TRANSPOWER

2025 Asset Management Plan

Managing and maintaining our grid, ICT and business support assets

September 2025

Contents

Introduction

Introduction

As the owner and operator of Aotearoa New Zealand's national electricity transmission system, we hold a unique position in the energy sector. We do not generate or sell electricity but provide the infrastructure and market system that connects electricity generators to major electricity users and the distribution networks that deliver electricity to homes and businesses.

Our role is critical in enabling Aotearoa New Zealand's electrification and a net zero carbon future. We are committed to enabling the significant increase in electricity required for Aotearoa New Zealand to meet its decarbonisation goals while ensuring the resilient, reliable, and safe operation of the grid. People and relationships are core to our business as we work alongside landowners, iwi, hapū, and the communities that host our assets.

Our services are regulated to help ensure we efficiently deliver the right services, with the right level of funding. We operate in 5-year regulatory control periods (RCPs). From 1 July 2025 we will embark on our fourth RCP, which will operate through to 30 June 2030.

This Asset Management Plan (AMP) is one of three supporting documents within our Integrated Transmission Plan (ITP). It is a regulatory requirement for us to produce an ITP. The ITP is a suite of documents describing our plans for our regulated transmission business.

It consists of:

- **ITP Narrative**: provides a concise, accessible overview of our plans
- **AMP:** documents our asset management approach, processes and investment requirements by asset class, covering our grid, Information and Communications Technology (ICT) and business support assets
- **Transmission Planning Report**: describes grid security and capacity issues that could arise over the coming 15 years due to changes in demand and generation. It includes detail on committed and potential grid enhancements.
- **Service Measures Report**: summarises the performance of our regulated transmission business, including service performance and asset health measures, quality standards, and targets and revenue incentives for RCP4.

Our AMP is a valuable resource to communicate our asset management approach and plans with our customers.

We are committed to enabling the significant increase in electricity required for Aotearoa New Zealand to meet its decarbonisation goals while maintaining the reliable and safe operation of the grid.

Our assets

We invest in, operate, and maintain approximately $5 billion of regulated electricity transmission infrastructure and associated support systems and facilities that together enable a functional, reliable, and safe grid. We have classified our assets into three portfolio categories based on their role within the business. These are grid assets, ICT assets, and business support assets.

Grid assets

We classify our grid assets as primary and secondary assets. Together, these assets operate as a system. Our primary assets consist of assets such as towers, conductors, and power transformers'; our secondary assets include protection control equipment. We group our grid assets into the following six portfolios that reflect their different characteristics:

- Alternating Current (AC) Substations
- Transmission Lines (TL)
- Buildings and Grounds
- High Voltage Direct Current (HVDC)
- Reactive assets
- Secondary assets.

ICT assets

Our ICT assets include all our information technology, systems, and telecommunications assets. We categorise our ICT assets into the following five ICT asset portfolios.

- Asset Management Systems
- Transmission Systems
- Shared Services
- Corporate Services
- Telecommunications, Network and Security Services.

Business support assets

Our business support assets are the essential infrastructure we need to support our operations and activities. These include corporate buildings, vehicles and other equipment including laptops and mobile phones used for day-to-day operations that are not directly related to the grid or ICT.

Structure of this document

This AMP is structured into six sections as shown in Table 1..

Table 1: AMP structure

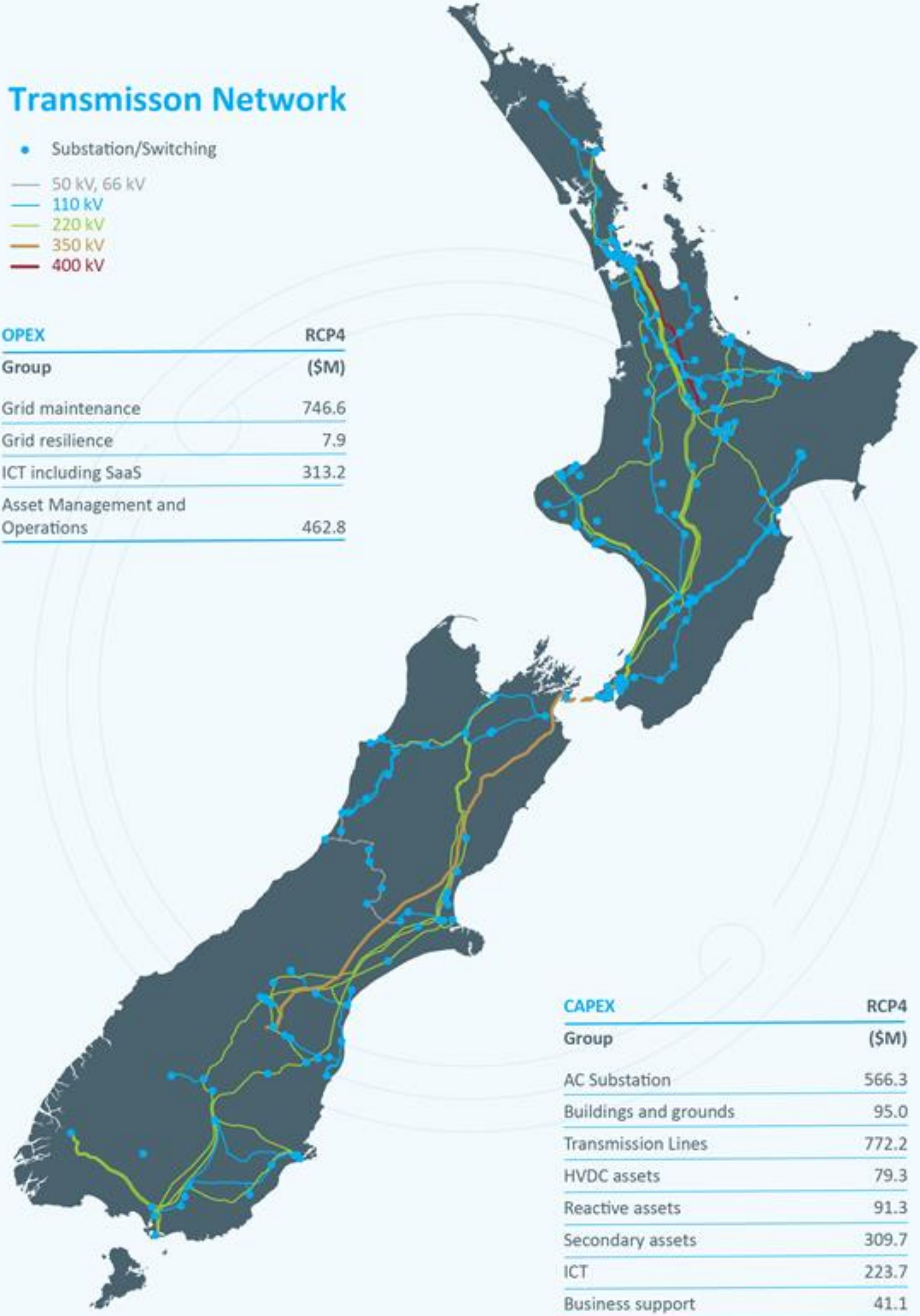
Section	Section name
1.	Introduction
2.	Plan Summary
3.	Our Approach to Asset Management
4.	Grid Asset Class Plans
5.	ICT Asset Class Plans
6.	Business Support Asset Class Plan

Plan Summary

Transmisson Network

- Substation/Switching
- 50 kV, 66 kV
- 110 kV
- 220 kV
- 350 kV
- 400 kV

OPEX Group	RCP4 ($M)
Grid maintenance	746.6
Grid resilience	7.9
ICT including SaaS	313.2
Asset Management and Operations	462.8



CAPEX Group	RCP4 ($M)
AC Substation	566.3
Buildings and grounds	95.0
Transmission Lines	772.2
HVDC assets	79.3
Reactive assets	91.3
Secondary assets	309.7
ICT	223.7
Business support	41.1
Grid resilience	127.5

Plan Summary

We submitted our fourth RCP proposal, covering the period 1 July 2025 to 30 June 2030, to the Commerce Commission on 21 November 2023. Through its determination process, the Commerce Commission approved 98% of our requested allowances for RCP4. The allowances cover our operational expenses (opex) and base capital expenditure (capex) funding requirements. Base capex funds the routine replacement and refurbishment of existing assets.

In addition to our RCP proposal process, we can submit proposals to the Commerce Commission to seek approval, for major capital projects that have expected costs greater than $30m. Although falling outside our RCP proposal approval process, our major capital projects proposals are developed with the same sound asset management principles that are applied to an RCP proposal.

During RCP4, we are seeking to deliver on the following outcomes:

- **A reliable and safe network.** We will deliver a transmission service that minimises interruptions at lowest whole of life cost, where assets are maintained and replaced in line with good electricity industry practices, and where risks to our staff, contractors and general public are minimised.
- **A resilient network.** A resilient network avoids extended power outages and quickly restores power when major events occur.
- **Enhancing the network.** We aim to ensure capacity is in the right place at the right time and customers continue to receive a reliable and secure transmission service that meets their needs[1].
- **A sustainable network.** We will reduce our carbon footprint over RCP4 to ensure we can achieve a 60% reduction in emissions by 2030 in our aim to reach a net zero target by 2050.

Our RCP4 proposal was submitted within the context of Aotearoa New Zealand pursuing a goal to be net zero carbon by 2050. Electrification of most of the energy used in Aotearoa's economy is happening, and the pace is only going to continue. We are experiencing a dramatic increase in enquiries for connections to the grid from both new generation developers and our load customers. In addition, the amount of electricity used at the busiest times on the grid – peak demand – has increased substantially. Our purpose, *Whakamana i te mauri hiko tu mai Aotearoa – empowering the energy future for Aotearoa New Zealand* reflects our commitment to the enabling role we play in the transition to a more electrified, renewable economy and ensuring a resilient and reliable power supply for all New Zealanders.

To enable this increase in electrification, to ensure resilience, and to face the challenge of climate change we need to have the foundation of a well-functioning grid. Consistent with our peer companies around the world, expenditure will need to increase over the coming years to maintain the reliability and resilience of the grid to support electrification. Many of our primary grid assets were built between the 1950s and the 1980s, which means a considerable number of our assets will need to be refurbished or replaced in the coming decades. This coincides with Aotearoa moving towards a period of increased electricity demand to meet its net zero carbon goals.

We are in the process of optimising ongoing refurbishment and life extension programmes for key assets such as power transformers, towers, conductors, the HVDC link, and the refresh of our TransGo network. This work will ensure our national grid remains safe, reliable, and cost-effective into the future. This investment is essential to enable us to support continued electrification and to help us avoid more costly and pressured expenditure in the future.

Aotearoa is not alone in electrifying its economy. Large scale electrification globally, with subsequent grid maintenance and expansion around the globe has created pressure within international supply chains and industry resourcing. This has resulted in significant price increases for electrical infrastructure equipment, driving price increases in our industry higher than CPI. Our RCP4 allowances accounted for real price effects (input prices including CPI). The price increases we are experiencing have far surpassed our allowances.

Managing these price pressures is a current focus for us. Our asset management approach is to continuously review and reprioritise

[1] For more details on grid enhancements, please refer to our 2025 Transmission Planning Report.

our workplan based on updated asset condition, health and criticality information, and the funding available for investment.

We're putting the right tools and processes in place to ensure we will meet our service targets, while balancing the significant increases in equipment prices. Where prices have increased significantly, we are actively both reprioritising work and exploring opportunities for increasing efficiency in how we deliver our work.

To ensure we efficiently deliver our growing work program across RCP4, we have implemented an End-to end Acceleration Programme which focuses on increasing throughput across a programme of initiatives that streamline our processes for planning, prioritising, and delivering projects. This will ensure we are able to concurrently deliver our opex and base capex program alongside increasing demand for customer connections and a large pipeline of major capital projects.[2] Delivery of all three will ensure we are able to continue to provide a safe and reliable service and enable electrification.

Global electrification has increased international competition for highly skilled industry staff. We are actively recruiting for highly skilled staff to support our forward work programme. Despite the challenging environment, we are recruiting well against our workforce planning targets, for the start of RCP4's work programme.

By actively seeking efficiencies and ensuring a highly skilled workforce, we are setting the stage for a sustainable future and building a foundation for growth and resilience. Our assets are subject to a diverse range of natural hazards. Climate change is increasing both the frequency and magnitude of many of these. Our asset planning accounts for this changing dynamic to ensure we appropriately invest ahead of these impacts by incorporating resilience to major hazards and climate change projections. Our first Climate Adaptation Plan sets out a journey recognising the need to adapt to climate change over times as we replace aging assets, build and operate new assets for the grid and for customers, and through our proactive resilience programme.

Our ICT investments are further focused on using data and digital technology to accelerate our organisational effectiveness and deliver outcomes required to support the business. Our aim is to assist our workforce with enhanced data driven decision making, while maintaining secure and reliable services. We are continuing to review and monitor emerging trends and actively adopt technology as it matures. We are progressing well with the upcoming changes to the Transmission Pricing Methodology (TPM), with approximately 80% of the work now complete. Our focus remains on ensuring that ICT system capabilities are robust and compliant, enabling accurate determination of regulated transmission charges for our customers once the new TPM takes effect. A key investment for us is the refresh of our nationwide area network, TransGO. Several key components are reaching the end of their effective life; this is driving a major investment to modernise the network during RCP4.

Electrification of most of the energy used in our economy is happening, and the pace is only going to increase.

Expenditure overview

We forecast an increase in our base capex requirements over the next 15 years, driven by an increased work programme, an ageing asset base, and escalating material and services prices.

Our total base capex is forecast to be $2,412.9 million for RCP4. Base capex is capex incurred in relation to asset replacement and refurbishment (R&R), business support, and ICT. It includes enhancement and development (E&D) base capex that supports increasing capacity and capability of the grid. The base capex within this AMP does not include capex associated with R&R listed projects. The capex is provided separately, as shown in **Figure 1**. Commentary on listed projects is provided within the applicable asset class plan within this AMP.

Please refer to the Transmission Planning Report for commentary on all our E&D expenditure, including major capital projects.

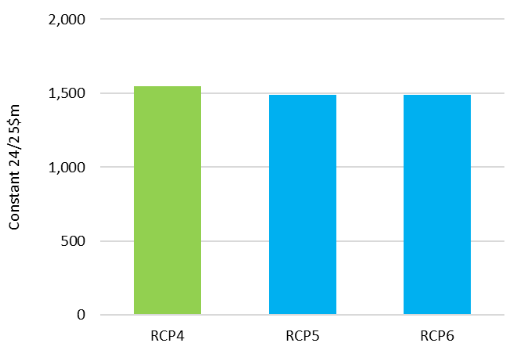
Figure 1 shows the forecast base capex, resilience, and listed projects expenditure profile for RCPs 4 to 6.

Figure 1: Base capex, resilience, and listed projects for RCP4 to RCP6

[2] Major Capex projects are detailed in our 2025 Transmission Planning Report.

Figure 2 shows the forecast opex profile over RCP4 to RCP6 for all grid, ICT, and asset management & operations. The opex costs associated with business support and other corporate opex costs are reported in the ITP Narrative document.

Figure 2: Grid, ICT, and asset management & operations, including sustainability and resilience opex RCP4 to RCP6



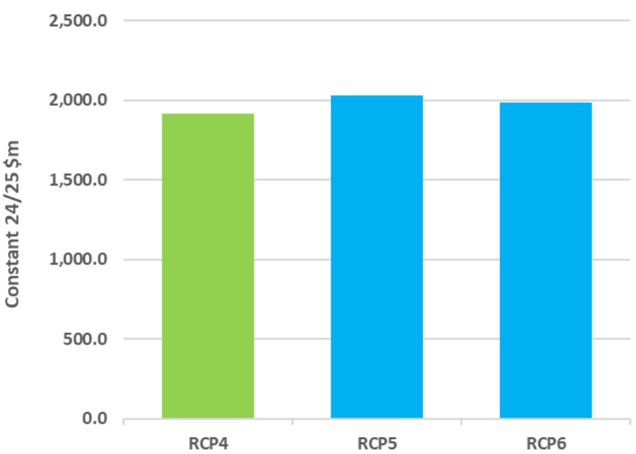
Grid expenditure

Grid expenditure detailed in this AMP covers-grid R&R capex and grid opex.

Grid R&R capex

Our grid R&R capex, excluding listed projects, is shown in Figure 3. The primary investment drivers in each RCP are discussed further below.

Figure 3: Grid R&R capex forecast RCP4 to RCP6 (excluding resilience and listed projects)



As a higher portion of our long-life higher-value assets reach their end of life, there is an expenditure increase over the next 15 years to support the outcomes sought. These outcomes include maintaining a safe and reliable network and realising improvements in resilience by replacement to current standards, improving environmental and sustainability outcomes, leveraging technology and innovation (such as our BIM strategic programme), and enabling the electrification of industry.

The grid base capex increase is primarily associated with:

- conductor replacements;
- an increase in substation asset replacements;
- the continuation of the life extension refurbishment work for HVDC and reactive support assets; and
- managing corrosion and degradation of our steel lattice towers.

The uplift in condition-driven expenditure provides a significant opportunity to align our investment to deliver on all of our key outcomes. Working with our customers will allow us to enable electrification and increase resilience of the grid assets at the least cost to Aotearoa New Zealand.

Our largest programmes of R&R work include the following:

Reconductoring

Our current modelling forecasts that during the coming 3 decades, approximately 35% of the North Island lines and 28% of the South Island lines will have sections of conductor reaching end of life and requiringe replacement.

Given the scale of possible reconductoring work, we have implemented an innovative method to reduce the scale of future reconductoring safely and sustainably through our Intelligent Conductor Management Programme (ICON). ICON utilises conductor condition information gathered through our new Digital Visual Data Capture (DVDC) programme using drones and high-definition photography. This together with defect modelling and targeted repairs, has enabled us to re-assess and validate our forward reconductoring programme.

ICON initially focused on confirming conductor degradation and the remaining life of the conductors forecast for intervention in RCP3. From this, we have been able to safely defer over 120 circuit kilometres (cct km) of reconductoring out of RCP3. We have used this model in forecasting the reconductoring need for the next 15 years. The specific projects proposed in RCP4 along with the longer-term volume forecasts of reconductoring has been validated using this information. This has confirmed that the volume of reconductoring is significantly less than initial RCP3 estimates. We initially forecasted over 800 cct kms of reconductoring needed in RCP4. Through ICON we have refined this to 314 cct km for the RCP4 period and have seen similar reductions in our forecast for RCP5 and RCP6. To date ICON has approximately halved the future investment forecast without compromising asset health or network risk. As we obtain more condition information on our lines through drone inspections, we can further refine our RCP5 and RCP6 forecasts.

Tower painting

Over recent years, we have assessed different options for managing our ageing towers. Traditionally, tower painting has been the lowest-cost lifecycle option to manage these assets. More recently, improvements in technology have helped enable reductions in the cost of alternatives such as replacing suitable towers with pole structures. Following investigation, we have now adopted a tower-to-pole strategy to address tower corrosion on a subset of our aging towers. We have identified that approximately one-quarter of our towers could be better managed through replacement with a pole structure or similar, compared with continued tower painting. These towers are generally the smaller, more lightly loaded towers on the network.

This work has also highlighted deferred tower painting, including painting within the Minimum Approach Distance (MAD), the area close to the conductor where an outage is required to carry out the work safely. The painting work we are forecasting for RCP4 and beyond now focuses on larger, more expensive towers than our original submission. Over the next 15 years we have included specific focus on MAD painting, aiming to address all MADs on towers that we paint. We expect the pole replacement programme, instead of painting, to start ramping up during RCP4, with significant volumes expected in RCP5 and 6. We will not see a corresponding reduction in the volume of tower painting for the immediate future, as we will start picking up the backlog of 'now-due' towers to be painted.

Power transformers
As our power transformer asset class ages, the need for asset renewal continues to grow. We undertake comprehensive analyses to prioritise projects, assets, and their critical components during the planning and scoping phases. This approach enables us to target specific component replacements rather than pursuing full unit replacements. Examples of site-specific solutions include installing firewalls, replacing bushings, implementing corrosion control measures, and applying other life-extension interventions.

Compared with a pure asset-health driven programme, our risk-based life-extension programme has resulted in an overall reduction in the number of total unit replacements planned. The replacement profile in RCP3 and beyond reflects the benefits that have been achieved from our risk-based strategy and implementation of life extension activities. From RCP4 onwards these life-extension opportunities begin to diminish, and we expect the number of replacements to increase again over the next 15 years.

Cost escalations continue to have a major influence on our power transformer programme. Procurement costs and lead times of power transformers have increased significantly in recent years. Other components, such as civil work, are also seeing significant inflation pressure. This has caused an increase in average unit rates across the programme.

HVDC
The majority of our HVDC assets can be divided into two categories based on their age: Pole 2 and Pole 2 era associated AC and HVDC assets (commissioned in 1992), and Pole 3 assets (commissioned in 2013). At 12 years into their operational life, most Pole 3 assets are still in relatively good condition. The Pole 2 control, protection system and some primary assets were also replaced as part of Pole 3 project.

Our investment planning is based on achieving a 50-year operational life from each HVDC pole by undertaking necessary interventions at the correct times. As such, a significant portion of the Pole 2 life extension programme has been delivered in RCP3. The replacement of the remainder of Pole 2 era primary AC assets, such as interventions to reactive support plant, refurbishment of remaining auxiliary systems, are planned for RCP4.

We have undertaken asset health modelling of our submarine cables to predict the (increasing) risk of failure and to determine when the cables require replacement.

The asset health model design is informed by a failure mode and effects analysis (FMEA) of the HVDC submarine cables. The model calculates and forecasts asset health using an expected life of 50 years combined with location factors, duty factors and observed and measured condition.

The forecast year for earliest intervention is 2032 for cables 4 and 5, and 2035 for cable 6. The intervention criteria represents an increased likelihood of failure, and as the asset health scores increase further so does the probability of failure at an increasing rate. Replacement of the cables is a risk-based decision. The planned replacement time is driven by the outputs of our asset health model with an understanding of the consequences of failure including restoration time, the lead times for the design, procurement, installation, and commissioning.

The type of cables (MIND) we require are made to order by only two manufacturers worldwide and current global demand is such that the lead times are now approximately 7 years. With those considerations, the plan is that we commence the process to procure replacement cables to ensure we can ensure a timely replacement of the three cables before 2032.

