES)

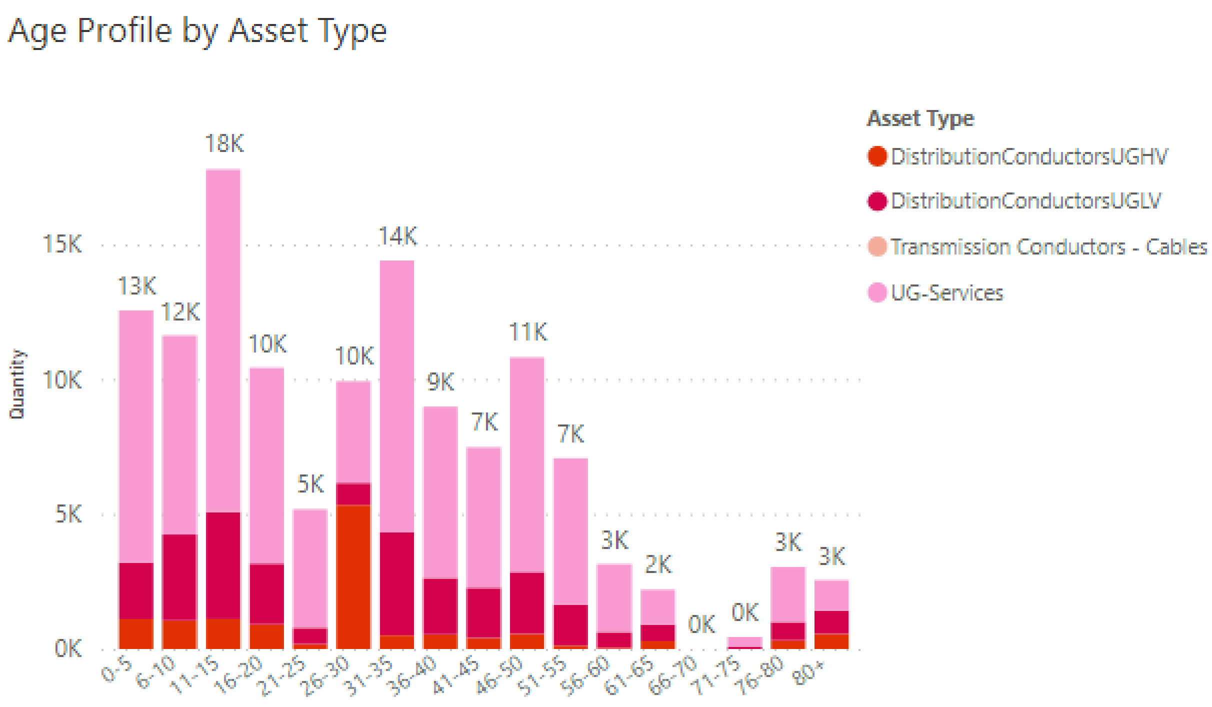
Design Life (yrs), Average Age, Quantity, Critical Health Qty, Unit, Average Health Score, Health Category

BY ASSET SPECIFIC PLAN, ASSET TYPE

Asset Specific Plan	Quantity	Unit	Design Life (yrs)	Average Age	Critical Health Qty	Average Health Score	Health Category
Underground Cables	90,367	each	80	30	5,953	92.41	Good
Transmission Conductors - Cables	6	each	80	17	0	100.00	Very Good
UG-Services	87,140	each		29	2,547	94.47	Very Good
DistributionConductorsUGHV	1,678	km		30	1,179	89.31	Good
DistributionConductorsUGLV	1,543	km		31	2,227	87.35	Good

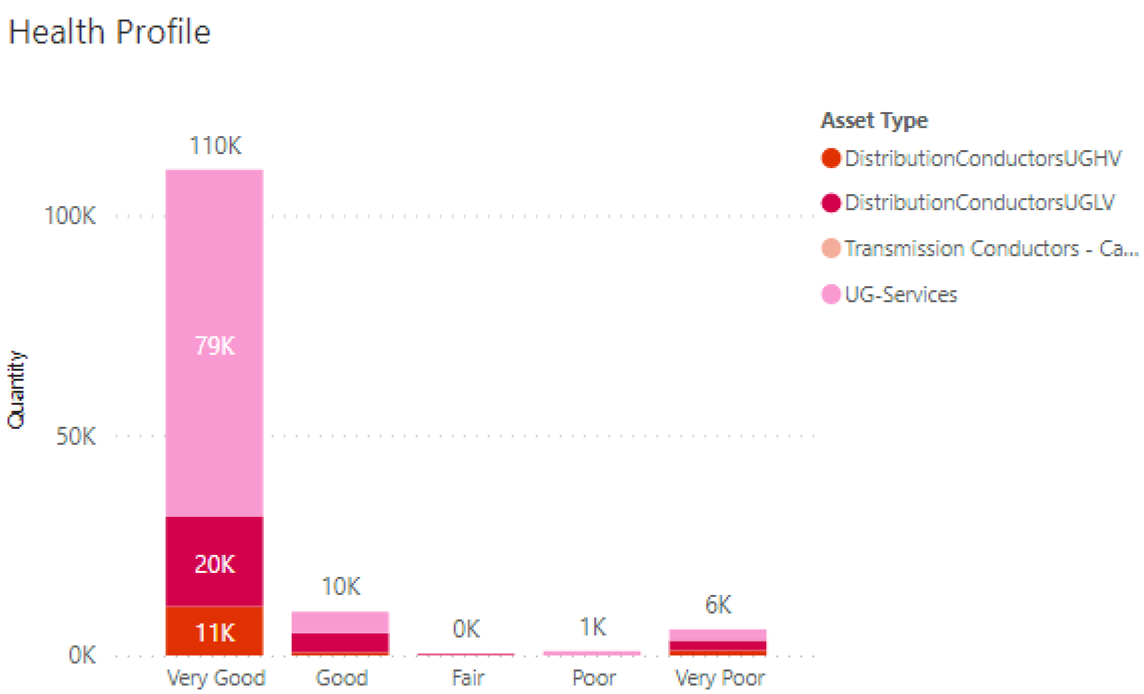
The age profile of existing assets is reflected in Figure 8.

FIGURE 8. ASSET AGE PROFILE CHART (AS AT JULY 2022) – UNDERGROUND CABLES



The asset class health profile is summarised in Figure 9.

FIGURE 9. ASSET HEALTH PROFILE (AS AT JULY 2022) – UNDERGROUND CABLES (BY COUNT OF CABLE SECTIONS)



The underground cable assets use a combination of desktop analysis and periodically performed online partial discharge testing on HV cable terminations to monitor and determine their health. The online (while energised) partial discharge testing of the HV underground cables, whilst it was performed historically, did not provide accurate failure predictors, and was considered ineffective. Hence this testing program was discontinued and presently there is no routine testing programme for the cables.

The linear nature of these assets allow for corrective maintenance works by way of removal of a failed portion of the cable and installation of a new piece of cable with two joints. The bulk of these assets tend to outperform their design life by large margins. The replacement decision is usually based on the deterioration of their operational reliability to an extent where the operational cost and the risk of unserved energy or loss of load is deemed unacceptable. Except for third-party damage, most of the in-service failures are instigated by cable joint failures or cable termination failures.

4.3.3.0 Transmission Cables

Transmission cables are presently not routinely inspected. Evoenergy's operational experience with this asset type during the current regulatory period does not indicate any concern regarding its condition and performance and as such no planned work is envisaged during the 2024-29 period. Any work performed on transmission cables will be unplanned and reactive.

4.3.3.1 Underground HV Cables

HV underground cables and joints are not routinely condition monitored. The cable terminations at substations are however visually inspected in a 5-yearly cycle during the substation inspection program. The HV cable terminations associated with the Hazemeyer RMUs are also tested for partial discharge every three years. Desktop assessments are carried out to determine the condition of this asset type. Any repair work performed on underground HV cables currently are unplanned and reactive.

It is deemed that the population of the oldest cables of both types PILC and XLPE are reaching their end of life and will require replacement. Evoenergy proposes to replace a certain portion of the aged cables every year in a planned manner to avoid the requirement of a bow wave type replacement requirement in the future. Cable placements need a substantial amount of planning and design work as well as resourcing.

4.3.3.2 Underground LV Cables

Neither service cables nor LV mains cables within the underground LV cable asset type are routinely inspected. Evoenergy's operational experience with this asset type during the current regulatory period does not indicate any immediate major concerns regarding their condition and performance. Any work performed on underground LV cables currently are unplanned and reactive.

Evoenergy foresees continuation of replacing its CONSAC cable population in the 2024-29 period. This is a long term and ongoing replacement program which has been delayed/paused during the 2019-24 period.

It is deemed that the population of the oldest cables of both types PILC and XLPE are reaching their end of life and will require replacement. Evoenergy proposes to replace a certain portion of the aged cables every year in a planned manner to avoid the requirement of a bow wave type replacement requirement in the future. Cable placements need a substantial amount of planning and design work as well as resourcing.

4.3.4 Risks and Opportunities

The key risk for this asset class is the changes to soil characteristics that they are installed in as it impacts the thermal rating and performance of the underground cable asset class. Having the cable continuously operate above its thermal rating limit can decrease the cable's life expectancy.

A driver for rationalisation, other than the operational lifespan of the asset, is the financial performance against other options, which could be explored in a business case. If the operational costs and risks (of loss of load, unserved energy, and impact on network reliability) outweigh the asset capabilities and functions, compared against more efficient options, this would be an opportunity to decommission the asset.

This asset type also provides greater network resilience against natural hazards such as bushfires, thunderstorms, and flooding.

4.3.5 Planned Projects, Replacement and Retirements

Customer-initiated projects and Evoenergy's network planning function will determine the augmentation of this asset class during the upcoming 2024-29 regulatory period. Please refer to the network planning reports to identify the timeline, asset types, and the volume of such network augmentation projects.

During the upcoming 2024-29 regulatory period Evoenergy plans to replace some of the existing assets from this asset class population by delivering the following projects:

- Risk-based replacement of oldest cables in the network
- Replacement of CONSAC type LV cables
- Risk based replacement of HV cable terminations that are deteriorating as per test results.

Customer-initiated projects, fault (asset failure) driven and need driven network re-configuration as identified by Evoenergy's network planning function will determine the decommissioning or retirement of this asset class during the upcoming 2024-29 regulatory period. Please refer to the network planning reports to identify the timeline, asset types, and the volume of such network retirement and re-configuration projects.

4.3.6 Asset Management Strategy

The preferred asset management strategy for this asset class in general is to continue with the existing strategy, which involves visual inspection of cable terminations of underground HV and LV cables as a part of the substation inspection regime, and Partial Discharge (PD) testing of HV cable terminations associated with Hazemeyer RMUs.

The asset health condition assessments for transmission cable and underground HV cable asset types include the following activities to identify higher risk feeders and prioritise their replacement:

- Tier 1 test – Preliminary desktop identification of at-risk assets based on age, fault history, and a metric determined by the date-spread of the fault history,
- Tier 2 test – For assets identified from the above desktop analysis, testing comprising of tan-delta analysis and/or online analysis (on a case by case basis), and
- Tier 3 test – For feeders that have failed Tier 2 health score requirements, testing comprising of offline partial discharge analysis.

With a few exceptions (such as underground LV CONSAC cables) the expenditure strategy is more reactive and event-based (fault, compliance, safety incident, etc.).

4.4. DISTRIBUTION EARTHING STRATEGY

This asset class consists of earthing connected to various overhead and ground assets. The earth grid of the zone substation is included in the Zone Substation Assets Portfolio Strategy document.

4.4.1 Asset Class Summary and Objectives

Earth potential rise occurs when there is a fault current flowing through to the ground. Electrical systems require earthing as it ensures safety and prevents hazards of electric shock and fires. Under fault conditions, earthing allows for electrical systems to remain in successful operation by ensuring voltage levels are within tolerance or provides protection to the distribution network by switching off faulty sections or equipment, providing low impedance pathways to bypass assets and people.

The distribution assets (and also transmission structures) discussed in this section must all have a direct connection with an earthing system to ensure protection of people and assets if insulation fails, to carry lightning strike surges, and to manage step, touch, and transfer potential rises.

The earthing components used for the various distribution (and transmission structure) earthing assets are installed during the construction stage of the respective assets, remaining active until the decommissioning or termination of the associated asset. The only time that these earthing systems associated with their equipment are taken out of service is when earthing tests are conducted or during improvement works. The improvement works are performed on an as-required basis as part of the planned augmentation or expansion works.