To support the current 1,200 MW HVDC capacity requires all eight existing synchronous condensers and the static synchronous compensator (STATCOM) at Haywards to be in service. A reduction in the available synchronous condensers can have an impact on the

HVDC transfer and the operation of the electricity market. To ensure high transfer capability, we are planning to perform major refurbishments on the synchronous condensers between 2025 and 2030 to improve current asset health levels. As part of the Net Zero Grid Pathway 1.1 programme, a new second STATCOM is to be installed at Haywards, to increase the availability of reactive equipment, that support the current maximum HVDC transfer level of 1200MW.

Grid opex

Grid opex consists of two components:

Grid maintenance incorporates external costs associated with maintaining the grid. This is made up of:

- preventive maintenance (routine servicing or inspections);
- predictive maintenance (maintenance performed based on condition prior to asset failure);
- corrective maintenance; and
- proactive maintenance.

Asset management and operations cover the costs related to internal staff and consultancy associated with the grid divisions such as:

- investigations relating to the enhancement and improvement of our transmission system;
- investigations work related to condition-driven replacement projects;
- innovation and exploring new technology for the grid; and
- funding of our internal workforce i.e. asset management, planning, and network operations, which is essential to enabling all work on our network.

Grid maintenance

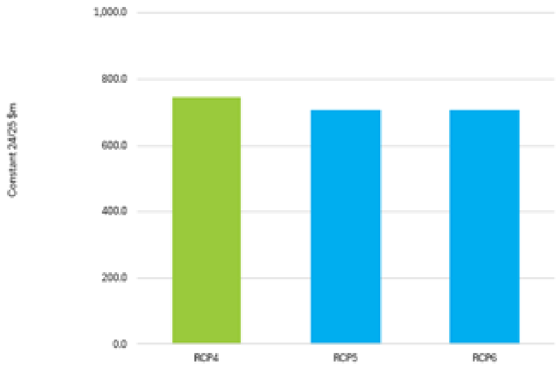
Grid maintenance covers all maintenance work on our HVDC and high-voltage alternating current (HVAC) transmission line assets, substation assets, and our communication-site and services assets (excluding communications bearer and network assets[3]). It is undertaken to address in-service deterioration of our assets, respond to transmission faults, proactively improve the assets, and implement projects to replace asset components.

Our approach to long-term grid maintenance is to optimise our time-based maintenance through risk-based analysis. This approach establishes maintenance tasks for each specific asset where the intervention and the timing are determined based on factors such as current asset condition, historical reliability and criticality of the asset.

ICT infrastructure is integral to our grid maintenance activities and a key area for our continued investment in innovation, efficiencies, and optimisations. This includes our core systems such as our asset information system (Maximo), our asset management planning system (AMPS), our inventory management, and our Health and Safety Management system. The ongoing investment and development of our field workforce mobility app (Mātai) has improved the speed and accuracy of collecting grid maintenance information, which is a key input into our asset planning process.

Our forecast grid maintenance is shown in **Figure 4**. RCP4 expenditure reflects an increase in work to enable deferral of capex, specifically an increase in our coverage of condition assessment information on conductors, increased maintenance on some towers to enable the tower to pole programme, and our improvements in sulphur hexafluoride (SF6) management. These increases are partially offset by improvements made through our preventive maintenance optimisation programme, which has allowed us to reduce preventative maintenance activities while maintaining the reliable and safe performance of the grid. Additionally, there is a reduction in capex as maintenance activities allow deferral of replacement of assets. We are forecasting a reduction in RCPs 5 & 6 due to expected realisation of maintenance efficiency opportunities, and the completion or near completion of some of our maintenance programmes.

Figure 4: Forecast maintenance expenditure, RCP4 to RCP6 (excluding resilience)



Asset management and operations

Our asset management and operations expenditure incorporate the essential costs for enabling the work on our network, including asset management, planning, scheduling of works, investigation, innovation, business improvement and network operations. It includes all the costs that are not allocated to capex in new assets (in accordance with our capitalisation methodology), including staff time and professional services.

The costs of ancillary services related to black start, over-frequency reserves and a share of instantaneous reserves, which support the operation of the power system, are also included.

The key asset management and operations activities are:

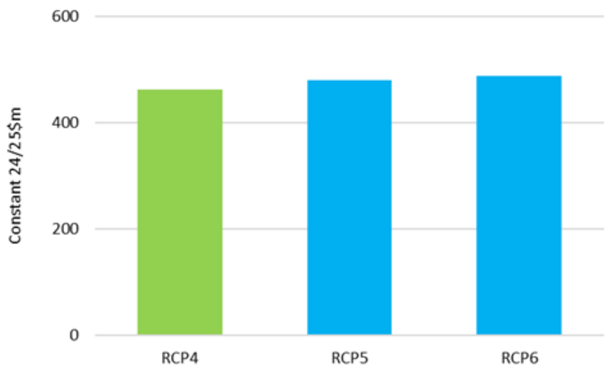
- long-term strategic planning for network assets while providing the required service levels;

[3] Maintenance of communications assets is described in the IT Portfolio Plan – Telecommunications, Network, and Security

- tactical planning to develop solutions to maintain and enhance the asset base in line with long-term development strategies;
- programming and scheduling of works based on the portfolio plans developed in the decision framework;
- safe and efficient delivery of project-based enhancements, refurbishments, and renewals;
- interfacing with service providers for scheduling and efficient delivery of maintenance programmes; and
- building on investments in digital switching and optimisation of outage processes, alarm rationalization and improved workflow management to deliver efficient day-to-day grid operation and real-time management of operating centers.

Our asset management and operations expenditure is shown in Figure 5. Expenditure is primarily driven by the increased internal resources necessary to plan and deliver the increased investment programme over RCP4 and RCP5.

Figure 5: Asset management and operations expenditure including sustainability



[3] ICT Strategy 2020

ICT expenditure

Our ICT portfolios encompass the ICT infrastructure and applications that interface with the grid and enable our corporate processes and systems; they cover communications, cybersecurity, and end-user services. Our overarching ICT strategy[3] is to:

- use data and digital technology to accelerate our organisational effectiveness and deliver outcomes required to support the business in delivering our objectives against the challenges presented in *Whakamana i Te Mauri Hiko*;
- enable our workforce with enhanced data-driven decision making through investments in data and analytics and BIM; and
- evolve our future workforce while maintaining reliable and secure services, streamline our processes and drive better maintainability, supportability and cost-effective outcomes, with a focus on risk-based cybersecurity investments.

Figure 6 outlines our approach to ICT investments. We respond to strategic priorities while taking advantage of opportunities enabled by emerging technologies and market trends. Overall, we consider that there is potential in future years to further enhance our business and processes by, for example, continued adoption of the Anything-as-a-Service (XaaS) model for modern cloud-based services, enhanced use of data and analytics, adopting digital workplace technologies and intelligent systems as they become sufficiently advanced.

Figure 6: ICT Strategy enabling the acceleration of our organisational effectiveness

ICT capex and software-as-a-service (SaaS) opex

Our delivery model is shifting to incorporate increasingly more Anything-as-a-Service (XaaS) solutions, including but not limited to Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). Historically, these costs have been accounted for as capex. However, in April 2021, the International Financial Reporting Standards (IFRS) interpretations committee published a decision on how entities are to account for the costs of configuring or customising a supplier's application in SaaS arrangements. The implication of this decision is that SaaS costs will be expensed instead of capitalised. Our RCP4, and RCP5 forecasts will see a shift in cost classification from capex to opex for SaaS-related initiatives. Our portfolio level overviews present both capex and SaaS opex together for comparative purposes.

The strategic direction for our base capex and SaaS opex forecast is listed below by portfolio[4].

Asset Management Systems. The strategic direction for the non-recurrent modernise, benefits and compliance driven investments in this portfolio is set out in *Asset Management, Network Risk and Planning systems, and Enterprise Information & Data* sub-strategies. These enable us to take a holistic approach to progressively digitise and transform our asset management processes, improve information sharing and collaboration, and implement maturity improvements as outlined in our Asset Health and Network Risk Roadmap[5].

Transmission Systems. We have developed a strategy to modernise our supervisory control and data acquisition (SCADA) systems as outlined in our *Energy Management Systems and SCADA* sub-strategy. Our *Transmissions Systems* sub-strategy sets out our approach to modernising our grid-switching operations that are becoming more complex as work on the grid increases and increasing customer connections impact grid operations. Some examples of work ongoing in this sub-strategy include investment in digital switch management as a key enabler for remote switching capability in our substations, outage planning, and improvements in our current device configuration management. Both sub-strategies enable us to support our grid operations teams

[4] ICT portfolios are described in section 2.1.1h

[5] Asset Health and Network Risk Roadmap

to effectively manage the grid as we move towards a net zero carbon future.

Corporate Systems. The strategic direction for the non-recurrent modernisation, benefits and compliance driven investments in this portfolio is set out in *Enterprise Business Capability*, *Customer and Stakeholder Engagement*, *Transmission Pricing and Compliance* and *Enterprise Information and Data* sub-strategies. We intend to progressively digitise and transform our corporate processes and improve our collaboration and empowerment across internal and external stakeholders to achieve higher levels of business performance.

ICT Shared Services. Our ICT Shared Services portfolio supports the ICT infrastructure, systems and processes that are required for the delivery of ICT services. The focus of the ICT Shared Services portfolio investments is predominantly on risk-driven lifecycle changes to ensure we continue to proactively maintain our ICT assets by upgrading them to remain supported and fit-for-purpose. The strategic direction for the non-recurrent modernise, benefits and compliance driven investments in this portfolio is set out in *Data Centre Services Modernisation* and *Digital Workplace* sub-strategies. We plan to continue with optimising our data centre footprint by adopting a more "as a service" approach. We will adopt a considered pace for this transition, aiming to reach the target state in the second half of RCP4. This will allow the market in New Zealand to mature and our critical applications to evolve to better utilise these services.

IT Telecommunications, Network and Security Services. Our Telecommunications, Network and Security Systems (TNSS) portfolio delivers services that provide a secure, high capacity and nationwide communications network and includes services ensuring the end-to-end protection against cybersecurity threats to our people, systems, and data. The strategic direction for this portfolio is to modernise our telecommunications network to ensure it continues to meet the needs of the business and is covered by the *Infrastructure* and *Telecommunications* asset lifecycle management strategies for recurrent maintain investments and by the *TransGO Refresh* and *Cybersecurity* sub-strategies for non-recurrent modernise and benefits driven investments.

In addition to the above base capex and SaaS opex portfolios, we are maintaining a forecast for regulatory purposes for the following:

Transmission Pricing Methodology (TPM) – ICT Enablement in RCP4. As regulations continue to evolve, we are building on the foundational work completed in RCP3 to further enhance our ICT capabilities in support of the Transmission Pricing Methodology (TPM). In RCP4, we are implementing several initiatives that were not undertaken in RCP3, including:

- Enhancements to support Regulatory Asset Base Indexation, Prudent Discount, and Benefit-Based Investment calculations;
- Continued development of the GMS Tool, which provides critical input into TPM calculations;
- Expansion of data publication capabilities to support the development of consumable and transparent reporting; and
- Planned ICT investments in the latter part of RCP4 to support any substantial changes to the Transmission Pricing System (TPS) following operational reviews of the TPM.

These initiatives will ensure that our systems remain compliant, robust, and capable of supporting the evolving regulatory landscape.

RCP4 and RCP5

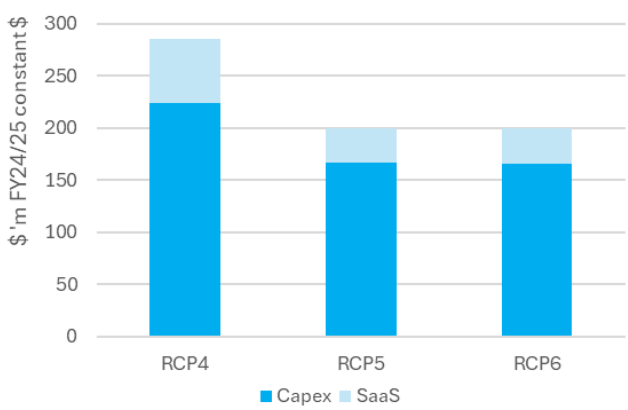
We estimated the need to increase our ICT expenditure to enable continued digitisation of our assets and to support delivery of a larger work programme.

Increases in ICT expenditure during RCP4 are primarily driven by the refresh of our TransGO network. This resulted in an uplift of approximately 17% in ongoing expenditure.

Looking ahead to RCP5, we expect spending to be maintained or further increased as we continue to adopt emerging technologies and scale our digital capabilities.

Over the long term, it is difficult to predict with certainty what technologies we will commission or exactly what techniques will be used to deliver them. Maintaining agility has the advantage of allowing us to consider emerging, cost-effective technologies and to adopt them if they are sufficiently mature. As such, we will continue to refine our forecasts over the period.

Figure 7: ICT Capex and SaaS opex forecast by RCP (including TPM)



ICT opex

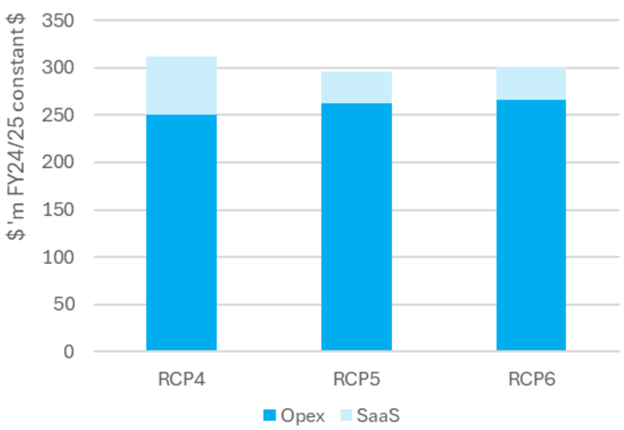
Our ICT opex covers the external costs to run our ICT function and comprises non-capitalised leases, third-party support and maintenance, outsourced services, licences, communications and control and investigations.

We applied the base-step-trend approach to forecast our opex for RCP4. We used the FY22/23 actuals as a base from which adjustments are forecasted due to known initiatives and trends. This aligns with grid opex which also used FY22/23 actuals as the base.

We believe that the costs of commodity ICT solutions will continue to rise in the long term, and Transpower's ICT support costs will increase to reflect our investments in new and expanded ICT solutions in support of the grid. As we continue to optimize our data centre footprint, we will progressively adopt cloud-based technologies for non-critical systems where it is cost-effective and practical. This includes a mix of Software as a Service (SaaS), Infrastructure as a Service (IaaS), and Platform as a Service (PaaS) solutions. We recognise that many of Transpower's ICT systems are critical to the secure operation of the grid and must be managed to ensure high availability and robust security. While increases in cloud service subscriptions are expected, these will be partially offset by reductions in traditional server support costs.

We continually review the balance between in-house and outsourced solutions to ensure operational support is cost-effective.

Figure 8: ICT opex forecast by RCP



Network Resilience

A resilient transmission service avoids extended power outages and quickly restores power when major events occur. It also ensures we fulfil our obligations as a Lifeline Utility under the Civil Defence Emergency Management Act 2002.

Major events stem from both natural hazards and asset-specific hazards. Relative to our international peers, a large proportion of our infrastructure is exposed to a broad range of natural hazards. Impacts from these hazards on our infrastructure could lead to a widespread and significant service interruption.

Changing climate exacerbates many of these threats and, together with increasing customer expectations of uninterrupted service, places expectations on us to invest appropriately to build resilience.

Our key objectives and strategic approaches are described by the four areas of resilience known as the 'four R's'.

- **Reduction:** Identification and mitigation of network vulnerabilities.
- **Readiness:** Contingency planning and preparation for major hazards.
- **Response:** Immediate actions before, during and after an event to make safe, and restore supply.
- **Recovery:** Post event reinstatement of network to provide pre-event security or better asset capability and supply.

Our capability to plan for resilience has matured significantly in the last few years, and we have dedicated funding for resilience workstreams in RCP4. Historically, our resilience investment has occurred as part of asset replacements by rebuilding to modern design standards. This investment has not been identified or tracked as resilience in the past because it has typically occurred through grid upgrades and asset replacement, rather than through targeted investment programmes.

The programme focuses on proactive investment on vulnerable and critical assets to reduce risk and improve readiness.

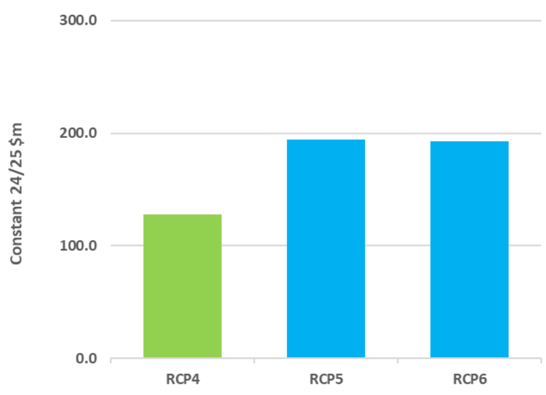
The programme includes improving readiness and risk reduction for substation flood risk, seismic risks, building fire, volcanic ash impacts, land stability, common mode failures and wind and flood strengthening for towers. We are continuing to investigate mitigations for solar storm impacts and have the option to apply for additional funding for transformer mitigations during RCP4.

Some of the climate change related investments form part of the Transpower Climate Change Adaptation Plan[6], which is required as part of Aotearoa New Zealand's first national adaptation plan.

Capex for the resilience programme is forecasted at $127.5 million in RCP4. In addition, under the uncertainty mechanism, there is a further $38.1 million of unapproved resilience work, which forms part of a possible reopener. RCP5 and RCP6 capex are forecast at $194.7 million and $192.8 million respectively. This is shown in **Figure 9**.

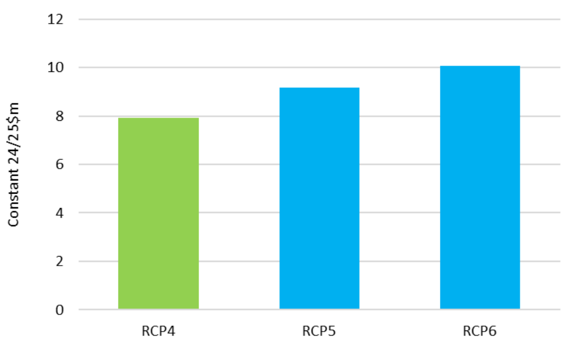
Figure 9: Grid resilience base capex

[6] Our Climate Adaptation Plan was published in September 2024



Opex for the grid resilience programme is forecast at $7.9 million in RCP4. Our resilience opex includes both emergency exercises and operational interventions to mitigate risks, where these are more appropriate than capex interventions. **Figure 10** shows our resilience opex for RCP4 to RCP5.

Figure 10: Grid resilience opex



Our resilience forecasts will continue to change as our approach matures, we continue to consult with our customers and stakeholders, and we continue to learn more about both the impact of natural hazards, and the cost effectiveness of our investments.

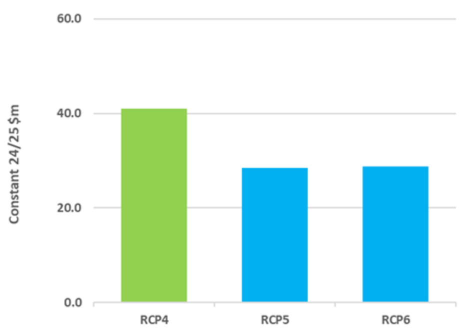
Business support expenditure

Business support assets cover our office buildings, vehicles and office equipment including office desks, chairs, meeting room furniture, laptops, and mobile phones. Since the relocation of our Wellington office in 2017, our business support expenditure has trended downwards. There are various refurbishments planned for our offices through RCP4 and we will continue to replace our passenger vehicles with plug-in hybrid or electric vehicles through RCP4.

Expenditure on the buildings and facilities that house and enable our grid assets such as control rooms, relay rooms, switchrooms, and substation grounds is all covered within our Buildings and Grounds asset class plan (ACP) and are not included within the business support expenditure profiles.

Our forecast capex is shown in **Figure 11**.

Figure 11: Business support capex by RCP



Uncertainties and risks

As already noted above we are facing increasing costs with inflationary and resourcing pressures across all parts of the supply chain, alongside an ageing asset base, and acceleration of ICT technology development.

We continuously monitor and evaluate our plans taking into account factors such as the latest asset health information, life extension modelling, emerging technology, and system need. As new information becomes available, we prioritise our workplan and expenditure accordingly. As with any long-term plan, the integrity and accuracy of the details tend to be more accurate in the earlier years as it is easier to predict the near-term state of our assets and required actions, plans and expenditure.

In the longer term, continued acceleration of ICT development and the adoption of value-driven SaaS solutions will almost certainly drive changes in forecast expenditure. We continue to monitor and evaluate the acceleration of ICT technology development, which is expected to influence future expenditure benefits. Hence, while the forecast expenditure is based on the best information we have today, expenditure beyond 5 years is relatively uncertain and will likely change as we adopt emerging technologies. We will utilise substitution mechanisms to accommodate these changes.

The forecast increase in workload, changing legislation, and consenting requirements will affect all our work in the field and require a step change in our resourcing. We expect the increase in grid work to be a long-term challenge. Coincidental increases in demand for these resources across the industry will compound the challenges and will likely put upward pressure on resourcing costs. We are undertaking initiatives to support workforce growth to support the RCP4 work programme.

Our Asset Management Approach

Our Asset Management Approach

A reliable and safe electricity grid is a foundation element of a modern economy. The importance of the grid only increases in the context of Aotearoa New Zealand's 2030 Paris Agreement, the 2050 net-zero carbon commitments, as it becomes core to enabling the further development of electrification and renewable energy projects around Aotearoa New Zealand. Our company-wide strategic and performance framework links our purpose and values to our strategic priorities, asset plans and performance measures, through to the work our staff and partners do every day.

Whakamana i Te Mauri Hiko[7] describes our changing strategic context, with climate change and other key trends creating the foundation for a scenario-based view of Aotearoa's energy future. Our corporate strategy *Transmission Tomorrow – Our Strategy*[8] (our strategy) builds on this context by setting out how we go about planning and developing the grid. It lays out our five strategic priorities and six performance objective areas.

Our asset management activities for both our grid and our ICT assets are directed by our company-wide strategic and performance framework. The six performance areas are detailed within our Grid Business Strategic Asset Management Plan, as shown in **Figure 12**. For each area, our Grid Network Strategy identifies network objectives which enable us to meet our objectives. The five strategic priorities are detailed within our ICT strategy, which defines our ICT strategic objectives as shown in **Figure 6**.. While our strategic context continues to evolve, the five strategic priorities in our strategy reflects the need for action and coordination across the industry to enable the electrification of Aotearoa New Zealand.

Our grid and ICT asset management approach is described below.

Grid asset management

Our asset management goal is to balance the cost, risk and performance of our assets to ensure the grid delivers reliable, safe, sustainable, and cost-effective transmission services.

Grid Business Asset Management System (AMS)

Our AMS enables coordinated activity to ensure we provide safe, reliable, and cost-effective electricity transmission services. It ties together and aligns everything we do in asset management to ensure good practice is embedded into all levels of our asset management activities, from senior leadership decision-making to delivery of assets and maintenance interventions. The assets within our AMS include the physical grid assets, as well as our systems, processes, information, and people.

Figure 12: Our strategic and performance framework

[7] *Whakamana i Te Mauri Hiko* can be found here.

[8] *Transmission Tomorrow – Our Strategy* can be found here

Table 2: Asset management divisions

Asset category	Divisions	Responsibilities
Grid asset management	Grid Development	Responsible for identifying the future needs that users of the grid require over the next 20-30 years; strategic asset management; asset planning, delivery of engineering support for grid assets; asset information, and developing an economically justified AMP that delivers capability at the right time and the right cost while ensuring least lifecycle costs for grid assets
	Future Grid	Responsible to develop Te Kanapu, a 'Grid Blueprint' for Aotearoa. The Grid Blueprint will be a whole-of-system plan for New Zealand's power system that identifies an Optimal Development Path – what to build where, and when. It will pull together a vision for the transmission grid of the future (2050 and beyond) and show how long-term planned and coordinated investment can support both net zero and economic growth.
	Grid Delivery	Responsible for undertaking maintenance to maintain the performance of our grid assets such as substations and transmission lines; the project management of refurbishment and replacement works, grid enhancements, and customer-funded projects
	Grid Operations	Responsible for operational control of grid assets to enable equipment outages for maintenance or other works and ensure safe accesses for work crews. Responsible for real-time communications and coordination with service providers and the System Operator before, during and after planned and unplanned outages, including engagement and communication with customers on the scheduling and delivery of workplans and outage coordination and commissioning of new equipment onto the grid
	Customer and External Affairs	Responsible for influencing environmental legislative and policy frameworks; Transpower's environmental management system and compliance; customer solutions, regular stakeholder engagement with a range of groups and individuals such iwi and landowners, and corporate communications
ICT asset management	Information Services and Technology	Responsible for maintenance and development of Transpower's ICT and development of asset management maturity of these assets
Business enabling assets and support functions	Corporate Services	Responsible for and provides a wide variety of services including finance, procurement and supply, treasury, and risk and assurance.
	Strategy, Regulation, and Governance	Responsible for the development and implementation of Transpower's business strategies; innovation and strategic change. Accountable for the RCP proposal process; delivery of the EMS Tradepoint service; oversight and management of all legal advice; development of corporate compliance framework; and administration of the Transpower Board and subsidiaries.
	People Services	Responsible for the company's corporate office property portfolio, oversight of health, safety and wellbeing, human resources and workforce development

Governance

Our overall corporate governance structure incorporates integrated checks and balances which ensure appropriate oversight during the development and execution of our asset management activities.

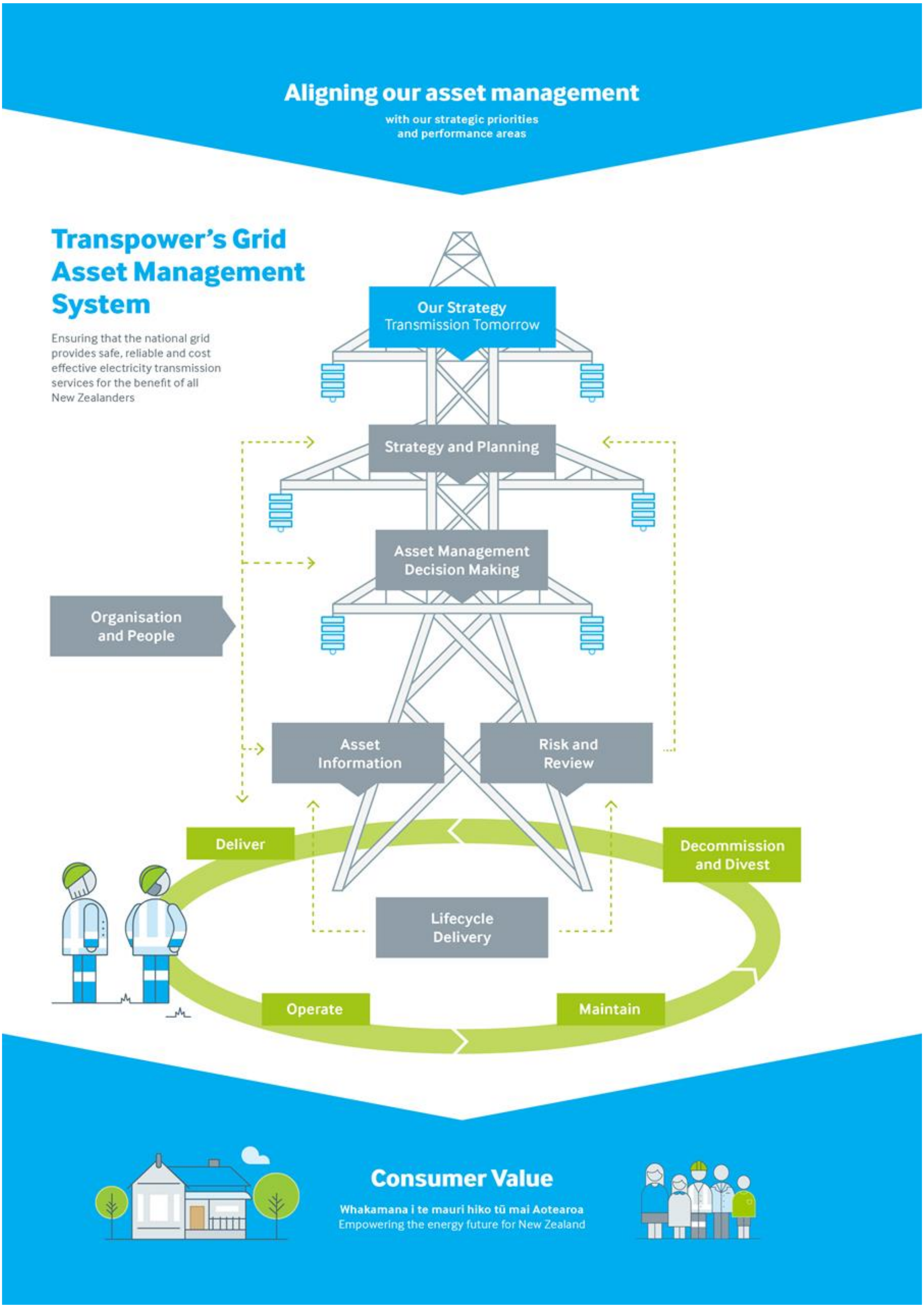
Governance of the AMS is provided by our Management Operating System, Executive General Management Team, and Board of Directors.

We maintain organisational roles, responsibilities, and authorities consistent with implementing our policies, strategies, and plans. This includes executive management oversight and review. Asset management decisions within Transpower reside with the divisions as described in **Table 2**.

AMS

The main activities and information flow within our AMS is shown in **Figure 13**. It reflects a holistic approach to asset management. Our AMS is captured in our asset management documentation.

Figure 13: Our AMS



Grid strategy and planning

The grid strategy and planning function aligns our asset management activities, and the outputs from our assets, with our organisation objectives from Transmission Tomorrow – Our Strategy. This stage consists of several interrelated activities used for asset planning. These require understanding asset management drivers, identifying, prioritising and integrating options, and estimating project costs.

Grid asset management decision making

Effective asset management decision making is essential to maximise the value realised over the lives of our assets. The group of activities within this component of our AMS considers the challenges faced and the approaches to decision making throughout the asset lifecycle.

The Asset Planning Decision Framework (the Framework) provides a consistent, repeatable, risk-based approach for asset planning decisions. The key drivers for investment are safety, network performance, future demand, risk of asset failure, and cost performance.

A simplified representation of the Framework is in Figure 14.

Within the decision framework process, there are four key decision steps.

Identify the need. A need is a clearly defined problem and/or opportunity to be addressed. The need can arise from asset health, asset feedback, and alignment with other work such as resilience improvements, grid enhancements or customer funded work. Identifying the need includes establishing a need date, and the planning lead time (i.e. the total time required to identify the solution, approve the delivery business case, and complete/commission the delivery project). A need can include a group of problems that have a common solution.

Assess options for each need. Options to address the need are assessed. Where a sole option is prescribed by an asset class strategy, other options are not generally considered. Needs that are complex, expensive and imminent receive more rigour than those that are simple, inexpensive, or more distant in the future. A do-nothing option, representing the status quo, is always considered.

An option assessment will normally account for:

- all lifecycle costs to deliver, maintain, operate, and dispose of the option
- residual risk costs associated with the option, where the need date is not solely based on asset age or condition
- benefit, including risk mitigation or opportunity value, provided by the option
- maximum net benefit that can be provided by the option and the associated need date
- changes in the net benefit that result when the need date is delayed or advanced

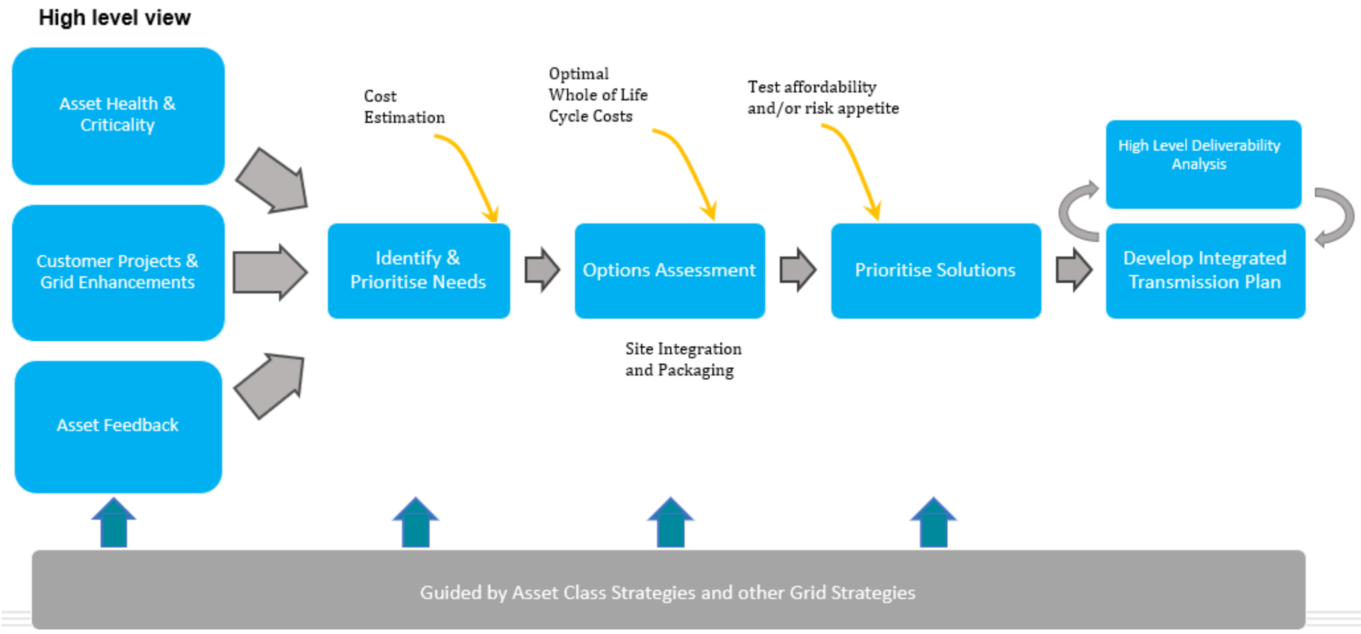
sensitivity analysis where two options have the same net benefit.

The option with the highest net benefit, subject to sensitivity analysis, is selected as the solution.

Prioritise solutions. Solutions are, in the first instance, prioritised based on need dates. Where based on a risk assessment, further prioritisation is undertaken based on magnitude of net benefits, with solutions with the highest net benefit prioritised first. Where available, criticality is also utilised in prioritisation.

Develop a plan. A plan is developed to ensure solutions can be delivered feasibly, reliably, and efficiently, including accounting for funding and deliverability constraints. If all solutions cannot be delivered by the need date, we will consider initiatives to increase delivery or potentially re-phase work based on priority. The need date is the required commissioning date.

Figure 14: Asset Planning Decision Framework (simplified)



Lifecycle delivery

Most asset-related expenditure is invested in our lifecycle delivery activities. A focus on integration of activities across the lifecycle, strategy and planning, and asset management decision-making stages enables us to reduce costs.

Deliver

Our priority is to deliver capital investments, maintenance projects, and life-extension work safely and cost effectively. Doing so requires us to continually challenge and improve our standards and specifications, engineering design, project planning, project management, and construction skills to deliver the required quality and reliability to customers.

Operate

We operate the grid to deliver a safe and reliable transmission service to our customers. This involves the planning and management of access to assets to optimise network availability while enabling maintenance and construction to be carried out safely.

Maintain

Assets on our network are maintained to ensure they remain safe, secure, and reliable. Decisions are made to ensure we effectively balance capital and operational investment when developing our maintenance approaches.

Decommission and divest

Asset disposal occurs when an asset is at the end of its useful life. There are a number of ‘triggers’ for disposal decisions, including poor condition, changes to safety or environmental standards, or changing need for the asset. Asset divestments, such as transfers to electricity distribution companies and other parties, are also made when they align with our long-term strategy and commercial interests.

Asset information

Good asset management relies on robust asset data and information. Our asset information systems capture our data and information, including quality requirements.

Good asset data has a critical role in driving better decision-making. Most of our asset strategies require consideration of condition and risk-based asset replacements to maximise our asset lives and minimise risks. We have significantly improved our asset information governance and invested in improving our collection and management of asset data, so that we can make decisions based on complete and accessible data. This challenge is significant but necessary, so our data, standards, and processes are fit-for-purpose.

We aim to collect the right data, of the right quality, at the right time, first time. We supply our service provider field staff with condition assessment photo guides and asset specific guidance on ratings, useful for driving consistency across service providers. For our substation and transmission lines assets, we have implemented a field mobility app enabling our service providers to access maintenance documentation and complete several tasks such as maintenance inspections, condition assessments, raise and manage defects, verify defects, add landowner notes, capture photos, and then upload directly to our AMS. This improves efficiency and simplifies capture, recording and reporting, ensuring up-to-date, quality data.

Drone use is now fully operational. Drones with high-resolution cameras flown by fully trained operators are now used for inspecting substations, structures, and lines. Drone use has a lower risk profile and increased safety benefits compared with traditional helicopter and climbing inspection methods and will reduce the need for outages. Drone use has, for example, allowed for urgent nationwide SF_6 outdoor circuit breaker inspections to be completed without the need for any outages, reducing the inspection programme from 12 months to 6 months, providing significant cost savings.

Our data management and analytics practice teams assist with modernising our enterprise data management and reporting platforms, supporting further enhancement of our asset information business capabilities, and streamlined delivery of asset information, which support asset management business decisions. We recently commissioned a new, centralised repository (integrated with our core applications) for storing photos and multimedia to ensure this content is easy to find, access and share.

Organisation and people

Our people and the structure of the organisation are highly interdependent and exert strong influences on our ability to adopt and embed asset management successfully. Therefore, we invest time and effort in ensuring we attract, develop, train and retain employees with the skills, performance, and behaviours that will support the successful delivery of our asset management strategy and objectives. This is important for delivering the level of business integration that characterises more mature asset management capability.

Our Grid Asset Management Policy

Our Asset Management Policy guides development of our asset management strategies, plans, and activities. It outlines the following principles.

- Alignment – ensure our asset management activities align with Transpower's strategic priorities and enable us to meet its safety, people, customers, financial, relationships, and sustainability performance targets.
- Legislative compliance – ensure we comply with all relevant laws and regulations.
- Customers and Stakeholders – consult our customers and stakeholders on matters relating to the management of our grid assets.
- Planning – ensure we apply good electricity engineering practice to our asset management activities.
- Resources – ensure we assign enough resources (people and money) to deliver on our asset management obligations.
- People – ensure our employees are trained, competent, and demonstrate a commitment to and understanding of asset management.
- Operation – ensure our grid assets deliver the performance expected of the grid by our customers and stakeholders.
- Improvement – ensure continuous improvement of our asset management system through effective systems and setting measurable objectives and targets.

Risk and review

Risk and review includes the identification, understanding, and management of risk, and the establishment of effective feedback and review mechanisms. Collectively, these activities provide assurance that objectives are being achieved and enable the continuous improvement of our asset management activities. It provides important inputs to our strategy, planning, and asset management decision-making through monitoring asset health and the performance of our assets.

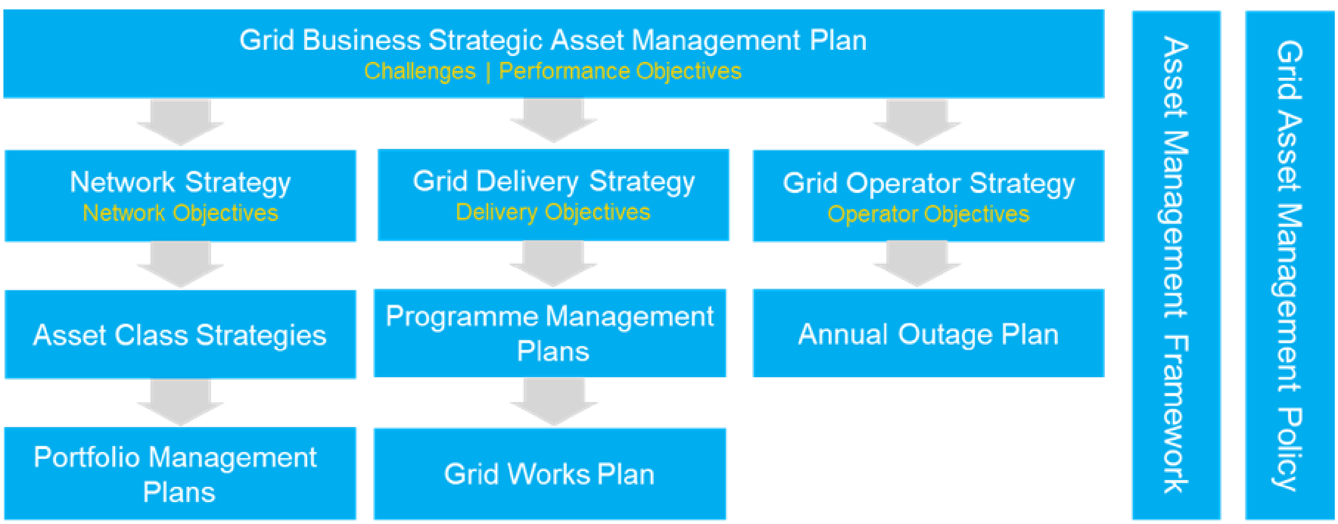
Grid asset management documentation

Our AMS is supported by our documentation.

Figure 15 illustrates the key grid asset management documents.

The grid business Strategic Asset Management Plan (SAMP) provides alignment between our corporate purpose and strategy and our grid business. It highlights the grid business challenges and identifies performance objectives to address them. Our Asset Management Policy guides the development of our asset management strategies, plans, and activities.

Figure 15: Grid asset management strategic documents



The grid AMS Framework describes the key functions and activities, including the activities undertaken by our service providers and engineering consultants within our AMS. It is available for use by staff and contractors to understand the scope of the AMS and their teams' role in enabling our asset management objectives to be met.

Our Network, Grid Delivery, and Grid Operator strategies translate our SAMP's objectives and performance targets into activities and objectives that can be understood by those responsible for implementing them in our grid divisions. The asset class strategies provide the detail on how we intend to drive and achieve our asset management objectives. They set out approaches specific to the management of individual asset classes throughout their lifecycles.

The Portfolio Management Plans (PMPs) apply the relevant asset class strategy and describe the detailed planning approach for that portfolio of assets. In some cases, more than one strategy will apply to a PMP. Our PMPs contain forecast expenditure for 15 years.

Programme Management Plans describe the end-to-end delivery cycle for certain groups of asset portfolios. Programme Management Plans are grouped by asset portfolios having similar delivery methods so often address multiple PMP's. The focus of the Programme Management Plan is the period covered by the 2+1 year rolling plan but may also include reference to longer-term strategic risks and opportunities in the relevant programme.

The Grid Works Plan is a list of grid project work across the grid that Transpower intends to deliver within the next 5 years. It provides a view of all grid project work planned (certain and uncertain) and allows service providers to resource, price, and plan for delivery of the relevant works.

The Annual Outage Plan details all outages for the current year. The annual plan is required under the outage protocol with the Electricity Authority.

Procurement

The global energy transition to electrification is underway and this will continue. Large scale electrification globally, has resulted in grid expansion around the world, and competition for essential transmission infrastructure components. Competing demand has put further pressure on existing supply chain bottlenecks with costs and procurement lead times increasing.

We are responding to global competition by taking steps to manage and mitigate the risks to our supply chain through improved planning, working closely with our suppliers, earlier ordering, holding increased safety stock levels to buffer against potential disruptions and investing in greater warehouse capacity.

Cost estimation

We use the Transpower enterprise estimation system (TEES), a cost-estimation tool, to support development of cost estimates for capital and cost database maintenance grid projects. TEES is integrated with our core planning and financial management systems (Asset Management Planning System and Financial Management Information System). It provides repeatable estimating and centralised management for foreign exchange and commodities escalation for the estimates created within the system, supporting estimation accuracy, and ensuring project forecasts are automatically updated as delivery dates shift.