Earthing also is used as a means of safety at times when live equipment is taken out of service for maintenance works after isolation from the live network.

The distribution earthing asset class consists of the following asset types:

- Surge Diverter Earthing
- Pole Transformer Earthing
- Overhead Switchgear Earthing
- Ground Substation Earthing
- LV Pits and Pillars Earthing
- Transmission Structure Earthing.

4.4.2 Asset Types

4.4.2.0 Surge Diverter Earthing

This consists of a conductor connecting the surge diverter to the metallic electrode buried under the ground. This buried metallic electrode can be copper rod(s). Its sizing, depth, and the type of surrounding soil/backfill is determined by earthing/grounding studies and appropriate design standards at the time of installing the surge diverter in the network.

A surge diverter protects network assets from excess voltage caused by external events like poor weather conditions or internal events like network switching or reclosing. It diverts this excess voltage to the ground using the low impedance earthing pathway.

Earthing is required for surge arresters to ensure correct operation. Typically, a low inductance down lead and an earthing resistance of 30Ω is required for surge arresters. It should also be recognised that faulty surge arresters can allow significant leakage current into earthing systems. Depending on the situation, significant Earth Potential Rise (EPR), touch, and step voltages can occur.

4.4.2.1 Pole Transformer Earthing

This consists of a conductor connecting the pole transformer to the metallic electrode buried under the ground. This buried metallic electrode can be copper rod(s) and/or copper mesh mat. Its sizing, depth, and the type of surrounding soil/backfill is determined by earthing/grounding studies and appropriate design standards at the time of installing the pole transformer in the network.

Pole transformer earthing provides a low impedance pathway from the metalwork (such as transformer tank, neutral bushing, etc.) to the earth mass to shunt transient over voltages safely to earth to protect the transformer.

Multiple Earth Neutral (MEN) system is predominantly used where two separate and distinct earthing systems shall be provided where the HV side connects transformer tank and high voltage surge arresters, conductive pole (e.g., concrete or steel), any metalwork associated with the HV system, metallic cable guard, HV earthing electrode(s), and the grading ring (if installed). The LV side in the MEN system connects the low voltage neutral of the transformer, low voltage neutral cables, and the low voltage surge arresters.

A Common Multiple Earth Neutral (CMEN) system is opportunistically considered in areas with multiple/many LV interconnections and low resistance to ground. This system connects the transformer tank and any high voltage surge arresters, low voltage neutral and any low voltage surge arresters, conductive pole (e.g., concrete or steel), metal work such as cable sheaths, local earthing electrode system, and grading ring (if installed).

4.4.2.2 Overhead Switchgear Earthing

This consists of a conductor connecting the overhead switchgear to the metallic electrode buried under the ground. This buried metallic electrode can be copper rod(s). Its sizing, depth, and the type of surrounding soil/backfill is determined by earthing/grounding studies and appropriate design standards at the time of installing the overhead switchgear in the network.

Overhead switchgear earthing provides a low impedance pathway from the metalwork to the earth mass to shunt transient over voltages safely to earth to protect the overhead switchgear. It consists of connecting the switchgear enclosure/tank and any high voltage surge arresters, control cubicle, conductive pole (e.g., concrete or steel), any metal work/cable sheath and metallic cable guards, local earthing electrode, and equipotential mat (if installed) or grading ring (if installed).

4.4.2.3 Ground Substation Earthing

This consists of conductors connecting the body of the ground substation transformer, its neutral point, and the non-energised metal components of the substation to the metallic electrodes buried in the ground. The buried metallic electrodes can be copper rod(s) and/or a copper mesh mat. Its sizing, depth, and the type of surrounding soil/backfill is determined by earthing/grounding studies and appropriate design standards at the time of installing the ground substation in the network.

Ground substation earthing systems play a pivotal role in Evoenergy's distribution network, providing a safe environment for personnel to perform maintenance of the substations and reducing the risk of a potential electric shock during fault conditions. It also provides protection to the substation equipment by providing an interconnection from the substation's grounding to key components within the substation, such as transformer neutrals, metal enclosures, and underground cable screens to keep them at the earth's potential.

There are the following types of ground substations within Evoenergy's network:

- Chamber substations
- Padmount substations
- Kiosk substations
- Stockade substations
- Switching stations.

Chamber substations usually have an earth mat installed in the ground to create an earth grid, to achieve the required low resistance levels. An earth mat consists of interconnected copper cables forming a horizontal grid connected to a number of earth stakes. This is connected to the substation earthing with copper cables at more than one point to achieve higher reliability. For other substation types, the required resistance levels are usually achieved using earth stakes.

A CMEN system is used in areas where there are multiple/many LV interconnections and a low resistance to ground. This system connects the transformer tank and any enclosure, HV cable screens and earth continuity conductors, grading rings, low voltage neutral of the transformer, LV neutral cable, and a local earthing electrode system.

If such conditions cannot be met, then an MEN system is used where two separate and distinct earthing systems shall be provided for the HV side and LV side. The HV earth bar is connected to transformer tank and any enclosure, HV cable screens and earth continuity conductors, grading rings, and HV earthing electrode(s). The LV side in an MEN system connects the LV earth bar to the low voltage neutral of the transformer, low voltage neutral cables, and the LV earthing electrodes(s).

4.4.2.4 Low Voltage Pits and Pillars Earthing

This consists of conductors connecting the non-energised components of LV pits and pillars to a metallic electrode buried in the ground. This buried metallic electrode can be copper rod(s). Its sizing, depth, and the type of surrounding soil/backfill is determined by earthing/grounding studies and appropriate design standards at the time of installing the LV pits and pillars in the network.

LV pits and pillar earthing provides a low impedance pathway from its enclosures and/or reinforced concrete foundation that they sit on to the Earth mass to shunt transient over voltages safely to earth to protect the operating personnel. On the LV connection boards the LV neutral is earthed in an MEN system.

4.4.2.5 Transmission Structure Earthing

This consists of a conductor connecting the tower structure to the metallic electrode buried under the ground. This buried metallic electrode can be copper rod(s) and/or copper mesh mat. Its sizing, depth, and the type of surrounding soil/backfill is determined by earthing/grounding studies and appropriate design standards at the time of installing the transmission line in the network.