Projects are classified as either volumetric or non-volumetric works. Volumetric are less complex, high-volume work and use building blocks to derive an estimated cost. Non-volumetric are large scale, complex projects that require investigation, optioneering and detailed design. These projects typically follow a defined investigation framework, and estimates are customised based on an agreed technical scope/basis of design. The two methods for estimating projects are as follows.

1. **TEES building blocks.** Typically used for volumetric R&R or maintenance projects allocated to service providers. Each building block has an agreed scope from which costs are derived. The cost components include materials, equipment, design, and overheads (internal and service provider). The methodology for updating or creating building blocks includes historical analysis of past projects, benchmarking against specific projects, and custom estimate build-up for new activities.

2. **Custom estimates.** Typically used for complex, large-scale projects where there is a high degree of site-specific variation or custom design and optioneering. The cost estimates for project deliverables are informed by a basis of design and built in TEES using cost data.

While both methods use cost data in the master cost library within TEES, building blocks are adjusted when service provider contracts and rates for allocated work are re-set.

Cost data is updated annually to reflect changes in market rates or how work is delivered (including new standard designs, legislation, or technology changes). These updates are applied to all active estimates in the database i.e. projects that have yet to be started.

We continue to deliver changes lifting the efficiency and capability in our cost estimation processes and systems, including a focus on TEES cost data integrity and alignment to the Association for the Advancement of Cost Engineering (AACE) standards and good practice estimation frameworks. Key outcomes are to improve feedback loops for cost data and analysis to improve the delivery of work programmes and estimation accuracy.

Corridor management

Maintaining our relationships with communities, iwi, and landowners to ensure we can continue to access and maintain our assets is essential to network management.

We need access to our assets for routine inspection, maintenance, to resolve incidents, and for quick response in emergency situations. We must protect our current and future network from development that might impact on safety or constrain our operations.

In this context, we continue to secure corridors through implementing the National Policy Statement on Electricity Transmission into regional and district planning documents. This work will ultimately result in council plans that will provide balanced controls on what can and cannot be developed in transmission corridors and adjacent subdivisions, in order to control inappropriate under-build. Likewise, appropriate buffers are sought around substations to protect against reverse sensitivity issues and to provide future protection on cable routes where appropriate. We have considered ongoing requirements for corridor management in our maintenance budget allocation.

The Resource Management Act (RMA) is about to be replaced by two new statutes (Planning Act and Natural Environment Act). We anticipate a 5-to 10-year transition as we move from the current RMA legislation to the new Acts' planning policies and instruments. As such, how we interact with local authorities, communities, iwi, and landowners will likely change at the regulatory level. Our legal and environmental teams will be actively involved in preparing Transpower's submissions on the legislation to promote our ongoing ability to develop and maintain the transmission network.

Technical standards and policies

Technical controlled documents (including design standards and standard drawings) are a cornerstone for managing asset risk. They cover design, procurement, construction, and operation, and incorporate legislative requirements, external standards, lessons learned and good industry practice. Such documents help ensure assets are built to meet our strategic objectives for each asset class.

We maintain a set of controlled documents that are an important part of our asset management process. They cover design standards, service specifications, and operating instructions. They refer to codes of practice or industry standards where relevant.

Standards typically cover technical or policy matters. They are required to go through a managed review and approval process. Table 3 describes the types of policies and standards that we use in our asset management processes.

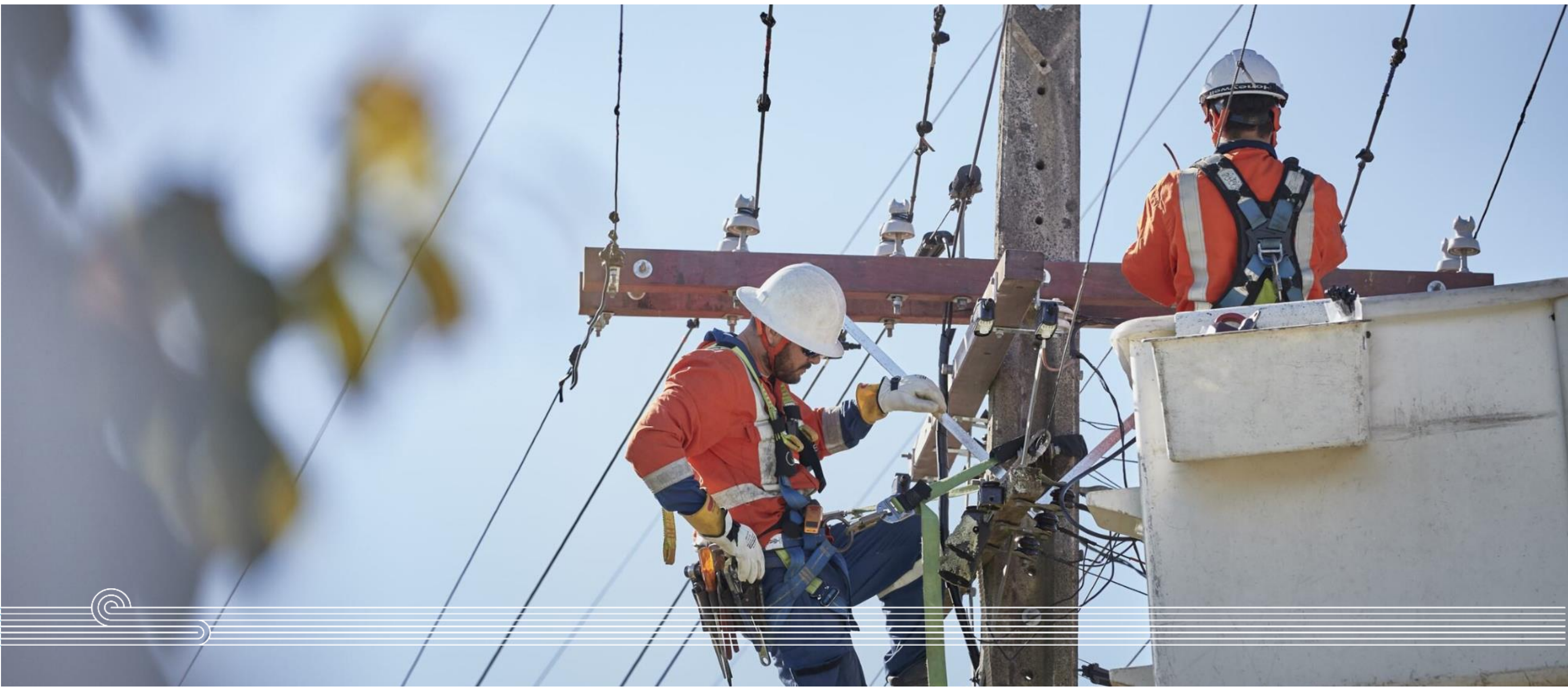


Table 3: Document and policy types used in our asset management process

Document type	Definition
Corporate policy	Represents the core requirement of good governance (such as the code of ethics and conduct policy) and/or are applicable across the company
Asset strategy	Sets out strategy and objectives in relation to assets or asset lifecycles
Technical policy	Specifies our policy on general commercial and technical issues (e.g. asset maintenance or replacement.) They are split into: • general policies • lines policies • stations policies • communications and computing policies • protection policies • outage coordination
General and technical standard	Specifies approved systems, guidelines, and processes and defines a minimum level of compliance. They are split into: • administration and management standards • design standards • maintenance standards • construction standards • operations standards • procurement standards
Service specifications	Are published as schedules to contracts, incorporating the requirements of appropriate standards. They are split into: • administration • equipment maintenance • design, construction, and testing • environment and landowners • safety and worker competence • operating and emergency management • commissioning
Service advisory	Interprets, extends, or provides supporting information for a standard or service specification
Standard maintenance procedures	Sets out step-by-step procedures for scheduled services on each asset type
Procurement specification	Specifies the performance and technical requirements for equipment and materials to be purchased for Transpower use
Operational procedures	Operational procedures for control room-based activities
Business continuity plan	Ensures Transpower’s preparedness to be able to sustain business critical functions

ICT asset management

This section describes our approach to managing ICT assets, which is the software and hardware necessary to operate the grid and support our corporate functions. The ICT project portfolio is focused on the delivery and development of organisational capabilities required to achieve our strategic objectives. We adapt and respond to changes in our business requirements by reviewing and incorporating new and emerging technologies where appropriate.

ICT strategic objectives and alignment

Our ICT capability supports the business to accelerate our organisational effectiveness by addressing key business drivers.

- *Strengthen customer collaboration*. Improve our customer engagement across all aspects of connections, operations, and investments through digital enablement.
- *Optimise our asset decisions*. With data and analytics investments, we can do the right work efficiently because we have access to accurate information about our network assets.
- *Improve our end-to-end works delivery*. Improve how we identify and schedule work and how staff and field workers operate as a fully mobilised, digitally connected field workforce.
- *Enable adaptive and proactive operations*. Effectively integrate distributed and intermittent generation which will require more adaptive and proactive operations.
- *Enable our future workforce*. Leverage opportunities created by advances in cloud services, automation, digital collaboration, and communications to enable our future workforce.

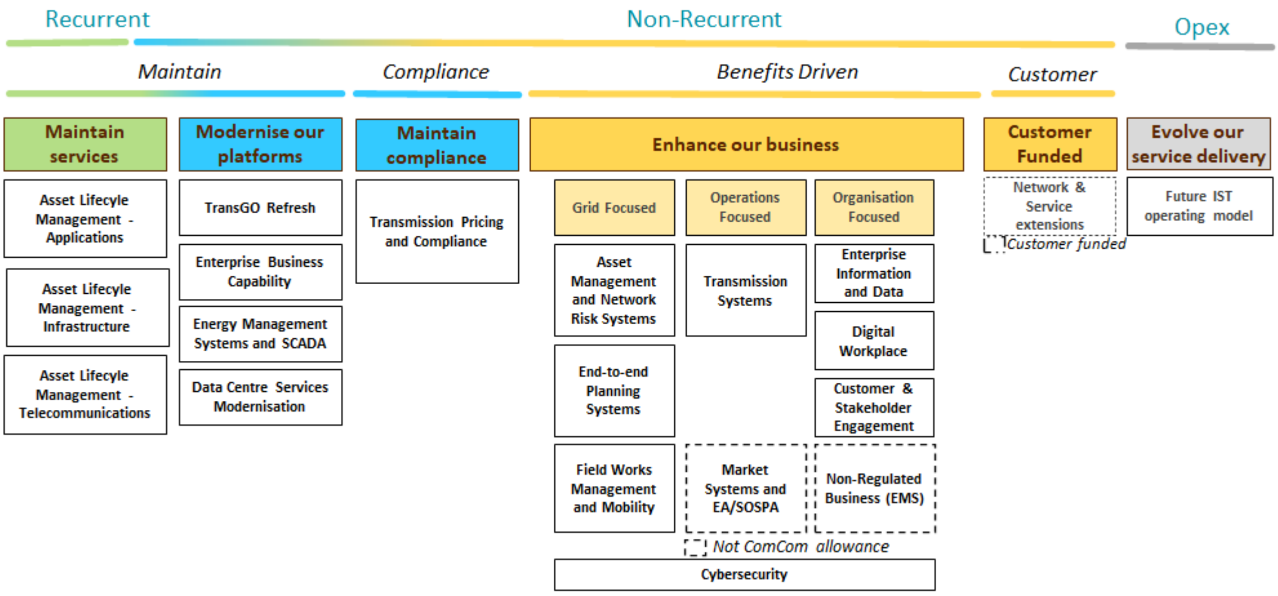
In response to these drivers, our ICT strategy defines five strategic objectives, outlined in Table 4.

Table 4: Our ICT strategic objectives

Enable a digital Transpower	Experiment with disruptive technology to determine value in our context. Where proven, adopt new value-adding technology to advance business capabilities in strategic focus areas. Focus on open data and modular systems using automation to digitalise our core business processes
Enable data-driven insights	Use data and analytics for proactive business decision-making to improve asset management and network risk decisions. Use insights to deliver grid works efficiently and manage the grid of the future. Leverage data and analytics to embed intelligence in our business functions
Adopt new ways of working	Adopt lean, agile and value-driven approaches to improve and optimise the delivery of services to our internal customers. Reduce service delivery timeframes and improve service quality by adopting DevOps practices
Drive cybersecurity by design	Design and manage our services for security. Enhance our cybersecurity practices for mobile and cloud services. Integrate security analytics into our cybersecurity function
Maintain and modernise services	Maintain and modernise reliable and resilient systems while delivering better customer engagement and experience. Deliver regulatory and compliance-mandated investments

To deliver our ICT strategic objectives, we have a series of sub-strategies to align our ICT investments to our strategic priorities. Our asset lifecycle management strategies focus on making sure we continue to proactively maintain our ICT assets by upgrading them to remain supported and fit for purpose. We have developed and implemented a *productisation*[1] framework and process to maintain the sub-strategies and to enable the continuous monitoring of the proposed programmes and portfolios. Our investments are grouped into programmes and categorised by investment type and investment category – see Figure 16.

Figure 16: Overview of ICT sub-strategies and asset lifecycle management strategies cased on investment type



Our required business capability has been categorised into five core ICT asset portfolios in our past publications. For reporting consistency and ease of reference, we will continue to maintain this categorisation.

- **Asset Management Systems -** Support the physical assets, systems and processes required for provision and maintenance of transmission services.
- **Transmission Systems -** Enable real-time operation of the national grid, and day-to-day operations and maintenance activities.
- **Corporate Systems** - Support Transpower's core day to day business functions, providing shared capabilities across all business teams.
- **ICT Shared Services** - Support the ICT infrastructure, systems and processes required for delivery of ICT services.
- **IT Telecommunications, Network and Security Services -** Deliver the underlying data services and provide a secure, high-capacity and nationwide telecommunications network supporting grid operations, critical switching, and grid protection functions, network services supporting our corporate and critical communications services, and protection against cybersecurity threats.

A summary of our approach and expenditure associated with our ICT portfolios is presented in Section 5.

ICT Investment Framework

Our objective is to be flexible enough to change our ICT investment direction as technologies and organisational needs change. The rate of change makes it challenging to forecast the precise technologies we will develop during RCP4 and RCP5.

We have transitioned categorisation of our investments to consider investment type and investment category. This enables us to have a balanced investment portfolio as we innovate and transform functions to deliver new digital business outcomes.

- **Investment type.** We differentiate between:
  - **Recurrent investments -** Regular expenditure that occurs periodically (typically at least once every 5 years).
  - **Non-recurrent investments -** One-off expenditure or expenditure occurring infrequently (typically less than once every 5 years).
- **Investment category.** Our investments are categorised into:
  - **Maintain -** Investments aimed at maintaining and updating existing ICT services, functionality, capability and/or market benefits through a regular upgrade programme (previously included in lifecycle classification).
  - **Modernise -** One-off investments to modernise current capability or an end-of-life system replacement (previously included in lifecycle classification)
  - **Benefits driven -** Investment in new capabilities to realise benefits for Transpower and electricity consumers (previously included in benefits driven and risk mitigation classification).
  - **Compliance.** 'Must do' investments to comply with regulations or standards.

1 *Productisation is the mechanism through which planning artefacts are maintained in an evergreen state*

Business support asset management

Our business support assets are categorised as:

- Office buildings
- Vehicles
- Minor fixed assets - office equipment
- Minor fixed assets – IT
- Residential houses.

Our management objective for business support assets is to provide the appropriate level of capability at the least cost but also reflect the diversity of the asset types.

Office buildings

Facilities management of our office buildings is managed centrally but undertaken by building services providers. Management of the leased offices, e.g. rent reviews, renewals, etc. are managed centrally. Our Auckland, Christchurch, and Hamilton offices and all warehouses and training facilities are on sites owned by Transpower. Budgets are centrally held for all the offices to ensure a consistent and cost-effective approach to this expenditure.

Vehicles

The vehicle fleet is managed by an outsourced provider. All the vehicles have global positioning system, (GPS) fitted to better manage the fleet and improve safety. We obtain monthly reports on the charges and lifecycle utilisation for each vehicle which, together with the GPS data, enables us to make informed strategic decisions about the vehicle fleet.

Minor fixed assets – office equipment

Office equipment is regularly maintained and generally replaced when it is unsafe, the cost of repair is not cost effective, or it requires refreshing. The budget for office equipment is held centrally to ensure a consistent and cost-effective approach to replacement.

Minor fixed assets – IT

Our minor IT assets comprise numerous commodity IT items such as tablets, laptops, keyboards, mice, monitors, and mobile phones. These are either maintained or refreshed.

Residential houses

The houses are predominantly ex-substation operator houses used up until the late 1980s that have been retained to act as a buffer between adjoining private properties. Some houses have been purchased as part of project work and retained as part of strategic landholdings for future line routes or substations.

The investment requirements for these areas are described further in Section 6.

Sustainability

Our Sustainability Strategy,[9] is focused on improving the sustainability of our ongoing operations while driving long-term change. It is underpinned by an extensive implementation programme to ensure delivery across all divisions and teams within Transpower, along with our service provider, supplier, and community partners. Over the long term, we are striving to drive behaviour change so that the sustainable way becomes business as usual. Our Sustainability Strategy sets out goals and enabling actions across the three challenge areas shown in .

Climate change

The electricity transmission system is a key component of enabling Aotearoa New Zealand's emissions reductions. We have a key role to enable a net zero carbon future by ensuring that Aotearoa New Zealand can make the change to a more electrified and more renewable economy. We expect to see the electrification of the road transport system with the growing use of electric vehicles along with the decarbonisation of Aotearoa New Zealand's industrial facilities, as more coal- and gas- fired industrial boilers are converted to electricity. This will result in electricity demand growing, and we expect to connect new load and more supply from renewable generation plants to support this.

In addition, we are working hard to cut emissions arising across our supply chain, including how we build, operate, and maintain the grid; the energy use in our buildings and substations; and the electrification of our vehicle fleet. We are working hard to reduce our SF_6 emissions through ensuring we develop the right strategies for key pieces of equipment on the network.

Not only are we looking to reduce emissions, but we are also investigating whether we have the right resilience to meet the challenges of climate change and ensure our infrastructure is able to withstand more frequent and severe extreme weather events.

Environmental stewardship

Given the scale and reach of our assets across many locations with high landscape, environmental, and cultural values, we have a responsibility to minimise the direct environmental impact of our operations. We aim to reduce the environmental impact and increase the efficiency with which we use materials and resources. As such, we seek to reduce contaminant discharges and minimise waste as well as restore the natural environment around our assets with the goal of creating a long-term net gain in biodiversity.

Sustainable business

We have a responsibility to consider the social and environmental impacts of all that we do and to report on our activities in a transparent way. We primarily do this through our adoption of the Integrated Reporting and Taskforce on Climate-related Financial Disclosures frameworks standards.

Having highly engaged, skilled, and capable people is central to all that we do. It is essential that we make the most of the strengths inherent in having a diverse and inclusive workforce and culture. We are committed to workforce development and promoting health and safety across all spheres of our operations.

Much of our work to improve the sustainability of our operations can only be delivered in partnership with the community. We acknowledge the connection of mana whenua to the land and seek to partner with them to remediate the natural environment and minimise the impact of our work on sites of cultural significance.

More broadly, we acknowledge our responsibility to promote kaitiakitanga. This encompasses the enabling role the development and operation of our assets play in reducing emissions and protecting Aotearoa New Zealand from the worst impacts of climate change. We also seek to work with local communities to be a good neighbour and minimise the physical presence related to our assets. This includes working closely with landowners to minimise disruption associated with our work.

Our CommunityCare Fund is one of the ways we contribute positively to the communities we operate in. We support a wide range of community projects with wide-reaching and lasting benefits to the community and our Community Advisory Panel brings together a diverse group of people who work closely with their communities.

Figure 17: Our Sustainability Strategy

[9] Our Sustainability Strategy | Transpower.

Risk management and performance improvement

Managing risk is an integral element of asset management and aligns with our corporate risk strategy. It is not a standalone activity, but integrated in everything we do, evolving over time to ensure we deliver our strategic priorities. Our approach to risk and assurance management is aligned with our corporate Risk Management Policy and guidelines.

Figure 18 provides a summary of the risks across our organisation.

Figure 18: Organisation risks

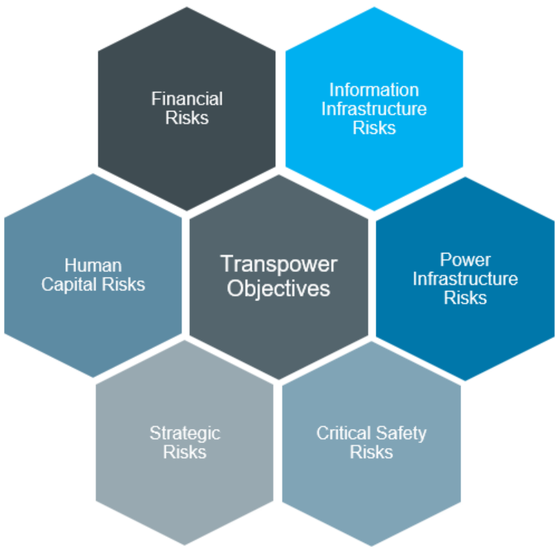
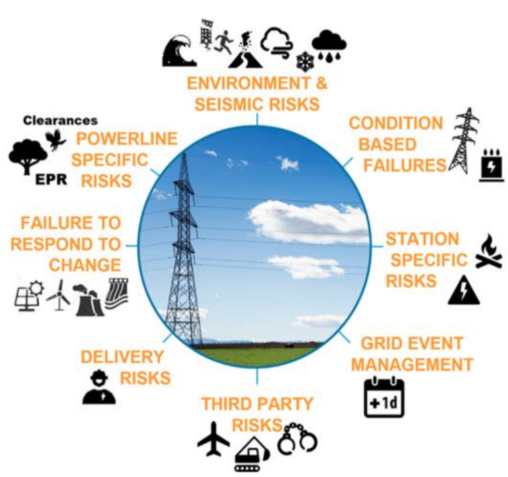


Figure 19 is a summary of our grid infrastructure critical risks. Consequences of these risks include service performance, public safety, worker safety, environment cost and direct cost.

The risks are as follows.

- **Environmental and seismic risks** are natural hazards that regularly impact the grid. Our design standards ensure new assets are built to cost-effectively minimise vulnerabilities to these risks. We also review the vulnerability and criticality of existing assets to identify those where further strengthening or upgrading would provide a cost-effective risk reduction.
- **Condition-based failures** relate to the likelihood of an asset failing and the direct cost impact, as well as consequential impact to supply, safety, and environment. These costs and impacts are informed by asset health and asset criticality and are mitigated through proactive and systematic asset planning. Importantly, we must also apply a network approach to asset replacement investments to ensure other critical risks are managed.
- **Station and powerline specific risks** which include earth potential rise (EPR), conductor clearances, access and occupation from other asset owners, and vegetation management. Our design standards and routine inspections and assessments ensure these risks are managed.
- **Failure to manage change** includes changes in electricity demand, generation, and the societal expectations of reliable electricity supply, as well as our own challenge to properly embed new technologies and processes. Current and future risks need to be understood to ensure our design and investment decisions result in a 'path of least-regrets'.
- **Delivery risks** exist throughout our maintenance and capital delivery activities. For example, risks can originate from equipment selection, design, construction, commissioning, handover of key information, and testing errors. Delivery risks also include skill shortages and supply chain challenges.
- **Third-party risks** are more difficult to control, and recent events include inadvertent contact such as aircraft crashes and irrigators hitting circuits, but also criminal activity such as deliberate interference with grid equipment. The effort we put in to communicating risks to the wider community, including industry groups, is a key preventive measure.
- **Grid event management** is how we respond to a large grid event, including recovery from a black-start (or blackout) event, one of our largest risks. While a high-impact, low-probability (HILP) event, it is one we actively prepare for to improve grid resilience. Power system resilience is the ability to avoid electricity supply outages, or maintain or quickly restore service delivery, when events occur. It is connected to the ability of systems and people to anticipate, prepare, absorb, adapt, and rapidly respond.

Figure 19: Our critical asset risks



We recognise there are areas of risk that relate specifically to particular assets, asset classes, or sites. Our asset management framework incorporates practices designed to identify and mitigate such risks.

Bow-tie risk analysis

Bow-tie risk analysis is a key methodology of our corporate risk framework which is consistent with AS/NZS ISO 31000. The purpose of the bow-tie is to inform us about the most likely causes of asset failure, the consequences of that failure and, most importantly, what preventive and mitigative controls we apply that will have the greatest effect on reducing the risk. Bow-tie modelling improves our understanding and treatment of risks and is incorporated into our strategies and plans.

Figure 20 shows a simplified version of the bow-tie for 'Major Hazards and Degradation of Transmission Line Circuit'.

Our bow-tie models for power infrastructure include:

- Major hazards and degradation of transmission lines
- Major hazards and degradation of AC transmission cables
- Major hazards and degradation of HVDC converter stations
- Major hazards and degradation of substation primary assets, busses, structures and plant
- Major hazards and degradation of secondary assets
- Major hazards and degradation of accessways
- Major hazards and degradation of HVDC subsea cables
- Major hazards and degradation of reactive support assets
- Major hazards and degradation of buildings and grounds
- Major hazards associated with site occupation by customers.

Our use of bow-tie risk analysis and our risk and resilience modelling, we consider both prevention and mitigation measures. Where the prevention of a causal pathway is cost prohibitive, or where consequences are major, we need to evaluate mitigation measures to reduce the impact.

Critical controls

Within a bow-tie, the controls can be preventive (reduce the likelihood of an event) or mitigative (reduce the impact if an event occurs), or both. A critical control is a control that has a significant effect on risk reduction or mitigation and appear almost universally across our bow-ties. Table 1 lists the critical controls and a brief description of each.

Control self-assessment

Undertaking control self-assessments on our critical controls gives assurance that our asset management practice is effective. They provide an opportunity to validate the definition of the control, the sub-control elements, and who is accountable for each element. Using criteria, the sub-control elements are assessed for both maturity and effectiveness, and opportunities for improvement are identified. Changes in control effectiveness are fed into our risk bow-tie analysis. Control assessment results and any corresponding changes in our risk bow-tie analysis are monitored by governance meetings and integrated into our corporate risk management system.

Figure 20: Simplified bow-tie - Major hazards and degradation on transmission circuits

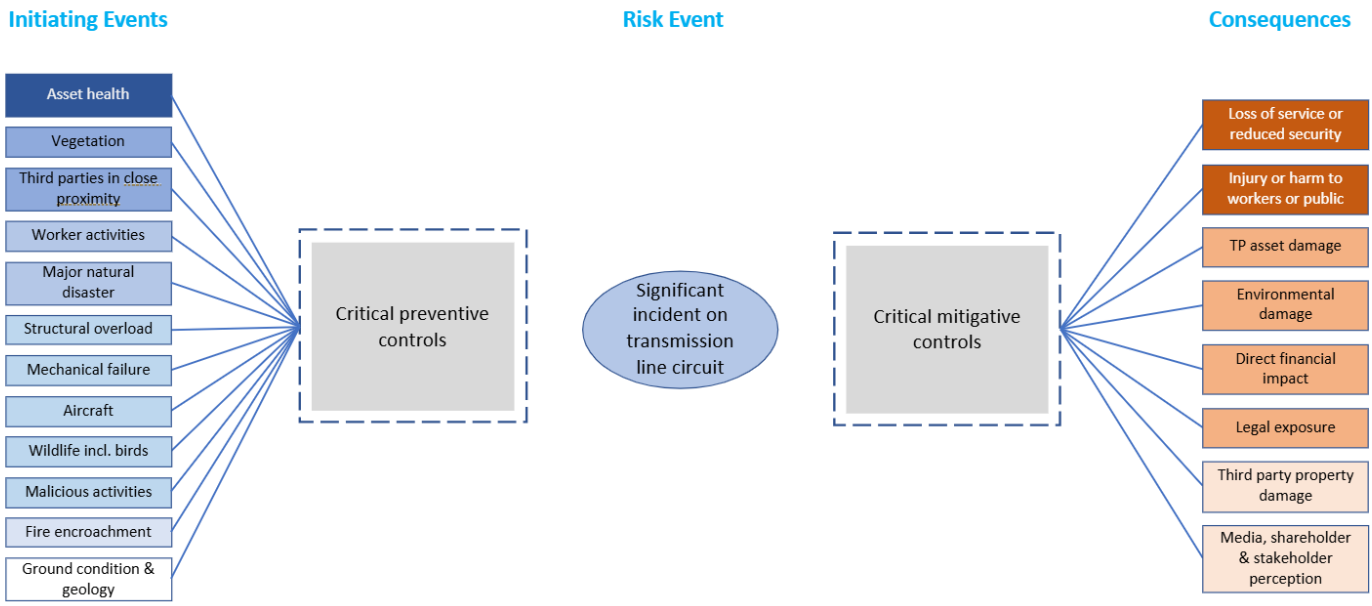


Table 5: Critical Controls

Control name	Control description
Activity planning	Planning and preparation to ensure safe and effective site activities to minimise adverse operational or environmental events
Customers and third-parties procedures	Procedures to manage the risk of other parties' assets and activities within Transpower-owned sites
Asset implementation management	Designing, installing, commissioning and handover of primary and secondary assets to specified codes and standards to enable effective operational management
Asset information management	Identifying, structuring, collecting, storing, updating, retrieving, monitoring, correcting, and disposing of asset information and data to enable asset analysis and decision making
Asset maintenance	Undertaking asset inspections, maintenance programmes, remediation works, pest management, and reporting key information to decision-makers to determine asset health and optimise asset life expectancy, service performance, and lifecycle cost
Competency management	External skills, knowledge and capability management for working safely on Transpower assets to optimise asset reliability and efficiency
Grid planning	The processes within the Grid Asset Management Framework to determine and justify all grid expenditure to develop the ITP
Health and Safety Management System	Prescribed health and safety system including policies, procedures, field practices, and assurance across those
Management of change	Assessing, managing, and minimising the potential risks of changes relating to grid assets, associated processes and systems, and responses to changed circumstances
Operational parameters, monitoring and alarms	Setting and monitoring the capability and real-time information on availability and performance of key assets
Physical security	Mechanisms and processes in place at substations to manage physical access to (and around) grid assets, to ensure the safety of people and protect assets from damage (preservation), malicious activity and service interruption
Procurement	Developing and maintaining procurement specifications; manufacturing and supply; supplier pre-approval; managing the procurement process for goods and services, and contract management.
Quality assurance	Planning, execution, and reporting of assurance activities across all asset management functions, including gap analysis, and developing and monitoring timebound improvement actions.
Standards, procedures and specifications	Grid-related technical standards, procedures, and specifications used as mandatory reference material
Contingency management	Planning and management of operational contingencies for planned and unplanned grid events to enable restoration of service while minimising the impact on connected parties.
Protection systems	Planning, implementing, and maintaining asset protection schemes to sense system and asset conditions, to prevent asset damage and personal harm, and maintain security of supply. Prevent cascade failure of the grid and optimise network capacity
Incident and emergency management	The preparedness and capability to respond, resolve, and recover from events. These include service interruptions and incidents.
Stakeholder management	Identifying and understanding stakeholders' perspectives, managing their needs, educating and communicating key messages to ensure reliable and safe grid service
Warranties, insurance and indemnities	Commercial avenues to reduce the direct financial impact of unplanned interruption events

Improvement plans

As part of our risk management, we undertake detailed assessments of critical controls and identify improvement opportunities. The opportunities are prioritised by the control owners and, where appropriate, improvement actions assigned. These actions, along with our wider improvement plans, are tracked and reported on in accordance with our asset management governance structure that meets quarterly on continuous improvement. The improvement plans include initiatives such as:

- Integration of asset information into systems such as test reports and hazard information.
- Management of change:
  - improvements to implementation of new grid technology
  - communicating procedural changes to external contractors
  - data acquisition and quality
- Reducing human errors through digital switch management and remote switching
- Improve data acquisition and data quality
- Integrating processes and information for spares management.

Measuring performance against objectives

Our Grid Business Strategic Asset Management Plan (SAMP) provides alignment between Transpower's strategic priorities and our grid business. The SAMP objectives cascade down to our asset class strategies via the asset class performance objectives.

The asset class performance objectives are measured and have a connection to the overall service performance and reliability of our network. This link between asset performance, service performance and our strategic priorities is shown in Figure 21.

Site-risk review

Our site-risk reviews reflect our risk-based approach to asset management. We undertake three types of site-risk reviews:

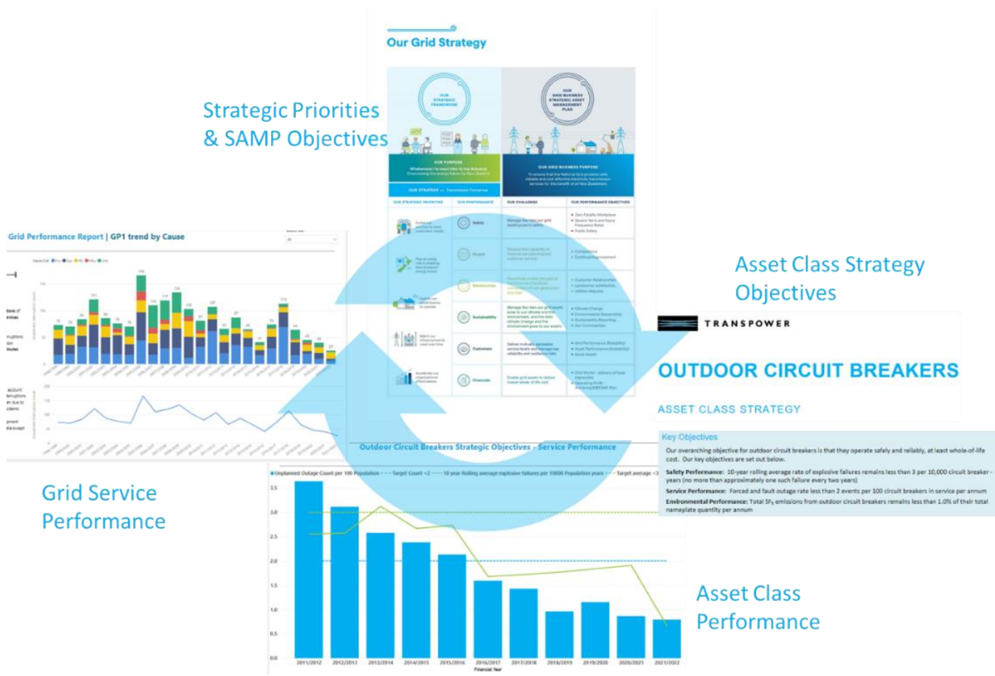
- Major hazards – fire, natural disaster, high-impact low probability events (HILP), and other high impact events.
- Customer hazards – confirm access and occupation schedules, identify third party risks.
- Condition and reliability – review of site asset condition and performance to support management of operational risks and costs.

Major hazard site reviews can assess specific major hazards where desktop assessments are insufficient, e.g. building fire. We have undertaken analysis to systematically identify vulnerabilities across the grid for prioritised threats. These assist with understanding cost-effective preventive or mitigative solutions, e.g. flooding. Where credible risks are identified, we will evaluate risk and potential options, which may result in actions through our resilience or wider investment programme.

The site condition and reliability reviews are a mechanism to collaborate with service delivery and service provider team members on the effectiveness of current maintenance efforts, provide assurance over the condition of assets, and identify improvement opportunities for asset integrity and maintenance strategies. Typically, these reviews will provide recommendations for resolving unreported defects, improvements requiring engineering effort, or changes to the investment plan for asset refurbishments and replacements.

Our customer site-risk reviews resulted from the 2014 Penrose fire incident, where a customer cable joint failed, causing a serious fire. The ongoing site reviews act as an audit of our records, to ensure they align with what assets are on site. Another aspect of the reviews is to identify, monitor, and resolve risks to our assets, employees, and operations caused by customer assets.

Figure 21:Asset performance objectives



Risk-based asset management planning

Together asset health, grid asset criticality, network resilience, risk-based maintenance, and readiness planning are key components to our risk-based asset management planning.

Asset health

Determination of asset health is a primary input into our replacement and refurbishment investment decisions. Understanding asset health for our assets is fundamental to planning and forecasting.

We use asset health models to predict how an asset will deteriorate and fail over time. Our asset health framework sets out a common health scoring across our asset classes, known as an Asset Health Index (AHI). An AHI is an indicator representing an asset's proximity to the end of its useful life. The end of useful life is when an asset will either need replacement or major refurbishment to extend life. Key principles guiding our asset health models are:

- Aligned and supported by the asset class strategy
- Integrated with the decision framework
- Making best use of our tacit expert knowledge
- Leveraging our empirical data where quality and correlation are strong
- Leveraging industry data, where appropriate
- Delivering value with respect to effort of modelling versus uncertainty
- Undertaking systematic and repeatable modelling.

How AHI is determined

The end of useful life is typically hard to predict, but when a combination of information is considered, an AHI can inform the expected time when an intervention is likely to be required.

The higher the AHI score, the more likely an asset is to fail. The common inputs into our asset health models are detailed below:

Nominal asset life
This is the 'normal expected life' for each asset class and the point at which significant signs of deterioration can be expected. The nominal asset life assumes normal operating conditions with respect to service duty and location. It is based on industry data, information gained from forensic assessments of assets that have performed well or performed badly, and our experience from observed data from the field.

Duty and location factors
With a known current asset health, a future asset health can be modelled. Depending on the asset class, our models forecast future asset health using duty, location, current observed, and measured condition, age, and reliability factors.

Current condition
The current condition of an asset is based on observed condition, or measured condition from test results. In most cases, asset condition is monitored regularly in accordance with our technical standards and asset class strategies.

Age
The asset age is used an input to the model as condition alone is often an imperfect measure, as it does not capture all failure modes or can be infeasible to collect.

Corrosion

The corrosiveness of the atmosphere significantly influences the condition and life expectancy of our grid assets. We have two methods of accounting for corrosion zone in our asset health modelling:

Corrosion codes

We have allocated the majority of our grid assets subject to corrosion-related degradation processes to one of six corrosion codes. Table 6 shows the corrosion codes in use for transmission lines and typical environment applicable.

Table 6: Corrosion codes

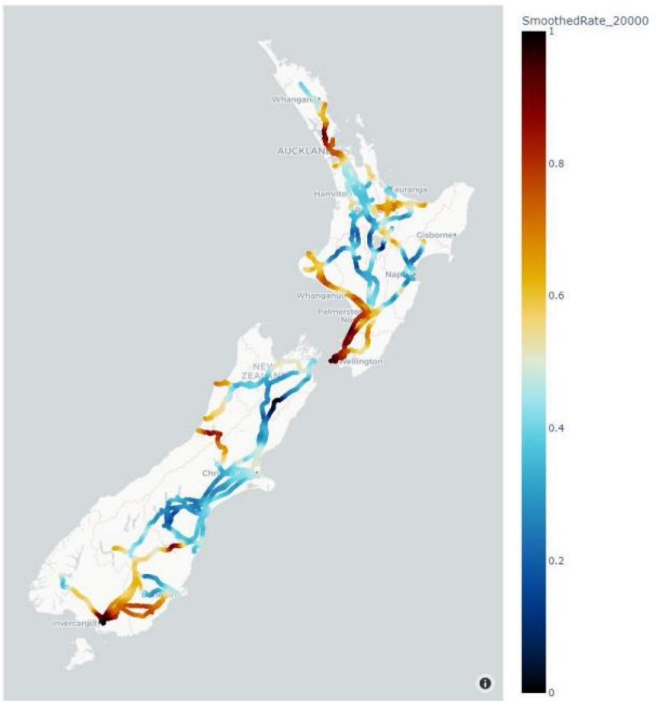
Corrosion code	Typical environment
100	Benign – dry island area with low rainfall
80	Low – inland area, no coastal contamination
65	Moderate – minimal coastal contamination
50	Severe – moderate coastal contamination
35	Very severe – heavy coastal contamination
20	Geothermal – special – extreme coastal, industrial, and/or geothermal contamination

Condition Assessment (CA) Degradation Bands

We have also undertaken modelling of our observed CA degradation rates for our insulator, attachment point, and conductor portfolios. These asset health models use CA degradation bands to account for corrosion degradation processes.

Figure 22 illustrates an example CA degradation rate map.

Figure 22: Example CA degradation rate map



AHI bands

We define asset health on a scale of 0 to 10 for current health, and future predicted health can exceed 10[10]. The asset health aligns with the probability of failure (PoF). The higher the AHI score, the more likely an asset is to fail. Typically, the intervention criteria will be an AHI score of 8 (as shown in Figure 23) but depends on the approach taken to manage replacement or refurbishment of the asset. For example, a risk-based approach may not proactively replace an asset based solely on an AHI score of 8.

Figure 23:Asset health score

For ease of understanding, we categorise the AHI into the eight bands shown in Table 7. The first band of 0–4 is wide, as PoF is considered the same for these AHI scores.

The remaining bands are incremented by 1, with the exception of the last two bands which are 0.5. The last two bands are at smaller increments as the PoF increases more rapidly as the asset degrades further.

Table 7: Asset health bands and descriptors

AHI Band	AHI Range	Descriptor
1	0.5≤AHI<4	Good
2	4≤AHI<5	
3	5≤AHI<6	
4	6≤AHI<7	Fair
5	7≤AHI<8	
6	8≤AHI<9	Poor
7	9≤AHI<9.5	
8	9.5≤AHI<15	Very poor

We continue to focus on improving the maturity and coverage of our asset health models. Coverage by asset class is shown Table 8 (two pages over).

Probability of failure (PoF)

The PoF used in asset health modelling is defined as the annual likelihood of a major failure due to degradation. For many of our asset health models, there is a corresponding PoF curve that shows the relationship between PoF and AHI. This can be used to inform the asset risk or risk of the portfolio over time. Developing the PoF curve can inform expected lives by identifying certain models or types that may have shown to have statistically shorter or longer lives.

Some asset refurbishment decisions are driven by economic factors, e.g. tower protective coating. In these cases, there is no material change in PoF from AHI 1 to 10.

Health-related major failure is defined for use in PoF and must meet three criteria.

1. Major work or impact: a replacement or major refurbishment required.
2. Failure urgency: operational decisions are urgent with respect to the asset class, and this is broadly consistent with international definitions used by CIGRE[11]/ITOMS[12].
3. Primary cause: the failure is asset health related, or for some assets, an environmental cause such as wind. Categorising an environmental cause as a health-related major failure is dependent on whether the conditions are within the design envelope of the asset. Extreme weather events that have return periods that exceed our design criteria, and events such as cascade failure, human error, and third-party action, are excluded from the health-related major failure.

[10] The future health score is capped at a value of 15, which is higher than the cap that is applied to the current health score (10). This is to enable modelling of further deterioration of all assets.

[11] International Council for Large Electric Systems; founded in 1921

[12] International Transmission Operations and Maintenance Study

Grid asset criticality

While asset health can indicate the PoF, asset criticality describes the consequence of failure. The risk associated with owning and managing an asset is derived using the likelihood and the resulting potential credible consequence of the failure.

We model asset criticality across five dimensions to calculate a monetised consequence. The monetised consequence is a societal cost and aligns with our corporate risk assessment matrix. The dimensions are additive and are as follows.

Service performance criticality
Estimates the impact of asset failure on transmission of electricity across our network. It is based on the cost of unserved electricity (value of lost load), the expected loads across a year, system configuration and coincident outages, and outages caused by failure of the asset. It represents the average impact (in dollars) on the wider network when an asset fails.

Public safety criticality
Estimates the impact of asset failure that could cause harm to the public. It is based on the expected consequence and does not anticipate worst case scenarios or HILP events. A primary contributor to public safety criticality is asset location and its surroundings.

Workplace safety criticality
Estimates the impact of an asset failure to our workforce. It is based on the expected consequences of asset failure rather than worst-case scenarios or HILP events. A primary contributor to workplace safety criticality is asset location and the probability of workforce presence around it. This accounts only for being near the asset when it fails; it does not consider the risk associated with any work being performed on the asset, for which an individual risk assessment is required.

Environmental criticality
Estimates the most likely environmental consequences of failure and is specific to the location of the asset and the risks the asset presents. It includes the potential environmental consequences of oil spill, oil fire, SF_6 leak, bushfire, and archaeological damage.

Direct cost criticality
Estimates the financial costs incurred in case of asset failure, including the average cost to restore service and to repair or replace the asset, and potential damage to private property.

Estimates of asset criticality are derived using a probabilistic approach to scenarios and rely on data available in our systems and in the case of service performance, from our power system models.