The transmission structure earthing allows for Evoenergy's transmission network to be unaffected during lightning strikes and prevents flashovers from occurring. It achieves this as the lightning has initial contact with the ground wire located on top of the transmission structure, allowing for this to travel safely to earth without disrupting the network.

Earthing of transmission structure such as 132kV towers may involve complex earthing solutions and also risk assessment to identify all likely earthing related hazard scenarios.

4.4.3 Current Population, Age, and Health Profile

Table 6 summarises the design life, count, average age, and health status of different types and sub-types/components of distribution earthing within the Evoenergy network. This provides a high-level view of the population's profile, performance, and potential concerns as highlighted in the Health Category column.

TABLE 6. ASSET POPULATION, AGE, AND HEALTH PROFILES – DISTRIBUTION EARTHING

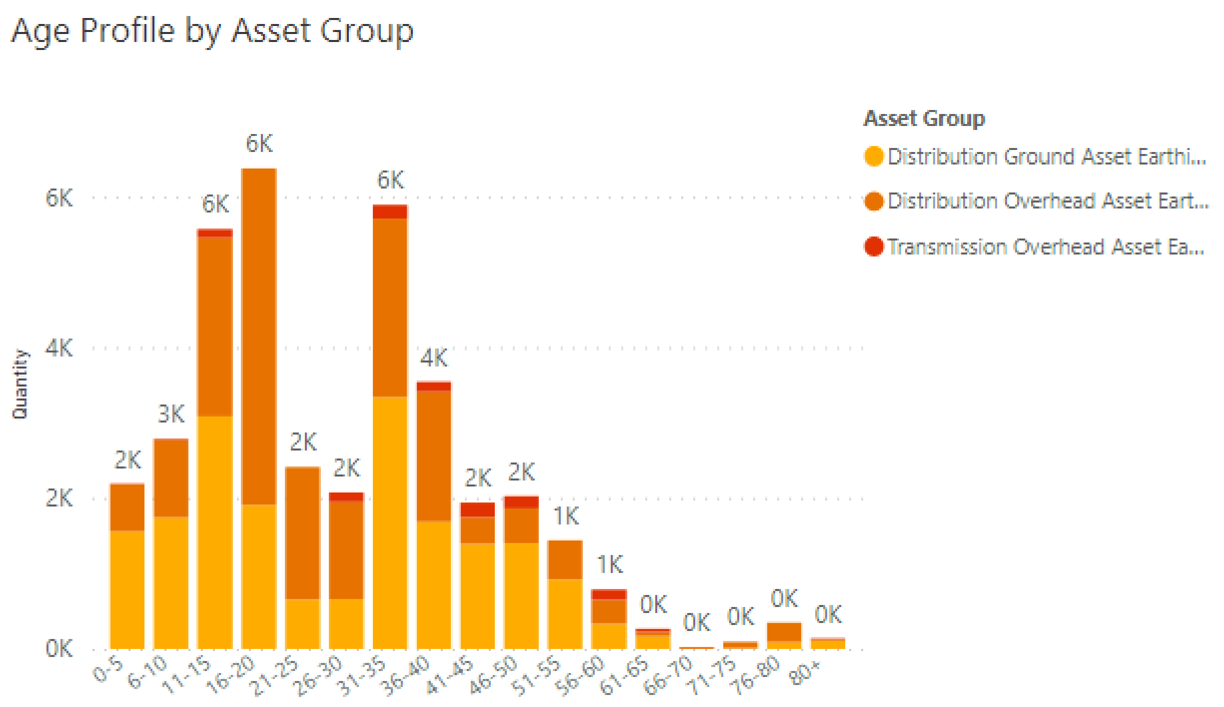
Design Life (yrs), Average Age, Quantity, Critical Health Qty, Unit, Average Health Score, Health Category

BY ASSET SPECIFIC PLAN, ASSET TYPE

Asset Specific Plan	Quantity	Unit	Design Life (yrs)	Average Age	Critical Health Qty	Average Health Score	Health Category
Ground and Overhead Network Earthing	37,915	each	40	27	4,951	77.18	Fair
Recloser Earth	48	each	40	14	0	95.40	Very Good
Overhead Gas Switch Earth	123	each	40	11	8	93.85	Very Good
Distribution Pole Earth	14,650	each	40	23	291	88.92	Good
LV Pillar Earth	15,297	each	40	27	2,375	75.51	Good
Load Break Switch Earth	6	each	40	26	0	73.67	Good
Ground Substation Earth - Two HV Connections	1,807	each	40	30	188	73.45	Good
Ground Substation Earth - Multiple HV Connections	633	each	40	32	82	68.36	Good
Ground Substation Earth - One HV Connection	1,329	each	40	30	255	66.48	Good
Transmission Tower or Pole Earth	1,126	each	40	39	348	53.54	Fair
Pole Substation Earth	1,384	each	40	38	581	48.86	Fair
Overhead Air Break Switch Earth	1,512	each	40	41	823	39.42	Poor

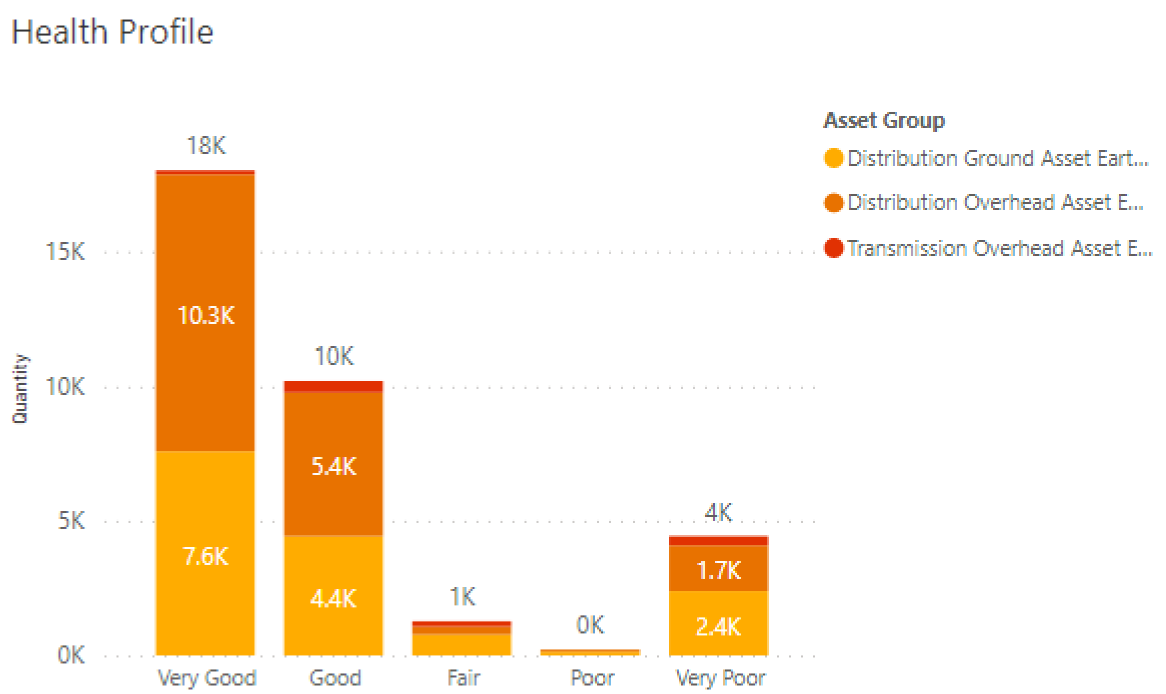
The age profile of existing assets is reflected in Figure 10.

FIGURE 10. ASSET AGE PROFILE CHART (AS AT JULY 2022) – DISTRIBUTION EARTHING



The asset class health profile is summarised in Figure 11.

FIGURE 11. ASSET HEALTH PROFILE (AS AT JULY 2022) – DISTRIBUTION EARTHING



As Evoenergy's distribution network continues to expand due to growth such as new suburbs and commercial developments, the earthing systems initially designed before these developments need to be reviewed to ensure appropriate low earth resistances are still maintained and not compromised.

4.4.3.0 Surge Diverter Earthing

The surge diverter earthing assets are tested in 7-year cycles and 89% of those inspected and tested during the current regulatory period do not need restoration. Therefore, other than the planned testing and repair programs, no other work is deemed necessary over the 2024-29 period to manage their performance.

4.4.3.1 Pole Transformer Earthing

The pole transformer earthing assets are tested in 10-year cycles and 81% of those inspected and tested during the current regulatory period do not need restoration. Therefore, other than the planned testing program and repair program, no other work is deemed necessary over the 2024-29 period to manage their performance.

4.4.3.2 Overhead Switchgear Earthing

Some of the overhead switchgear earthing assets (e.g., ABB R-series type) does not require a periodic testing regime and their current condition is good. Therefore, other than planned testing program, no other work is necessary over the period of 2024-29 to manage their performance. The remainder of the majority of the overhead switchgear earthing assets are tested in 7-year cycles and maintenance is carried out accordingly. Therefore, other than the planned testing program and repair, no other work is deemed necessary over the 2024-29 period to manage their performance.

4.4.3.3 Ground Substation Earthing

All different types of ground substation earthing assets except chamber substation earthing (i.e., padmount, kiosk, stockade, and switching) are tested in 10-year cycles and their current condition is very good as 95% of those inspected and tested during the current regulatory period not needing restoration. Chamber substation earthing is deemed to not require routine testing unless they get damaged by third parties as the earth mats have high reliability being under buildings, etc. Therefore, other than the planned testing program, no other work is deemed necessary over the 2024-29 period to manage their performance.

4.4.3.4 Low Voltage Pits and Pillars Earthing

The LV pits and pillars earthing assets are not on a routine testing regime as their monetised risk is very low as per studies conducted. Therefore, other than the unplanned repairs or restorations that may become necessary, no other work is deemed necessary over the 2024-29 period to manage their performance.

4.4.3.5 Transmission Structure Earthing

The transmission structure earthing assets are tested in 10-year cycles and restoration are carried out accordingly. Therefore, other than the planned testing program, no other work is deemed necessary over the 2024-29 period to manage their performance.

4.4.4 Risks and Opportunities

There is little opportunity for rationalisation, as earthing systems are implemented to achieve the required levels of earthing resistance to manage risks. Therefore, this allows only the design and testing criteria to be rationalised. Earthing has multiple design standards, and these standards get updated over time. There are opportunities to ensure the appropriate standards are followed to maximise effectiveness. Evoenergy has focused attention on earthing design, testing, and training in recent years. A new earthing testing manual is being rolled out. More structured testing is being carried out and the associated training is underway.

The consequences of failed earthing can range from earth current leakage and risks of safety to people and of damage to assets. Evoenergy has the responsibility to manage its safety risk to keep it as low as reasonably possible.

A small proportion of the distribution earthing assets inspected in the current regulatory period is expected to need restoration in the upcoming 2024-29 period as noted in Section 4.2.3. Such restoration work is rationalised on a risk basis by considering the assets type, its criticality in the network, to the load, and exposure to people.

4.4.5 Planned Projects, Replacements and Retirements

To meet the increasing demand, new distribution networks and upgrades will need to be made. The earthing system used for the different earthing asset types need to be considered during new development projects and upgrades. The earthing requirements will remain and need assessment during asset replacements and will only be not needed when the asset is decommissioned.

Evoenergy have planned no asset retirements for this asset class in the 2024-29 revenue period.

4.4.6 Asset Management Strategy

Full inspection and testing is completed on the distribution earthing asset class once every 7 to 10 years, depending on the asset type/sub-type. Defects are discovered and earthing is restored as a part of the asset life cycle management.

There are no planned maintenance or refurbishment activities for this asset class. At the end of asset life, the associated asset along with its earthing systems are retired and replaced. Earthing is reassessed at the time of asset replacement or where the tests show they do not comply with the earthing criteria previously adhered to.

Evoenergy’s preferred asset management strategy is to maintain and continue the existing program for distribution earthing in most instances, i.e., periodic testing for distribution earthing systems. The objective is to maintain its reliability and functionality throughout the entire life of the respective assets they are associated with. This is achieved by validating that the requirements of the initial earthing designs or any subsequent earth grid augmentations and upgrades continue to be met.

Increased fault levels are expected due to augmentations on Evoenergy’s network. The earthing used is consistently verified to ensure it can still meet the protection performance requirements. Site tests are performed by trained personnel to ensure these high safety standards on the distribution network are met.