Site criticality and significance

Site criticality estimates the impact of complete site failure on transmission of electricity across our network, where site failure means all assets at a substation are removed from the grid. The analysis uses the cost of unserved electricity (site specific value of lost load) and the expected loads across a year. Unlike general service performance criticality, it does not consider a second order failure at other sites or circuits. The loss of a site could be caused by multiple different factors, such as flooding, earthquake, fire etc, which may have different restoration times. Due to this, site criticality is calculated as a rate ($/h) and therefore provides a relative ranking of a site's importance, rather than a cost per event.

We have used this quantified criticality, combined with black-start and regional contingency plans to categorise our substations and line sections into national, regional, and local significance ratings.

Table 8: Asset health coverage by asset class

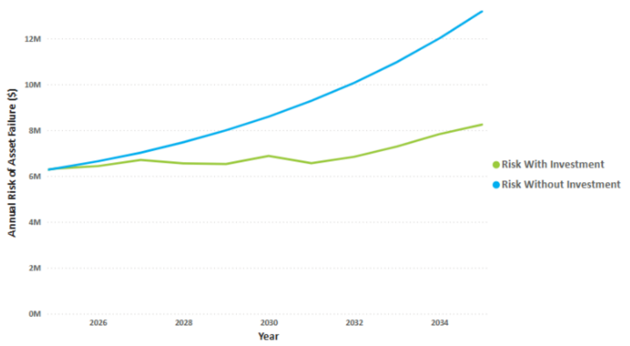
Asset group	Asset class	Asset group	Asset class
Transmission lines	Conductors (cct km)	Substations	Instrument transformers
	Earthwire		Outdoor circuit breakers
	Tower protective coating		Power transformers
	Tower steelwork		Indoor switchgear
	Tower foundations - grillage		Power cables - solid (km route length)
	Tower foundations – non-grillage		
	Foundation interfaces - towers		Disconnectors
	Pole foundations		Earth switches
	Pole structures		Wall and roof bushings
	Insulators		Local service transformers
	Attachment points		Low-voltage AC (LVAC) distribution
Secondary systems	Battery banks	Reactive	Synchronous condensers
	Battery chargers		Capacitors
	Protection relays		Reactors
	Outdoor junction boxes (ODJB)	HVDC	Converter transformers HVDC
	Substation management systems (SMS) asset types		Subsea cables HVDC
	Revenue meters		

Condition based asset risk

Asset risk profiles are calculated by combining PoF (derived from the asset health models) and consequence of failure, derived from asset criticality.

We use the asset risk information to help understand the cost-effectiveness of risk reduction interventions and support prioritisation of our plans where required. This information is part of solution prioritisation within the Asset Planning Decision Framework. It is worth noting that the risk profile is for condition-based failure risk and does not include our other critical risks. For example, only 30% of service interruptions are due to asset failure, and even then, not all asset failures are from life-ending degradation **Figure 24** shows the combination of PoF, derived from asset health and criticality, to present a future risk profile with different investment scenarios.

Figure 24: Outdoor circuit breakers risk profile with and without investment



Improvements in asset health and network risk

We are committed to continually evolving our maturity in asset health and network risk. We have benchmarked other utilities and assessed our maturity in these areas. This information, combined with our operating context, informs areas for improvement.

As a prudent, customer-focused business, we must ensure improvements deliver value that outweighs the cost of those improvements. Our improvement plan focuses on enhancing areas that provide the most economic value and risk reduction.

Recent improvements in capability include our ICON programme which has lifted our ability to forecast our conductor replacement need considerably. This has been achieved through a comprehensive programme of data collection, modelling, and analysis. We have also improved our ability to forecast degradation rates relating to corrosion on transmission line assets through using our historic CA scores instead of historic corrosion zones.

To complement asset health and criticality models, we are also developing more decision support tools, such as options assessment and risk assessment tools.

From an ICT perspective our continued investment in tools and associated integration continues to support the breadth and sophistication of models needed. For example, recent investment in python tools and deployment pipelines enables more flexibility, integration, and automation. Our investments in data and analytics will help to simplify the process of combining data and generating insights that feed into our models.

Risk-based maintenance

Since 2016, we have managed to keep grid maintenance spend consistent without negatively impacting reliability or asset health by optimising the work plan and moving to a more risk-based approach.

Our long-term goal is to maintain our assets using risk-based maintenance. This approach establishes maintenance tasks for each specific asset where the intervention and the timing are optimised based on factors such as current asset condition, historical reliability, and criticality of the asset.

To support this goal, we have developed a tool to prioritise our ongoing defect management/remediation work, using likelihood of failure and criticality. The Work Order Risk Prioritisation (WORP) tool works by scanning the description of our defect work orders and categorising them into word clusters using machine learning techniques. It calculates the frequency and relevance of terms in each cluster, sorting and ranking them based on likelihood, and consequence, which is provided by our criticality framework.

We also utilise reliability informed maintenance (RIM), which includes the principles of reliability-centred maintenance, to further review and optimise the work that should be included within our maintenance programmes, and at what frequency, on each asset. The RIM approach also includes preventative maintenance optimisation. The RIM programme is expected to increase condition-based predictive maintenance and reduce time-based preventive maintenance. The programme aims to ensure the least whole-of-life costs for the level of asset reliability required. Asset planning uses RIM to inform decisions on allocation of spend.

Our RIM programme is ongoing and reviews targeted areas each year.

Grid Resilience

Whakamana i Te Mauri Hiko recognises that factors affecting our transmission service requirements will change rapidly over the next 30 years. The decarbonisation of the energy sector will see more reliance on electricity and societal expectations for a resilient service is increasing.

A resilient transmission service avoids power outages or quickly restores service delivery when major events occur. As a lifeline utility under the Civil Defence Emergency Management Act 2002, we must be able to function to the fullest possible extent during and after an emergency, even though this may be at a reduced level.

A large proportion of our infrastructure is situated within areas prone to natural hazards. Aotearoa New Zealand's environmental and physical features mean that our critical infrastructure is exposed to a broader and more consequential range of shocks, particularly natural hazards, than any other developed country,[13] and climate change will increase both the frequency and the magnitude of many of the natural hazards that occur. Our infrastructure has potential to be impacted by other major hazards as well, such as building fires, damage by third parties and criminal sabotage.

Our risk review process identifies and collects information to understand the network hazard exposure, vulnerabilities, service impacts, and direct impacts for a range of credible resilience threats, including common mode failures, physical security and natural hazards. The risk review process includes collaboration with researchers and other agencies including Local Government and within the energy sector. **Figure 25** outlines the major hazard threats, vulnerabilities, and potential mitigation strategies for the transmission network.

We are delivering proactive risk reduction and readiness workstreams on the grid, following the approval of this funding within the RCP4 programme of work. The workstreams under investigation for delivery, or in delivery, include:

- Seismic strengthening of buildings
- Flood – hardening critical and vulnerable HVAC and HVDC towers in braided rivers
- Flood – resilience solutions at substations
- Fire – stopping, detection and suppression upgrades to substation buildings
- Volcanic – hardening transmission lines for a volcanic ash event
- Land stability work for towers and poles
- Hardening bridges and access tracks against land instability and flooding
- Pre-enabling works for major failures of non-air bushings/gas-insulated switchgear (GIS)
- Remove earth wire overhead stations – common mode failure risk mitigation
- Hardening HVDC towers against wind damage
- Portable switchroom solution to minimise response time and run emergency exercises

Other areas we continue to work on include solar storm preparedness and reviewing our spares holdings.

Climate reporting and adaptation planning

Preparing for, and responding to, climate change is integral to our business, both in terms of the risks it presents to our assets and service and how it drives electrification.

In 2024, we published our Climate Statement – our first set of annual climate-related disclosures required by the Aotearoa New Zealand Climate Standards. This builds on four years of previous voluntary climate-related disclosures.

We also published our first dedicated climate adaptation plan to make New Zealand's electricity transmission system more resilient to climate change. Our adaptation plan sets out a journey, recognising the need to adapt to climate change over time as we replace aging assets, build and operate new assets for the grid and for customers, and through our proactive resilience programme. This progressed our action in the National Adaptation Plan to develop and implement a Transpower climate adaptation plan.

Our adaptation plan sets out actions for the next five years. We are focused on continuing to build capability and further integrate climate adaptation into our asset management approach, as well as delivering tangible improvements in climate resilience and adaptive capacity.

We are continuing to refine our understanding of climate related risks and opportunities and have started to deliver our climate adaptation plan, with work underway on Dynamic Adaptive Pathways Planning, and transmission line ratings.

Collaboration on resilience and adaptation

We see the benefit of working together on resilience and adaptation – from understanding risks, to responding to emergencies, through to longer term adaptation planning.

Our decisions, and outcomes for New Zealand, also depend on the response of our suppliers, and other stakeholders such as central government, councils, communities, Māori, the wider energy industry, and other critical infrastructure providers. Some risks, options and decisions are beyond our direct control.

Working together supports informed, efficient, and integrated resilience and adaptation planning, for both our infrastructure and power system, and for wider national, regional, and local planning. We collaborate on resilience issues to understand needs, assess options, and develop business cases to deliver projects. We are joining a growing number of adaptation conversations across Aotearoa.

We recognise the knowledge and insights our stakeholders bring from their work on adaptation, such as experts, councils and Māori. We continue learn alongside others working in this space and aim to contribute to developing innovative and practical approaches to adaptation.

[13] https://www.lloyds.com/worldatrisk

Figure 25: Threats to transmission networks

		THREATS	GRID MAJOR HAZARDS
NATURAL HAZARDS		Seismic	• Substation buildings, equipment, and bus structures • Transmission lines, HV and underground communication cables • Accessways
NATURAL HAZARDS		Volcanic	• Insulator flash-over from ash • Mechanical line loading damage • Disruption to electronics, AC systems • Lahar impacting sites, lines, accessways • Pyroclastic density current flows impacting stations, lines, and access ways
NATURAL HAZARDS		Tsunami	• Towers and poles • Substations • Subsea cables[14] and cable stations
NATURAL HAZARDS		Space weather	• Transformer damage due to geomagnetically induced currents • Reduced security: voltage control, protection and GPS clocks
NATURAL HAZARDS	WEATHER RELATED RISKS	Land stability	• Towers, poles, and communication cables • Access ways • Landslides damaging buildings and structures
NATURAL HAZARDS	WEATHER RELATED RISKS	Flooding	• Towers, poles, accessways, and communication cables • Towers and poles in braided rivers • Substations, control equipment, and cables
NATURAL HAZARDS	WEATHER RELATED RISKS	Severe wind and tornadoes	• Substation asset damage • Transmission lines and optical ground wire failures • Increased bush fire risk
NATURAL HAZARDS	WEATHER RELATED RISKS	Snow & ice	• Increased mechanical loading on lines and optical ground wires • Increased mechanical loading on buildings
NATURAL HAZARDS	WEATHER RELATED RISKS	Increased temperatures	• Derating of all current carrying assets and a shift to a summer peak • Insufficient cooling of control equipment, particularly at stations
NATURAL HAZARDS	WEATHER RELATED RISKS	Bush fire	• Bush fire encroaching assets • Transpower's assets starting bush fire
ASSET RISKS		Common mode failure	• Overhead earth wire failures • HV power cable joint and termination failures • Critical tower foundations understrength • HVDC converter station control system failures • Synchronous condenser auxiliary plant failures
ASSET RISKS		Third party activities	• Malicious attacks: cyber and physical • Non-malicious activities: unauthorised entry, third party utility asset risk, and poor housekeeping • Physical impacts with our assets: land, air, and water
ASSET RISKS		Significant Asset fires	• Substation building • Switchyard

[14] Subsea cables include subsea communication cables.

Readiness planning

We apply a range of approaches to ensure we prepare for and respond well to unexpected events. We apply a Coordinated Incident Management System as our standard approach for managing major incidents and have contingency plans and spares available to address grid asset failures.

We have readiness plans for real time, for different types of events and for specific assets. Our readiness planning framework uses four pillars: the plans, alignment across teams and with customers, resources such as spares and service providers and training. The ongoing development and review of readiness plans aims to ensure we have adequate preparation for the first 24-48 hours of an event that we can foreshadowed as part of scenario planning.

Readiness exercises

We also undertake readiness exercises, such as emergency tower structure deployment and business continuity exercises and will ensure that the additional portable/mobile solutions planned for delivery during RCP4 will also have associated readiness exercises in place.

Spares

Our spares are condition-monitored, maintained, and ready for immediate installation and service.

Our substation spares include the following.

- One spare emergency portable 33/22/11 kV switch room that can be deployed in the event of a major failure of a medium-voltage (MV) switchboard. This could also cover a failure of an entire outdoor 33 kV switchyard under an event such as a major fire, landslide, or earthquake.
- A mobile substation (15 MVA 110 kV/33-22-11 kV) which can be used at N sites where site made ready works have been undertaken (provided it is not in use for project works).
- Twenty strategic spare transformers which provide coverage for 98 percent of our entire present and future three phase power transformer assets with the aim to restore full security of supply within 4 weeks of a major transformer failure. On-site spares are provided at most sites where single-phase transformers are installed. In addition, spare power transformer components such as high-voltage (HV) bushings, Buchholz relays, pressure-release devices, etc. are available to respond to any partial transformer failures.
- A minimum of two circuit breakers per type are kept as spares, including appropriate quantities of components, e.g. trip coils, contacts, gauges, SF_6, gas etc., that can be used for emergency response.
- Spare cables, cable joints and cable terminations are held in Transpower’s stock, or, for newer standardised installations, these are held by the manufacturer. Some spare components have limited shelf-life and are replaced every 5-10 years. Throughout RCP3, we are purchasing additional spare cables, joints, and terminations.
- Spare conductors, insulators, and hardware are available to respond to outdoor structure and buswork failures. Typically, 36 insulators for each voltage rating are held as spares.
- Instrument transformer spares are available in all voltage ratings to respond to failures. Typically, six spares for each rating type are maintained as spares.
- Minor LVAC equipment is typically readily available from commercial suppliers.

Our transmission line spares include the following.

- 163 km of spare conductors, insulators, and hardware that are specific to each service area.
- 42 emergency response structures and poles strategically located throughout the country including HVDC.

Following the Rangitata river flooding in November 2019, which washed away a number of towers, we undertook a lessons-learnt exercise to review our response. From this, we have completed an end-to-end review of the emergency lines spares and processes, our inspection specifications, and our Transmission Line Emergency Management Plan. This has resulted in an updated strategic spares policy and refurbishment of our emergency restoration structures. Following this event, we have also commenced a review of our key towers in waterways to ensure we have the appropriate levels of resilience to these types of major event.

Our HVDC spares include the following.

- HVDC emergency spares, including converter transformer bushings, wall bushings, filter coupling caps, DC current transformers and circuit breaker spares for converters and filters.
- HVDC subsea spare cable joints and cable terminations. Some spare components have limited shelf-life and are replaced at regular intervals.
- Eight HVDC temporary pole structures.
- Specialist tools and equipment to complete emergency work.

Our reactor assets spares include:

- Spare oil-filled shunt reactor.
- Spare capacitor cans.
- One 110 kV 50 MVAr capacitor bank.
- Components for capacitor banks, power electronics, and synchronous condensers (including consumables).

Secondary assets include:

- Some 2,000 spare protection relays for a population of over 12,000 and over 600 variants.
- Maintain 5% holdings of modern battery charger spares for both rectifier modules and fully assembled chargers, taking into account future replacement/upgrade work.

Digital SMS spares include:

- Salvaged and reconditioned legacy remote terminal units (RTUs).
- Salvaged and reconditioned legacy RTU I/O modules.

Grid asset class plans

Grid asset class plans

Our grid asset class plans describe the approach, plans, risks, and capex and opex forecasts for our grid assets.

We have categorised our expenditure into seven portfolios within which we categorise 21 asset class plans. The portfolios are as follows.

Grid Maintenance: Grid maintenance covers all maintenance work on our HVDC and HVAC transmission line assets, substation assets, and communication-site and services assets (excluding communications bearer and network assets). Such work is undertaken to address in-service deterioration of our assets, respond to transmission faults, proactively improve the assets, and implement projects to replace asset components. We have one asset class plan for maintenance.

AC Substations: A substation contains a set of equipment, including power transformers, that enable energy transfer between voltage levels. A substation solely for the purpose of transmission rather than supply is called a switching station. Our substations have power system equipment that operates at 220, 110, 66, 50, 33, and 11 kV. AC substations encompass all the electrical equipment within a substation boundary. We have 10 asset class plans associated with AC stations.

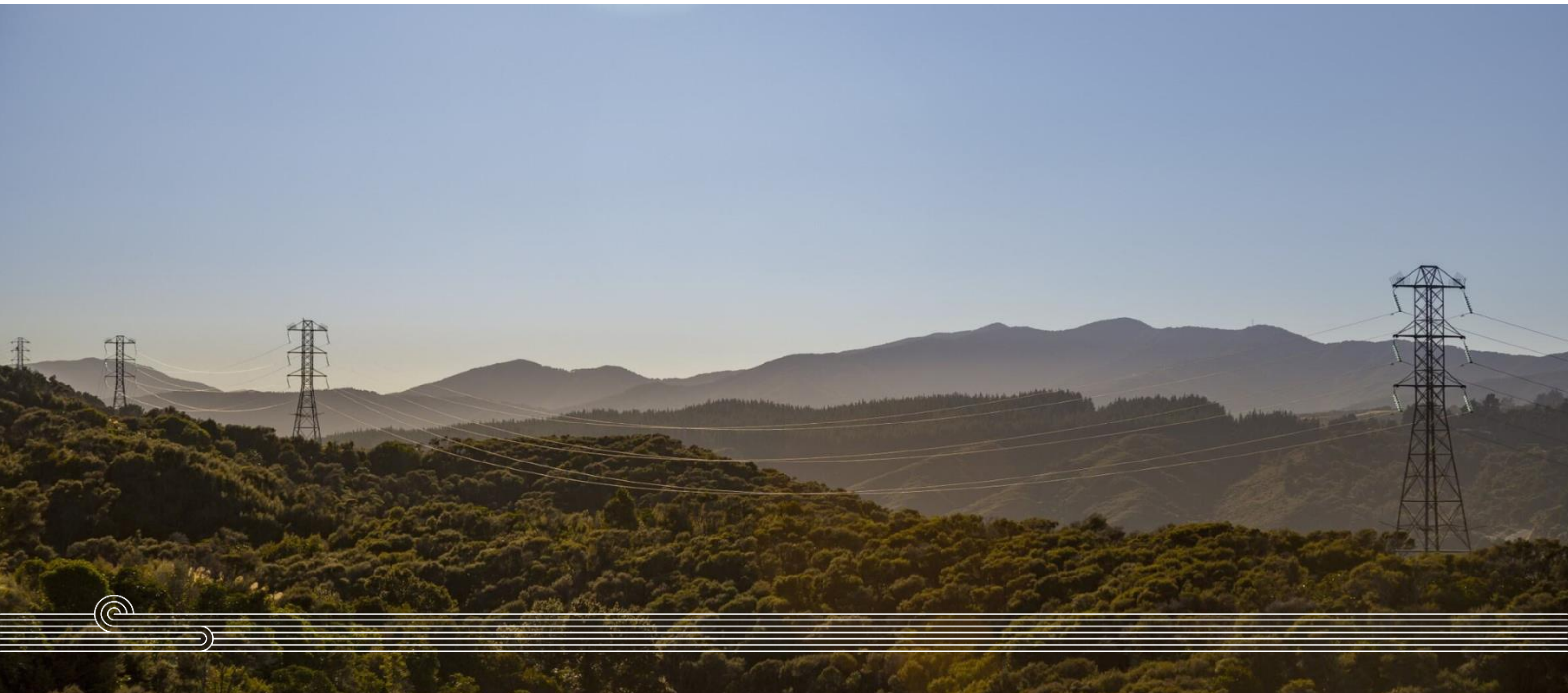
Transmission Lines: Our transmission line assets transport electricity from generation sources around the country to where it is consumed within our homes and places of business. They consist of transmission towers, poles, foundations, conductors, earthwires, insulators and other hardware. We have six asset class plans associated with our transmission line assets.

Buildings and Grounds: Our buildings and grounds assets provide the accommodation, services, and physical security for critical grid equipment and systems. They cover the buildings, site infrastructure, building services and security fences. We have one asset class plan that covers all our buildings, building services, and grounds assets.

HVDC Assets: Our HVDC assets include the interisland HVDC link. The HVDC consists of HVDC converter stations, cable stations, undersea Cook Strait cables, electrode stations, sea and land electrodes, communication systems connecting the system to control centres, harmonic filters, and supporting reactive power assets. The HVDC assets are covered in one asset class plan.

Reactive Assets: Our reactive assets include our dynamic and static reactive assets on the grid. Our reactive assets incorporate capacitor banks, reactors, synchronous condensers, static VAR compensators (SVCs), STATCOMs, and associated control, protection systems, and auxiliary systems. Reactive assets are covered in one asset class plan.

Secondary Assets: Our secondary assets support the overall operation of the grid and provide essential services for the monitoring and control of equipment. They cover the protection, station DC systems, revenue metering and substation management systems. Our secondary assets are covered within two asset class plans. Our asset class plans document the basis for the forecast expenditure in more detail. The operation and maintenance costs that span our grid asset portfolios are described below.



Grid maintenance

Grid maintenance covers all maintenance work on our HVDC and HVAC transmission line assets, substation assets, and our communication-site and services assets (but excluding communications bearer and network assets). It is undertaken to monitor and address in-service deterioration of our assets, respond to transmission faults, proactively improve the assets, and implement projects to replace asset components. We categorise grid routine maintenance work into four main work types. These are preventive, predictive, corrective, and proactive maintenance work.

Our approach to long-term grid maintenance is to optimise our time-based maintenance through risk-based analysis. This approach establishes maintenance tasks for each specific asset where the intervention and the timing are determined based on factors such as current asset condition, historical reliability, and criticality of the asset.