5. PROGRAM OF WORK

This section provides a detailed breakdown of quantities and yearly budget per program of work

5.1. REPLACEMENT PROGRAM

TABLE 7. REPLACEMENT PROGRAM OF WORK YEARLY BUDGET FY25-29

EXPENDITURE CATEGORY	FY 24-25		FY 25-26		FY 26-27		FY 27-28		FY 28-29	
	QTY	TASK COST ($)	QTY	TASK COST ($)	QTY	TASK COST ($)	QTY	TASK COST ($)	QTY	TASK COST ($)
Asset Renewal and Replacement Distribution Ground	**222.186**	**5,420,974**	**216.186**	**5,130,852**	**223.186**	**5,316,425**	**222.186**	**5,327,626**	**222.186**	**5,249,338**
Ground and Overhead Network Earthing	**10**	**66,200**	**10**	**66,200**	**10**	**66,200**	**10**	**66,200**	**10**	**66,200**
Reactive Replacement	**10**	**66,200**	**10**	**66,200**	**10**	**66,200**	**10**	**66,200**	**10**	**66,200**
-	**10**	**66,200**	**10**	**66,200**	**10**	**66,200**	**10**	**66,200**	**10**	**66,200**
Replace Earthing - Underground	10	66,200	10	66,200	10	66,200	10	66,200	10	66,200
Ground Distribution Equipment	**126**	**2,731,223**	**120**	**2,441,101**	**127**	**2,626,674**	**126**	**2,637,875**	**126**	**2,559,587**
Reactive Replacement	**63**	**685,058**	**65**	**694,324**	**67**	**703,590**	**69**	**712,856**	**69**	**712,856**
-	**63**	**685,058**	**65**	**694,324**	**67**	**703,590**	**69**	**712,856**	**69**	**712,856**
Replace distribution ground transformer	1	91,515	1	91,515	1	91,515	1	91,515	1	91,515
Replace LV Circuit Breaker	1	38,295	1	38,295	1	38,295	1	38,295	1	38,295
Replace LV pit	6	27,798	8	37,064	10	46,330	12	55,596	12	55,596
Replace Pillar	50	336,750	50	336,750	50	336,750	50	336,750	50	336,750
Replace ring main unit	5	190,700	5	190,700	5	190,700	5	190,700	5	190,700

EXPENDITURE CATEGORY	FY 24-25		FY 25-26		FY 26-27		FY 27-28		FY 28-29	
	QTY	TASK COST ($)	QTY	TASK COST ($)	QTY	TASK COST ($)	QTY	TASK COST ($)	QTY	TASK COST ($)
Replacement	**63**	**2,046,165**	**55**	**1,746,777**	**60**	**1,923,084**	**57**	**1,925,019**	**57**	**1,846,731**
-	**63**	**2,046,165**	**55**	**1,746,777**	**60**	**1,923,084**	**57**	**1,925,019**	**57**	**1,846,731**
Replace HV Circuit Breaker	2	123,318	5	308,295	3	184,977	8	493,272	6	369,954
Replace LV Circuit Breaker	22	842,490	9	344,655	17	651,015	9	344,655	10	382,950
Replace Padmount	4	844,632	4	844,632	4	844,632	4	844,632	4	844,632
Replace Pillar	35	235,725	37	249,195	36	242,460	36	242,460	37	249,195
Underground Cables	**86.186**	**2,623,551**	**86.186**	**2,623,551**	**86.186**	**2,623,551**	**86.186**	**2,623,551**	**86.186**	**2,623,551**
Reactive Replacement	**53**	**1,033,126**	**53**	**1,033,126**	**53**	**1,033,126**	**53**	**1,033,126**	**53**	**1,033,126**
-	**53**	**1,033,126**	**53**	**1,033,126**	**53**	**1,033,126**	**53**	**1,033,126**	**53**	**1,033,126**
Replace HV Underground Cable Joint	20	388,700	20	388,700	20	388,700	20	388,700	20	388,700
Replace HV underground cable termination	11	328,504	11	328,504	11	328,504	11	328,504	11	328,504
Replace LV Underground Cable Joint	14	208,894	14	208,894	14	208,894	14	208,894	14	208,894
Replace LV underground cable termination	2	12,414	2	12,414	2	12,414	2	12,414	2	12,414
Replace underground service cable	6	94,614	6	94,614	6	94,614	6	94,614	6	94,614
Replacement	**33.186**	**1,590,425**	**33.186**	**1,590,425**	**33.186**	**1,590,425**	**33.186**	**1,590,425**	**33.186**	**1,590,425**
-	**33.186**	**1,590,425**	**33.186**	**1,590,425**	**33.186**	**1,590,425**	**33.186**	**1,590,425**	**33.186**	**1,590,425**

EXPENDITURE CATEGORY	FY 24-25		FY 25-26		FY 26-27		FY 27-28		FY 28-29	
	QTY	TASK COST ($)	QTY	TASK COST ($)	QTY	TASK COST ($)	QTY	TASK COST ($)	QTY	TASK COST ($)
Replace HV underground cable	0.186	394,213	0.186	394,213	0.186	394,213	0.186	394,213	0.186	394,213
Replace LV underground cable	8	847,872	8	847,872	8	847,872	8	847,872	8	847,872
Replace Transformer Tails	7	64,498	7	64,498	7	64,498	7	64,498	7	64,498
Replace underground service cable	18	283,842	18	283,842	18	283,842	18	283,842	18	283,842
Augmentation Capex Distribution	**2**	**899,000**	**2**	**1,241,000**	**2**	**1,640,000**	**2**	**2,039,000**	**2**	**2,381,000**
Ground Distribution Equipment	**1**	**399,000**	**1**	**741,000**	**1**	**1,140,000**	**1**	**1,539,000**	**1**	**1,881,000**
Replacement	**1**	**399,000**	**1**	**741,000**	**1**	**1,140,000**	**1**	**1,539,000**	**1**	**1,881,000**
EP-01161 - EN24 Distribution Substation Upgrade (NZ45 - Augex) -1	1	399,000	1	741,000	1	1,140,000	1	1,539,000	1	1,881,000
EP-01166 - EN24 Distribution Substation Upgrade (NZ45 - Augex) -2										
Underground Cables	**1**	**500,000**	**1**	**500,000**	**1**	**500,000**	**1**	**500,000**	**1**	**500,000**
Replacement	**1**	**500,000**	**1**	**500,000**	**1**	**500,000**	**1**	**500,000**	**1**	**500,000**
EP-01163 - Distribution Feeder Reliability Underground (NZ45 - Augex) -1	1	500,000	1	500,000	1	500,000	1	500,000	1	500,000
EP-01165 - Distribution Feeder Reliability Underground (NZ45 - Augex)-2										