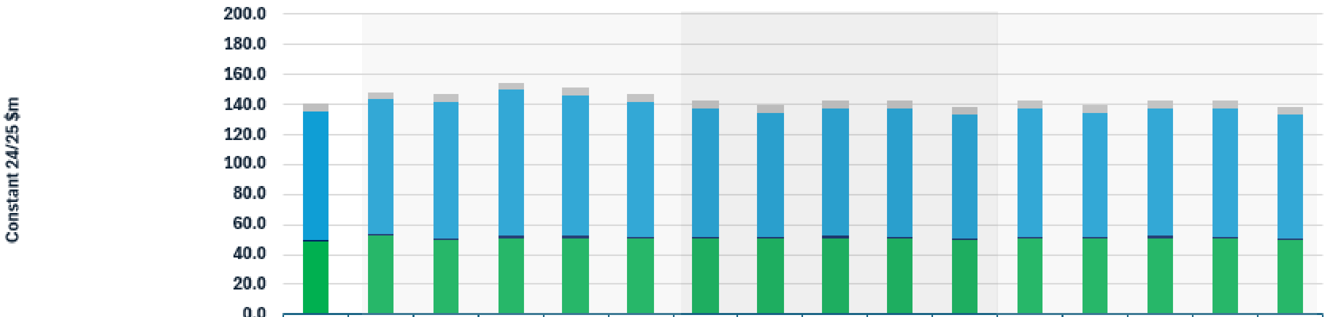
Our forecast grid maintenance, along with the trend, is shown in Figure 26. The forecast for RCP4 is $746.5 million, $706.4 million for RCP5, and $706.4 million for RCP6. With an increasing need that comes with maintaining an ageing asset base, optimising opex capex trade-offs, and a greater visibility of asset condition, we are forecasting an increase in RCP4 compared with RCP3.

ICT Infrastructure is integral to our grid maintenance activities and a key area for our continued investment in innovation, efficiencies and optimisations. This includes our core systems such as our asset information system (Maximo), our Asset Management Planning system our inventory management and our Health and Safety Management system. Our field workforce mobility app (Mātai) has improved the speed and accuracy of collecting grid maintenance information as an input into our WORP tool and our broader asset planning functions. Ongoing investments in Mātai and our cloud-based photo storage system (Recollect) are continuing to improve feedback from the field about observed risks, issues, hazards, and non-conformances.

These capabilities drive the quality of maintenance improvements and increase first-time fixes, providing engineers with quick access to defect information and photos to advise on the best course of remediation. We are implementing the use of drones and machine learning to support the analysis and life extension of our conductors, through our ICON programme. We are initiating our site digitisation roll-out as a key enabler to improve our maintenance effectiveness and efficiency. This will reduce site visits and enable quicker access to accurate information.

Our data and analytics programme is starting to provide improved awareness and readiness for planned and unplanned asset maintenance activities, such as outages. The programme also improves the accuracy of our work order management data, which will better quantify the impacts of minor failures.

Figure 26: Grid maintenance forecast expenditure



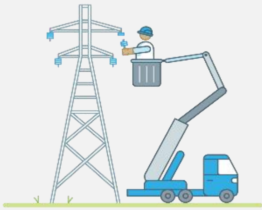
	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Corrective Maintenance	5.0	4.4	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Predictive Maintenance	85.0	89.5	91.0	97.2	93.6	89.3	85.0	83.1	85.5	85.7	82.8	85.0	83.1	85.5	85.7	82.8
Proactive Maintenance	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Preventive Maintenance	48.9	52.5	49.2	51.1	51.1	50.9	51.0	50.3	51.1	50.7	49.4	51.0	50.3	51.1	50.7	49.4

Asset class snapshot

Maintenance opex

RCP4 (forecast in 2025 constant $s)

$746.5m



Maintenance opex by type

	RCP4
Preventive	$254.9m
Predictive	$460.5m
Proactive	$5.8m
Corrective	$25.2m

Asset class strategy

Our maintenance work programmes are determined from our asset class strategies, maintenance service specifications, and standard maintenance procedures (SMPs).

Each grid asset class strategy sets out the high-level maintenance required for the asset class to ensure the asset performance aligns to the asset class objectives. Our maintenance service specifications then establish the work that needs to be carried out on each asset type, clarify the details of what is involved, and assign a priority to the work. SMPs define, at task level, the current appropriate practice for maintenance on all asset types. The SMPs provide for consistent practices over a diverse asset base, by a field workforce that is geographically spread and managed by different service providers. Service provider personnel must use the SMP documents while on the job. Typically, these are attached to the maintenance work orders and accessed via the Mātai app in the field. The maintenance expenditure forecasts presented in this plan are the total sum of the work required from these strategies, service specifications, and maintenance procedures.

Maintenance categories

We categorise grid maintenance into four main work types, as summarised in Table 9.[15] The work types are distinguished by how the work is initiated. This enables relatively granular tracking of maintenance interventions and their costs and drivers.

Table 9: Maintenance work types

Work type	Description
Preventive	Routine servicing or inspections to prevent failure or understand asset condition. This is our most regular asset intervention, so is a key source of effective feedback to the overall asset management system
Predictive	Maintenance performed based on known equipment condition before its condition deteriorates into an unsatisfactory state (e.g. outside service specification). Unlike corrective maintenance, this work occurs prior to failure. Activities include condition-based repairs, vegetation control, and additional targeted condition monitoring
Proactive	Improvement work initiated from formal analysis and investigation by the engineering or reliability teams to reduce risk or provide an efficiency gain. Activities are driven by either tactical or strategic reliability analysis, and include special inspection, reliability-driven corrective work, and one-off condition-monitoring tasks
Corrective	Fault response or maintenance work undertaken to restore an asset to service, make it safe or secure, or prevent an imminent unforeseen event that causes damage, degradation, or an operational failure. Corrective maintenance work is usually identified directly because of a fault or during preventive maintenance inspections

15 Routine maintenance expenditure also includes routine service charges such as site leases.

Forecasting approach

We use base-step-trend and bottom-up forecasting approaches for the maintenance forecast. The application of the approach is dependent on the availability of information and the degree of uncertainty in the forecast volume of work required. Table 10.summarises the forecast approach we use for each maintenance category.

Table 10: Maintenance forecasting approach

Maintenance type	Forecasting approach
Preventive maintenance	Bottom-up
Predictive maintenance	Base-step-trend and bottom-up
Corrective maintenance	Base-step-trend
Proactive maintenance	Base-step-trend

Base-step-trend

The base-step-trend provides a controllable approach to ensuring that the incremental rolling incentive mechanism works as intended and is used by many utilities and economic regulators to forecast recurring expenditure.

The base-step-trend approach involves the following main components.

Base expenditure. A key requirement of the base-step-trend forecasting framework is that the base amount included in the forecast must be representative of the future expenditure requirement and be cost efficient. That is, the base expenditure is a 'revealed cost' that represents the ongoing, efficient maintenance expenditure requirement over the forecast period.

Step changes. Increases or decreases in costs, relative to the base expenditure, required to meet the needs of the network or to allow for external requirements. These can be one-off or ongoing changes and involve a change in the scope of work delivered.

Trends. Reflect the expected changes in cost.

Base-step-trend is utilised to forecast expenditure categories that have a reasonable degree of consistency from year to year and are built up from large volumes of smaller items. This applies to predictive, corrective, and proactive maintenance categories.

Bottom-up

We use a bottom-up approach to forecast preventive maintenance expenditure. The bottom-up approach is used as our AMS contains the forecast annual work volumes for each job type, specified according to our standard maintenance procedures. To obtain the expenditure forecast, we multiply the work volumes by the relevant unit rates. The unit rates are based on those currently agreed with our service providers.

We also use a bottom-up approach to forecast our maintenance project work over the near term: between 1 and 5 years depending on the portfolio. Longer-term maintenance project spend forecasting utilises a base-step-trend approach and is informed by our asset health models.

Provisions

During RCP2 we began provisioned funding for earth potential rise, under-clearance and asbestos mitigation. These obligations are necessary but uncertain, and this value has and will continue to change as the work is progressed. This work has continued into RCP3 and 4, with further provisions taken where new risks have been identified. It is considered predictive maintenance but is excluded from the future forecast expenditure as it has already been accounted for in prior years. Under-clearance does enter the forecast from 2028 onwards, as the provision was for high-risk sites, which are expected to be completed by then. The remaining under-clearance will be lower risk and un-provisioned.

Maintenance plans

The maintenance plan for each maintenance work type is described below.

Preventive maintenance

Preventive maintenance predominantly consists of delivering our risk and/or time-based maintenance schedules. This work enables us to understand the condition of our assets, identify defects, undertake small servicing jobs to maintain assets and to meet statutory and compliance requirements. Preventive maintenance is our most regular asset intervention and is a key source of asset information feedback to our AMS.

Maintenance drivers

The main drivers of preventive maintenance activities are:

- Asset-specific characteristics including age, asset type and manufacture.
- network risk and criticality
- compliance with safety and other regulations.

These are used in the development of the preventive maintenance approach within the asset class strategies, the maintenance tasks set out in the asset service specifications, and SMPs.

Work activities

The main preventive maintenance activities are as follows.

Inspections: Non-intrusive checks, patrols and functional testing to confirm safety and integrity of assets, check continued fitness for service, and identify follow-up work.

CA and condition monitoring: Periodic measurement activities performed to monitor asset condition and to provide systematic data for analysis.

Servicing: Routine tasks performed on the asset to ensure that its condition remains at an acceptable level.

Several preventive maintenance optimisation exercises have been implemented over the last ten years which look to ensure we do the most appropriate level of PM maintenance across our AC substation and transmission lines assets. During the same period, we have identified new requirements or gaps in our preventive maintenance schedule that has led to an increase work in some portfolios.

We also regularly review our asset reliability via our reliability informed maintenance (RIM) activity. This can identify gaps and needs in our preventive maintenance schedules as well as provide insight into potential optimisation. Our RIM may increase maintenance activity across both preventive and predictive categories but is expected to reduce whole-of-life cost, with a focus on improving asset reliability.

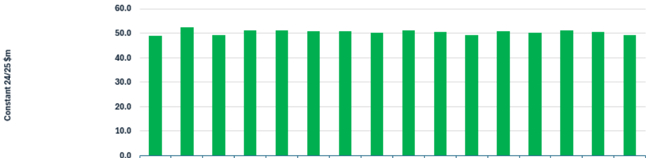
Unit costs

Our base preventive maintenance forecast uses the unit costs currently agreed with our service providers. These are set out in our price books, a component of our maintenance service provider agreements. These are usually repriced on an annual basis and compared across all service providers to ensure they are in line with the market.

Preventive maintenance expenditure forecast

Our preventive maintenance forecast has been derived from the forecast work volumes within our asset management system multiplied by the unit costs for the works activity type. In addition, the preventive maintenance forecast includes non-field work components such as service provider fixed overhead fees. Figure 27 shows the forecast preventive maintenance expenditure.

Figure 27: Preventive maintenance forecast expenditure



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Preventive Maintenance	48.9	52.5	49.2	51.1	51.1	50.9	51.0	50.3	51.1	50.7	49.4	51.0	50.3	51.1	50.7	49.4

Predictive maintenance

Predictive maintenance addresses defects identified through the preventive maintenance and asset feedback processes, i.e. in response to condition-based inspection and monitoring programmes. Predictive work is carried out prior to failure or before asset condition deteriorates to an unsatisfactory state.

Maintenance drivers

The main drivers of predictive maintenance activities are asset condition, asset criticality and compliance with safety regulations.

These are used in the development of the predictive maintenance approach within the asset class strategies and the maintenance tasks set out in the asset service specifications, and SMPs.

Work activities

The main predictive maintenance activities are:

Rectifying defects: Repairing assets or replacing minor components to correct defects, address wear and tear or repair damage, or to return the asset to a condition that complies with a defined standard.

Targeted condition monitoring: Using specialised test equipment to validate condition or predict the likelihood of failure.

Vegetation control: Cutting and/or trimming vegetation to maintain electrical clearance standards.

We typically address around 15,000 defects per year. While in any given year more defects than this might be identified, maintenance intervention timing is optimised.

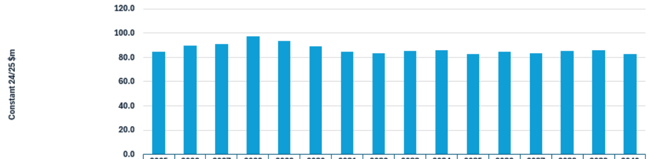
Our Mātai application streamlines data collection in the field ensuring accurate prioritisation via the WORP tool.

Predictive maintenance also includes some replacement and refurbishment of assets that are deemed to be opex. These are managed as maintenance projects or predictive maintenance large work orders.

Predictive maintenance can be impacted by some capex lead initiatives that reduces total capex and whole of life cost but increases opex. An example of this is the tower-to-poles initiative which reduces whole of life costs but may increase maintenance work.

Predictive maintenance expenditure forecast

Figure 28:Predictive maintenance forecast expenditure



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Predictive Maintenance	85.0	89.5	91.0	97.2	93.6	89.3	85.0	83.1	85.5	85.7	82.8	85.0	83.1	85.5	85.7	82.8

Our predictive maintenance expenditure trend can be seen in Figure 28. . There is an increase in RCP4, compared with RCP3, which is driven by a step change increase in key maintenance programmes as our assets age and we adapt our strategies to support sustainability and climate change objective.

Proactive maintenance

Proactive maintenance incorporates improvement work initiated as a result of formal asset performance analysis and investigation. It is used to prevent the failure of equipment in the future by determining potential root causes of failure.

Maintenance drivers

The key driver for proactive maintenance is reliability or cost improvements.

Work activities

The main proactive maintenance work activities are as follows.

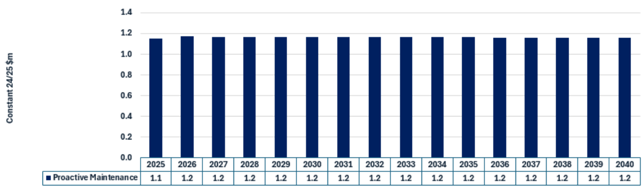
Special inspection: Special reliability engineering inspections to further determine fault causes or validate findings.

Reliability driven corrective work: Improvement modifications, design changes, or adjustments undertaken as scheduled activities that are planned and scheduled in advance to address reliability concerns.

Condition monitoring: One-off condition monitoring using specialised test equipment to further determine fault causes or to validate findings for root causes analysis or reliability engineering purposes.

Proactive maintenance expenditure forecast
Figure 29 shows our proactive maintenance forecast from the last year of RCP3 to RCP6. Proactive maintenance expenditure is expected to continue at a similar level in the future.

Figure 29: Proactive maintenance forecast expenditure



Corrective maintenance

Corrective maintenance involves fault response activities or maintenance work following a fault. The work is undertaken to return equipment from an unsatisfactory or failed condition back to a serviceable condition. Its purpose is to restore an asset to service, make it safe or secure, or prevent an imminent event that will likely cause damage, degradation, or an operational failure.

Maintenance drivers
The key driver of corrective maintenance is safety and reliability.

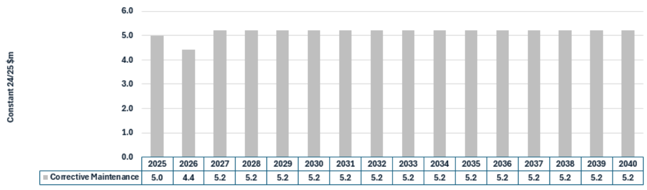
Work activities
The main corrective maintenance activities are as follows

Fault restoration: Immediate response to repair a fault that has safety, environmental, or operational implications.

Repairs: Work necessary to repair damage or to prevent the failure or rapid degradation of equipment that is in an unsatisfactory condition.

Inspections: Information gathering that is not directly related to the fault restoration activity itself.

Figure 30: Corrective maintenance forecast expenditure



Corrective maintenance forecast expenditure
Figure 30 shows our corrective maintenance for the last year of RCP3 to RCP 6 forecast. While our aim is to reduce our corrective maintenance expenditure to align with industry best practice by improving our prioritisation and optimisation of our maintenance work, we have also revised our forecast based on extrapolation of expenditure over the last 5 years. This has resulted in an increase in the expenditure forecast for corrective maintenance.

Substations

Our AC substations comprise all the primary assets within the substation boundary. They enable safe operation of the grid, transform transmission voltages, and are the points of connection to transmission lines, generating stations, lines companies and direct connect users.

Our AC Substations portfolio includes the structures on which primary equipment is installed, the HV electrical conductors and cables connecting the primary equipment within the substation, and the LVAC supply system for the substation itself. It covers 10 asset classes.

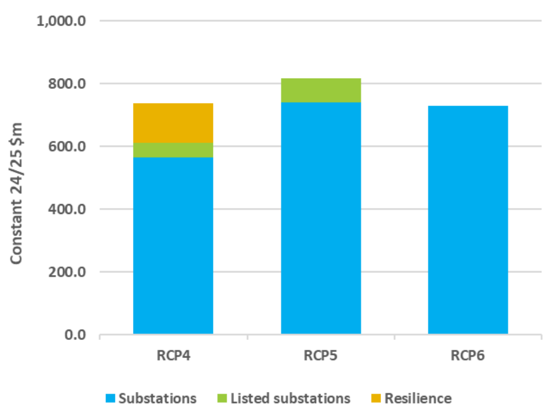
- Power transformers
- Indoor switchgear
- Outdoor circuit breakers
- Outdoor instrument transformers
- Power cables, including between substations
- Outdoor disconnectors and earth switches
- LVAC distribution systems
- Structures and buswork
- Other substation equipment

Our AC substation portfolio assets do not include our Secondary Assets, Communications, and Building and Grounds. It is also a typical in terms of the boundary between the grid and our customers' assets compared with international peers. For example, we own many transformers and switchgear for supply at the lower voltages of 11 kV or 33 kV to a customer. This means there is a relatively large number of these assets on the grid that, in other countries, would typically be owned by electricity distributors. This proportion is decreasing over time through mutually beneficial opportunistic divestment, transferring some of these lower-voltage assets to local electricity distributors.

Our AC substation assets are generally older than those of our international peers. We do not believe having older assets is an issue as our replacement strategies primarily focus on condition and risk-based replacements instead of age. This requires reliable asset data and a more extensive focus on modelling, which we are continuing to develop to ensure we set robust investment and maintenance expenditure plans.

Where possible we align our condition-driven investments with E&D plans to ensure our substations have the capability and flexibility to keep pace with advances in consumer technology, and that they enable electrification and renewable connections while continuing to support a reliable and safe network.

Figure 31: AC substations capex by RCP



Our BIM strategic programme of work will enable creation of digital representations of the physical characteristics of assets, also known as digital twins. BIM is being implemented across all our substation sites in the next 15 years, prioritised to support those sites in the forward work programme. BIM will enable cost and time savings across the project and asset lifecycle.

Remote switching minimises safety risks and reduces the time to undertake switching activities, thus reducing overall outage requirements. Our Digital Switch Management (DSM) programme (funded by the ICT Transmission Services Portfolio) is a key enabler for remote switching across our devices. We will commence trials of remote switching in RCP4 to capture the full benefits of DSM.

The key investment themes within our AC substations are as follows:

- Power transformers: During RCP4 there is a need to begin replacing units that have previously undergone life extension or those units where life extension is not possible.
- Environmental factors: Our renewed approach to management of SF_6 gas includes reliance on life extension to delay the replacement of some circuit breakers until alternative technologies (SF_6 free) can be developed and tested. An increase in maintenance expenditure in life-extension work will enable these assets to remain in service beyond their current expected lives while limiting SF_6 gas loss. Management of SF_6 leakage from HV GIS indoor switchgear is targeted through online monitoring, proactive refurbishment work and accelerated replacement where necessary.
- Remaining AC substations: Previously implementing asset health models and improvements in our asset data resulted in life extensions in many asset classes through both more targeted condition-based replacements and refinement in strategy to undertake more proactive maintenance. In RCP4, many of these deferral benefits have been realised and the overall capex trend is increasing as assets reach replacement criteria.

The capex by RCP is shown in Figure 31. There is a forecast increase in substations work from RCP4 to RCP6, as we see an increasing need to undertake condition-based replacements to maintain a safe and reliable network.

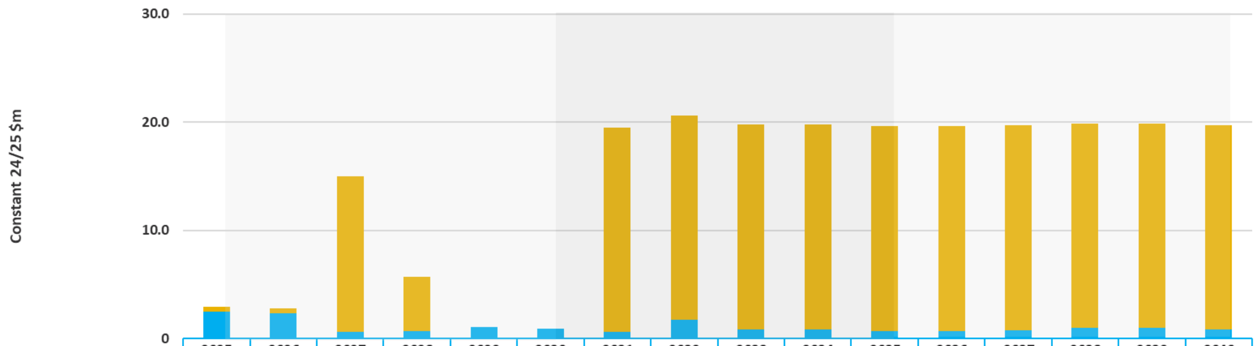
Grid Development Other and Substation General

Within this expenditure, funding is provided to operational teams, as yearly contingency allowances, to support fault response activities where the activity should be capitalised rather than a maintenance expense. Examples of this are replacement of relays, pole structures and instrument transformers. This expenditure sits alongside our corrective maintenance programme. Funding is based on historical expenditure which can vary year to year.

Also included is funding to install primary assets for grid skill use to train our service providers. These assets are generally used to support training modules and the replacements planned in RCP4 are to ensure the training assets are aligned to the in-service assets on our grid.

Resilience projects make up most of the planned expenditure in this category. The resilience funding covers resilience work to mitigate flooding in our substations with RCP4 work primarily in 2027 and 2028. Figure 32 shows the grid development other and substation other actual and forecast capex

Figure 32: Grid development other and substation other actual and forecast capex



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Resilience	0.5	0.4	14.4	5.0	0.0	0.0	18.9	18.9	18.9	18.9	18.9	18.9	18.9	18.9	18.9	18.9
Other general substation work	2.5	2.3	0.6	0.7	1.1	0.9	0.6	1.7	0.9	0.9	0.7	0.7	0.8	1.0	1.0	0.8

Substation risk, resilience, and sustainability

Our substations face many vulnerabilities and major hazards. To address this, our resilience programme includes specific strategic programmes to manage substation fires, flooding, seismic events, volcanic eruptions and space weather. We are also working on several sustainability workstreams such as laminated wooden buildings, low-carbon concrete and solar panel installations to support our Sustainability Strategy and reduce the carbon emissions from our activities.