5.2. MAINTENANCE PROGRAM

TABLE 8. MAINTENANCE PROGRAM OF WORK YEARLY BUDGET FY25-29

EXPENDITURE CATEGORY	FY 24-25		FY 25-26		FY 26-27		FY 27-28		FY 28-29	
	QTY	TASK COST ($)	QTY	TASK COST ($)	QTY	TASK COST ($)	QTY	TASK COST ($)	QTY	TASK COST ($)
Maintenance Distribution Ground	**5092**	**5,080,954**	**4689**	**5,041,381**	**4480**	**5,024,287**	**4417**	**5,068,225**	**4451**	**5,170,784**
Ground and Overhead Network Earthing	**1704**	**855,630**	**1319**	**856,222**	**1116**	**855,592**	**1026**	**856,305**	**978**	**857,774**
Condition Monitoring	**1682**	**812,444**	**1297**	**813,036**	**1094**	**812,406**	**1004**	**813,119**	**956**	**814,588**
-	**1682**	**812,444**	**1297**	**813,036**	**1094**	**812,406**	**1004**	**813,119**	**956**	**814,588**
Test Earthing - Overhead	1341	644,331	955	644,430	752	643,800	663	645,006	613	645,489
Test Earthing - Underground	341	168,113	342	168,606	342	168,606	341	168,113	343	169,099
Unplanned Maintenance	**22**	**43,186**	**22**	**43,186**	**22**	**43,186**	**22**	**43,186**	**22**	**43,186**
-	**22**	**43,186**	**22**	**43,186**	**22**	**43,186**	**22**	**43,186**	**22**	**43,186**
Repair Earthing - Overhead	12	23,556	12	23,556	12	23,556	12	23,556	12	23,556
Repair Earthing - Underground	10	19,630	10	19,630	10	19,630	10	19,630	10	19,630
Ground Distribution Equipment	**3099**	**2,274,402**	**3081**	**2,234,237**	**3075**	**2,217,773**	**3102**	**2,260,998**	**3184**	**2,362,088**
Condition Monitoring	**2085**	**306,718**	**2093**	**309,085**	**2098**	**310,056**	**2098**	**311,304**	**2119**	**315,669**
-	**2085**	**306,718**	**2093**	**309,085**	**2098**	**310,056**	**2098**	**311,304**	**2119**	**315,669**
Clean Chamber Enclosure	173	86,154	174	86,652	174	86,652	178	88,644	171	85,158
Inspect - Thermovision - HV Switchboard							1	409	3	1,227
Inspect Distribution Substation	580	102,080	580	102,080	584	102,784	582	102,432	581	102,256
Inspect fire extinguisher	980	24,500	980	24,500	980	24,500	980	24,500	980	24,500
Test ring main unit - partial discharge	352	93,984	359	95,853	360	96,120	357	95,319	384	102,528
Planned Maintenance	**396**	**726,540**	**370**	**684,008**	**359**	**666,573**	**386**	**708,550**	**447**	**805,275**

EXPENDITURE CATEGORY	FY 24-25		FY 25-26		FY 26-27		FY 27-28		FY 28-29	
	QTY	TASK COST ($)	QTY	TASK COST ($)	QTY	TASK COST ($)	QTY	TASK COST ($)	QTY	TASK COST ($)
-	**396**	**726,540**	**370**	**684,008**	**359**	**666,573**	**386**	**708,550**	**447**	**805,275**
Maintain Hazemeyer Switchgear	130	360,230	128	354,688	128	354,688	130	360,230	130	360,230
Maintain HV Circuit Breaker	108	171,180	87	137,895	76	120,460	106	168,010	153	242,505
Maintain Load Break Switches							4	0		
Maintain LV Circuit Breaker	158	195,130	155	191,425	155	191,425	146	180,310	164	202,540
Unplanned Maintenance	**618**	**1,241,144**	**618**	**1,241,144**	**618**	**1,241,144**	**618**	**1,241,144**	**618**	**1,241,144**
-	**618**	**1,241,144**	**618**	**1,241,144**	**618**	**1,241,144**	**618**	**1,241,144**	**618**	**1,241,144**
Clean Distribution Enclosure	15	5,715	15	5,715	15	5,715	15	5,715	15	5,715
Investigate HV Switchgear Failure	2	25,932	2	25,932	2	25,932	2	25,932	2	25,932
Remove Graffiti	50	24,800	50	24,800	50	24,800	50	24,800	50	24,800
Repair Dist. Transformer Oil Leak	240	540,960	240	540,960	240	540,960	240	540,960	240	540,960
Repair Distribution Enclosure	15	61,665	15	61,665	15	61,665	15	61,665	15	61,665
Repair Door	20	15,680	20	15,680	20	15,680	20	15,680	20	15,680
Repair Ground Transformer (minor)	10	33,880	10	33,880	10	33,880	10	33,880	10	33,880
Repair HV Switchboard	5	16,960	5	16,960	5	16,960	5	16,960	5	16,960
Repair LV distribution circuit breaker	20	136,840	20	136,840	20	136,840	20	136,840	20	136,840
Repair LV Pit	6	24,222	6	24,222	6	24,222	6	24,222	6	24,222
Repair LV Switchboard	30	51,180	30	51,180	30	51,180	30	51,180	30	51,180
Repair Padmount Site	30	30,720	30	30,720	30	30,720	30	30,720	30	30,720
Repair pillar	45	88,380	45	88,380	45	88,380	45	88,380	45	88,380
Repair ring main unit	30	148,170	30	148,170	30	148,170	30	148,170	30	148,170
Test distribution ground transformer - PCB	70	16,030	70	16,030	70	16,030	70	16,030	70	16,030
Test Soil Resistivity	30	20,010	30	20,010	30	20,010	30	20,010	30	20,010
Underground Cables	**289**	**1,950,922**	**289**	**1,950,922**	**289**	**1,950,922**	**289**	**1,950,922**	**289**	**1,950,922**
Unplanned Maintenance	**289**	**1,950,922**	**289**	**1,950,922**	**289**	**1,950,922**	**289**	**1,950,922**	**289**	**1,950,922**

EXPENDITURE CATEGORY	FY 24-25		FY 25-26		FY 26-27		FY 27-28		FY 28-29	
	QTY	TASK COST ($)	QTY	TASK COST ($)	QTY	TASK COST ($)	QTY	TASK COST ($)	QTY	TASK COST ($)
-	**289**	**1,950,922**	**289**	**1,950,922**	**289**	**1,950,922**	**289**	**1,950,922**	**289**	**1,950,922**
Inspect Cable Failure - Root Cause Analysis	4	67,392	4	67,392	4	67,392	4	67,392	4	67,392
Investigate HV Underground Cable Failure	15	61,470	15	61,470	15	61,470	15	61,470	15	61,470
Investigate LV Underground Cable Failure	25	71,050	25	71,050	25	71,050	25	71,050	25	71,050
Reactive HV Underground Cable - Attend Site and Locate Fault	45	216,405	45	216,405	45	216,405	45	216,405	45	216,405
Reactive LV Underground Cable - Attend Site and Locate Fault	40	124,760	40	124,760	40	124,760	40	124,760	40	124,760
Repair HV underground cable	20	406,560	20	406,560	20	406,560	20	406,560	20	406,560
Repair LV underground cable	30	415,350	30	415,350	30	415,350	30	415,350	30	415,350
Repair underground service cable	105	577,605	105	577,605	105	577,605	105	577,605	105	577,605
Test LV Underground Cable	5	10,330	5	10,330	5	10,330	5	10,330	5	10,330

5.3. LONG-TERM FORECAST

Higher level long term forecast from FY24/25 to FY33/34 that captures budget only

TABLE 9. HIGHER LEVEL LONG-TERM BUDGET FORECAST

EXPENDITURE CATEGORY	FY 24-25	FY 25-26	FY 26-27	FY 27-28	FY 28-29	FY 29-30	FY 30-31	FY 31-32	FY 32-33	FY 33-34
Asset Renewal and Replacement Distribution Ground	**5,420,974**	**5,130,852**	**5,316,425**	**5,327,626**	**5,249,338**	**5,290,792**	**5,472,610**	**4,865,914**	**4,879,384**	**4,654,234**
Ground and Overhead Network Earthing	66,200	66,200	66,200	66,200	66,200	66,200	66,200	66,200	66,200	66,200
Ground Distribution Equipment	2,731,223	2,441,101	2,626,674	2,637,875	2,559,587	2,601,041	2,782,859	2,176,163	2,189,633	1,964,483
Underground Cables	2,623,551	2,623,551	2,623,551	2,623,551	2,623,551	2,623,551	2,623,551	2,623,551	2,623,551	2,623,551
Augmentation Capex Distribution	**899,000**	**1,241,000**	**1,640,000**	**2,039,000**	**2,381,000**	**2,780,000**	**3,236,000**	**3,540,000**	**3,996,000**	**4,300,000**

EXPENDITURE CATEGORY	FY 24-25	FY 25-26	FY 26-27	FY 27-28	FY 28-29	FY 29-30	FY 30-31	FY 31-32	FY 32-33	FY 33-34
Ground Distribution Equipment	399,000	741,000	1,140,000	1,539,000	1,881,000	2,280,000	2,736,000	3,040,000	3,496,000	3,800,000
Underground Cables	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000
Maintenance Distribution Ground	**5,080,954**	**5,041,381**	**5,024,287**	**5,068,225**	**5,170,784**	**5,060,992**	**5,066,583**	**4,948,355**	**5,069,185**	**5,113,921**
Ground Distribution Equipment	855,630	856,222	855,592	856,305	857,774	856,201	854,122	863,639	858,730	859,138
Ground Distribution Equipment	2,274,402	2,234,237	2,217,773	2,260,998	2,362,088	2,253,869	2,261,539	2,133,794	2,259,533	2,303,861
Underground Cables	1,950,922	1,950,922	1,950,922	1,950,922	1,950,922	1,950,922	1,950,922	1,950,922	1,950,922	1,950,922

GLOSSARY

TERM	DEFINITION
ACT	Australian Capital Territory
AEMO	Australian Energy Market Operator
AIS	Air Insulated Switchgear
ALARP	As Low As Reasonably Practical
AMS	Asset Management System
CAPEX	Capital Expenditure
CB	Circuit Breaker
CMEN	Common Multiple Earth Neutral
CT	Current Transformer
ENSMS	Electricity Networks Safety Management System
EPR	Earth Potential Rise
FSA	Formal Safety Assessment
HDPE	High-Density Polyethylene
HV	High Voltage
LV	Low Voltage
MCCB	Moulded Case Circuit Breaker
MEN	Multiple Earth Neutral
NBN	National Broadband Network
NER	National Electricity Rules
OPEX	Operational Expenditure
PD	Partial Discharge
PILC	Paper Insulated Lead Covered
POE	Point Of Entry
PVC	Polyvinyl Chloride
RMU	Ring Main Unit
SCADA	Supervisory Control And Data Acquisition
SF6	Sulfur hexafluoride, used as an electrical insulator and arc suppressant in Gas Insulated Switchgear.
TCCS	Transport Canberra and City Services
URD	Underground Residential Developments
VT	Voltage Transformer
XLPE	Cross-linked Polyethylene

REFERENCE DOCUMENTS

DOCUMENT NAME	DOCUMENT NUMBER	VERSION	PUBLISH DATE
Asset Management Strategy	PO0746	10	14/08/2020
Asset Management Objectives	PO0744	5	07/10/2018
Earthing Strategy	PO07141	1	09/12/2021
Evoenergy Asset Management System Framework	PO0749	2	26/11/2020

VERSION CONTROL

VERSION	DETAILS	RELEASE DATE
0.1	Initial Draft for internal review	7 October 2022
0.2	Second Draft for internal review	16 October
1.0	Release for regulatory proposal EN 2024–29.	19 January 2023

DOCUMENT CONTROL

DOCUMENT OWNER	PUBLISH DATE	REVIEW DATE
Group Manager Network Services	19 January 2023	19 January 2025