Consolidated simplified bow-ties

We have developed two simplified bow-ties describing major hazards and degradation of primary assets in a substation, and a significant incident on a transmission cable circuit16. These are as shown in Figure 33 and Figure 34. The bow-ties inform us of the most likely causes of failure across our AC substation assets, along with the most likely resulting consequences of failure.

Our risk modelling has identified which preventive and mitigative controls[17] are to be used to reduce the likelihood of a significant initiating risk event occurring on our primary assets within a substation and to reduce the consequential impact of that event. We have used the bow-tie analysis to inform our:

- ongoing maintenance activities
- the type of CA undertake
- our procurement specifications to ensure assets procured suit Aotearoa New Zealand conditions
- ensure our new assets are designed, installed and commissioned to the latest specifications and standards
- ensure appropriate signage so third parties are alerted to the presence of our assets
- ensure robust asset management systems are in place.

Each of our substation asset class plans advises the predominant likely causes of each asset class failure and the key controls that we have implemented to reduce the likelihood and resulting impact of a failure.

[16] Transmission cable circuits are managed within the AC Substations Power Cables Asset Class Plan as the key component is the power cable. Our HV cables provide transmission services in urban areas where the use of overhead lines is undesirable.

[17] Table 5 within the Risk Management section of this AMP details each critical preventive and mitigative control.

Figure 33: Major hazards and degradation of primary assets in a substation simplified bow-tie

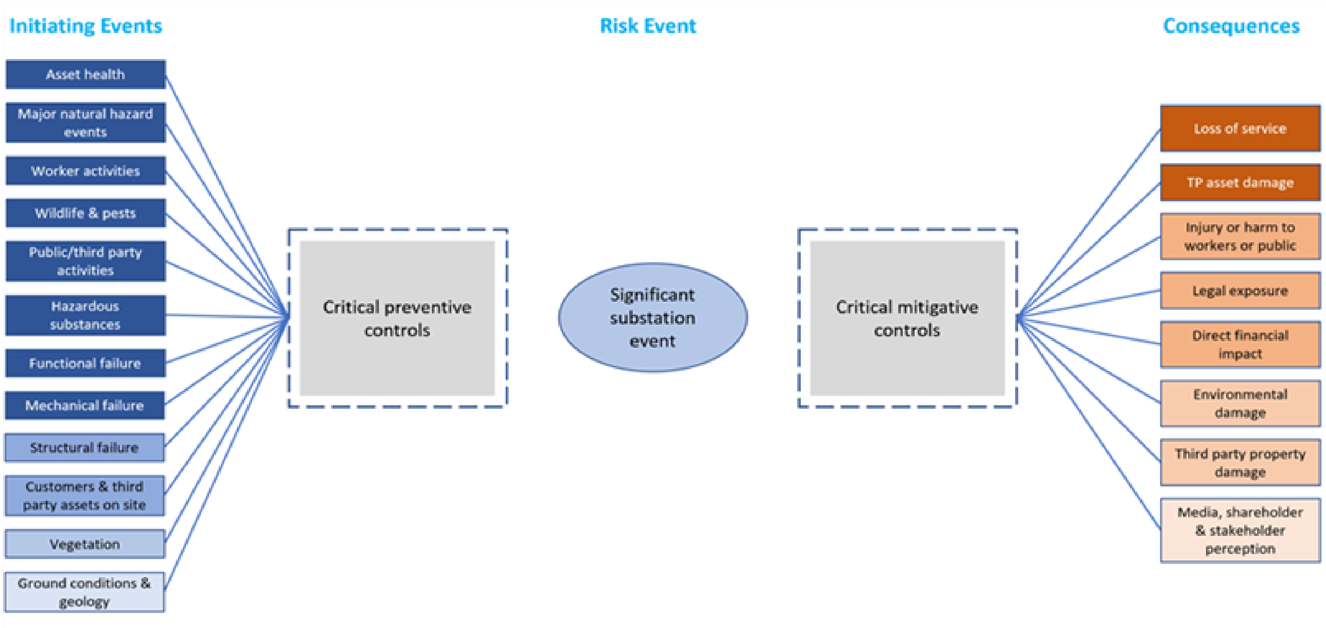
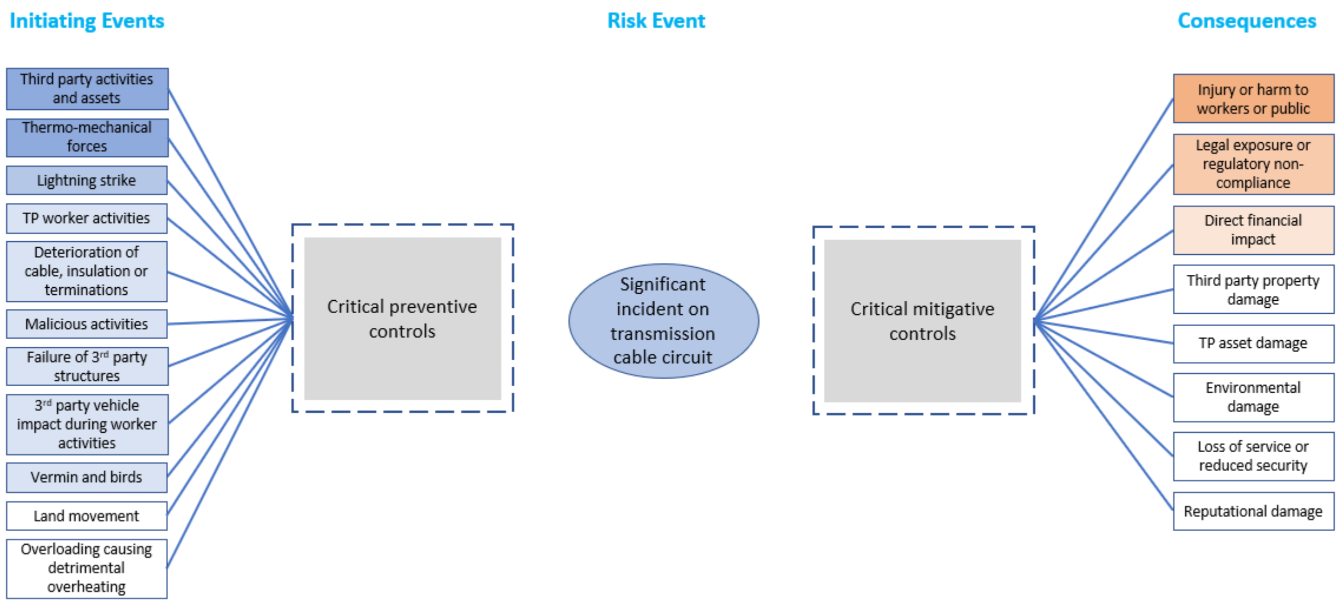


Figure 34: Significant incident on a transmission cable circuit simplified bow-tie



Common terms

Within the AC Substations portfolio there are some common terms used. These are:

- **HVAC:** High voltage alternating current.
- **HVDC:** High voltage direct current.
- **Substation:** A general term to cover substations, power stations and switching stations. Often the terms station and substation are used interchangeably. A building, structure or enclosure incorporating equipment used principally for the control of the transmission of electricity.
- **Switchyard:** An area enclosed by a security fence, containing normally live conductors and/or other exposed materials.
- **Switching station:** A substation solely for the purpose of transmission rather than supply.

Maintenance – tests, inspections, and condition assessments

We undertake proactive, preventive, predictive and corrective maintenance on our substation assets. As part of our maintenance activities, we undertake regular inspections and condition assessments to ensure our assets are maintained in an appropriate condition and operate as required.

Table 11 shows the frequency of the general condition monitoring tests and inspections undertaken on the full substation.

The specific tests, inspections and condition assessments for each asset type are outlined in each substation asset class plan.

Risks and uncertainties

The following are the material risks and uncertainties associated with this portfolio:

1. There is increasing uncertainty related to customer investment plans and proposed divestments of connection assets. This may impact the timing and scope of programmes that include connection assets such as outdoor-to-indoor (ODID), where we seek agreements with customers before proceeding.
2. We have seen some recent cost increases across most portfolios during periods of increased inflation. Supply chain pressure as a result of COVID-19 and international electrification has further amplified some of these pressures.

Asset class plans

The following sections describe in more detail our asset management approach for each of the AC substation asset classes. These asset class plans describe the strategy, asset characteristics, management approach and expenditure profile for each asset class. The expenditure covers the capital requirements, along with any specific maintenance projects to be undertaken.

Table 11: General tests, inspections and CAs undertaken on all substation assets

Activities	Frequency
Station Level 1 Inspection: A general visual inspection including housekeeping, collection of protection operation data, minor servicing, and security and functional checks. The inspection covers but is not limited to: • Buildings and building services, including security, safety, and fire protection equipment • Indoor and outdoor equipment, including switchyard grounds • Transformer condition checks, including on-load tap changer operation & silica gel replaced when saturated • Health and site safety equipment, e.g. defibrillator checks and burns kits are clearly marked and in date	2 monthly
Station Level 2 Inspection: This covers the same station assets and inspections as Level 1 but is a more comprehensive inspection. It requires a more detailed visual inspection of the equipment and includes operational checks (which may require the opening of cubicles, panels, etc. with the objective of identifying any significant deterioration or damage that has occurred since the previous level 2 inspection), thermographic survey, hazardous substance level 1 Inspection, hazardous substance location certification, and hazardous substance stationary container test certification.	1 yearly
Oil Services Inspection: Visual inspection of oil interception facilities including but not limited to: • Oil interceptors and discharge system soakage holes free of visible hydrocarbons and debris • Drainage sumps emptied with buffer water retained and free of visible hydrocarbons and debris • Oil storage tanks, oil spill trailer and spill kits free of damage, secured and in good operational order	6 monthly

Power transformers

We have two categories of transformers: power transformers and auxiliary transformers.

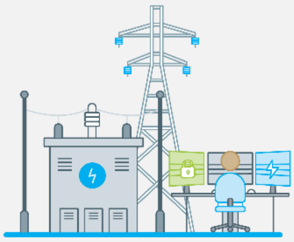
- Power transformers are bespoke, have long lead times, and are generally the highest-value assets in substations.
- Auxiliary transformers (sometimes called local service) are of much lower value and have shorter lead times. Although less critical to the supply of electricity, they are critical for station and communication supply.

Asset class snapshot

Population

321 Power transformers

310 Auxiliary transformers



Capex

RCP4 (forecast)

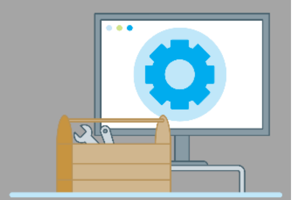
$224.4m

Power transformer asset health

- 73.8% Good
- 21.1% Fair
- 2.2% Poor
- 2.9% Very Poor

Work programme

	RCP4
Power transformers	18
Bushings	43



Asset class strategy

Objective
Safe and reliable operation, at least whole-of-life cost.

Measure
Reduce forced and fault outage rate for power transformer banks to fewer than 18 events per year.

Asset strategy
Targeted and prioritised investment based on unit-specific quantified benefit (monetised risk) analysis to meet our asset performance measures.

Investment need is primarily based on asset health and risk. We undertake quantified benefit (monetised risk) analysis to evaluate and prioritise solutions based on unit-specific probability and consequence of major failures. Rare but severe failure modes are included in the evaluation of options. Instead of just full replacement it considers investment in specific risk mitigations. This includes site-specific solutions, such as adding a firewall, refurbishment, corrosion repaints, tap changer overhauls, corrosive sulphur oil replacement, bushing replacements, and, if required, the full replacement of the transformer.

Alternative options are compared using net whole-of-life costs, including annualised risk costs. Our quantified benefits approach shows that maintenance or refurbishment options can often extend the remaining life of the assets. There is generally no economic benefit from replacing transformers unless the winding is showing end-of-life signs or the existing unit is undersized, and the impact of a failure is significant. Compared with past age and condition-based replacement approaches, this strategy often extends transformer life and defers replacement. However, transformer end-of-life failure is hard to predict, and we remain mindful of taking a balanced approach that considers the overall asset condition.

Figure 35: Power transformer age profile

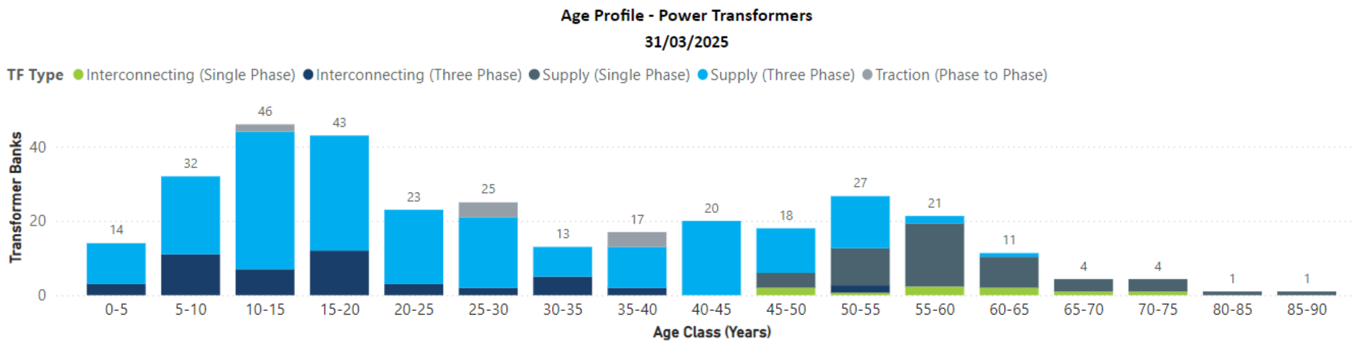
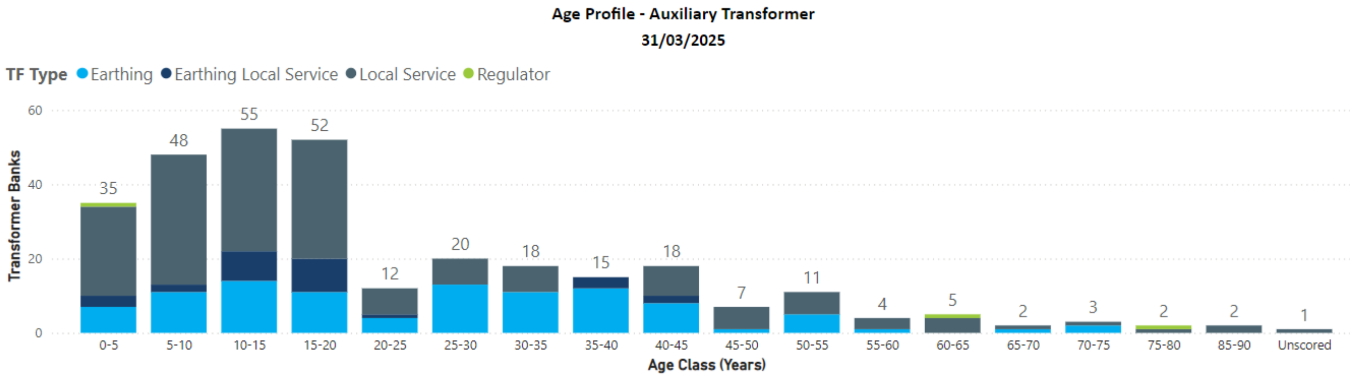


Figure 36: Ancillary transformer age profile



Auxiliary transformers are often replaced as part of other major works on site, e.g., transformer replacement or a 33 kV ODID conversion project or where it is found an unacceptable condition level has been reached .Figure 35 shows the population and age profile of our power transformers by type. Our older transformers are predominantly single-phase transformers, while all transformers that have been replaced or installed in the last 40 years are three-phase units. Figure 36 shows the age distribution of our local service, earthing, and regulating transformers. The majority of these are relatively young.

Lifecycle – deliver, operate, maintain, decommission, and disposal

Delivery times for new power transformers include allowance for investigation, detailed design, procurement, outage planning and coordination with other works at the site. It typically takes 2-3 years to complete this work.

We plan and manage outages in a way that creates a safe environment for employees while minimising disruption for customers. We undertake regular CAs and planned maintenance in accordance with our standard maintenance procedures and routine substation inspections. Our programme of routine condition monitoring-inspections is in Table 12.

Maintenance activities include routine on-load tap changer maintenance; replacing Buchholz relays which have mercury contacts to remove risk of tripping during earthquakes; corrosion control and repainting as condition dictates; corrosive sulphur oil replacement; replacement of faulty or defective instrumentation; and bund repairs.

We scrap decommissioned end-of-life power transformers. The oil is sold to a licensed oil dealer for regeneration and re-use.

Table 12: Transformer condition monitoring and inspections

Activities	Frequency
Dissolved gas analysis sampling, oil screen tests	Annually
Diagnostic inspection, service, and testing	5- yearly
Major service of on-load tap changer (frequency based on type)	2, 4, 8 or 10-yearly
Furan oil test, oil anti-oxidation inhibitor level test (transformers from 1975)	4-yearly
Winding temperature monitor calibration check	10- yearly

Metals such as steel and copper are sold to scrap dealers. A few decommissioned transformers are retained as spares for specific sites where justified. Where transformers have been replaced before end of life (for added capacity at that location) these transformers are stored and reused as replacements at other substations, kept as strategic spares, or on-sold to third parties.

Accelerated electrification may result in more replacements before end of life, and we will continue to identify opportunities to re-use as part of system planning when working with customers on their capacity needs.

Asset risk – health and performance

Figure 37 and Figure 38 show the asset health forecasts. The auxiliary transformers have recently been added to the asset health model, although the outputs are yet to be fully implemented into our planning. However, we do not foresee a material change in replacement volumes compared with our current approach.

Figure 40 shows the trend of unplanned outages and the 10-year rolling average for winding faults per 100 population. Asset performance is influenced both by our transformer replacement programme, targeting old and poor condition single-phase units (from 2008), and our life-extension programme, targeting major component refurbishment or replacement (from 2017).

Figure 38 shows a decline in asset health over RCP4. Our asset management approach is to continually review and reprioritise our work plan to minimise the risk. As the opportunities for life extension works reduce during RCP4 and RCP5, we expect an increasing requirement to begin replacing units that have previously undergone life extension or those units where life extension is not possible.

Figure 37: Local service transformer current asset health

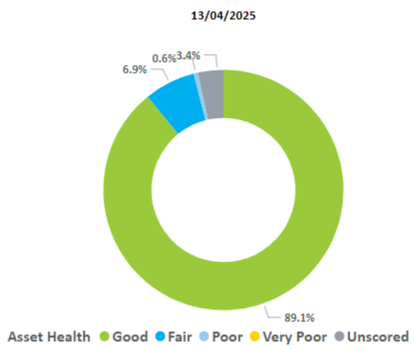
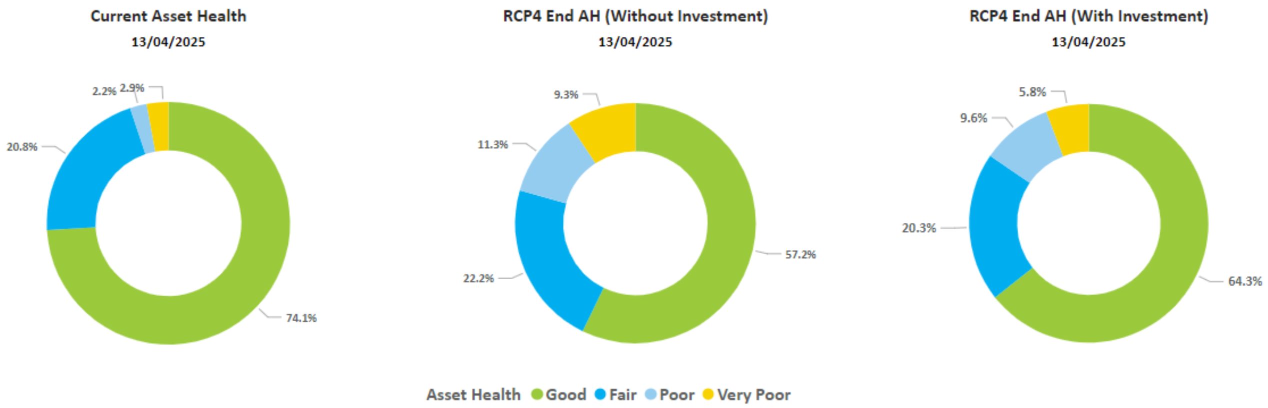


Figure 38: Power transformer asset health



The predominant causes for power transformer failure are insulation failure, mechanical failure, over-rating, and material degradation. The three key preventive controls critical to reducing the likelihood of a service failure event are good procurement processes, operation, and maintenance. Good procurement processes ensure good design and quality in manufacturing which includes having representatives on site to witness factory acceptance tests of all new transformers.

Figure 39: Transformer risk profile

We undertook a review of our asset health model calibration in 2021. The risk profile for the portfolio is Figure 39. The risk-based planning approach ensures our investment is targeted to those transformers that are the most critical to maintain reliable supply to our customers. Beyond RCP4 (2030) modelling uncertainty begins to increase.

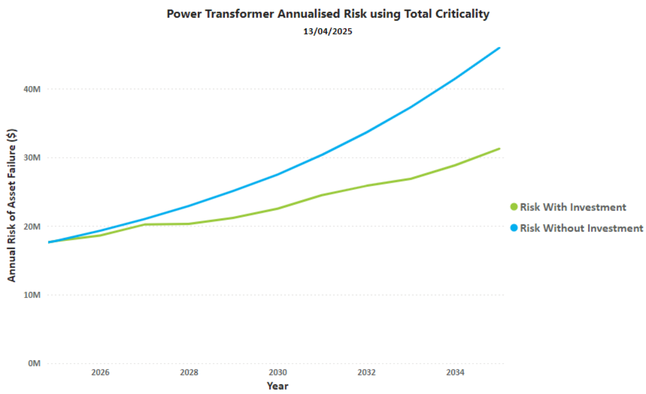
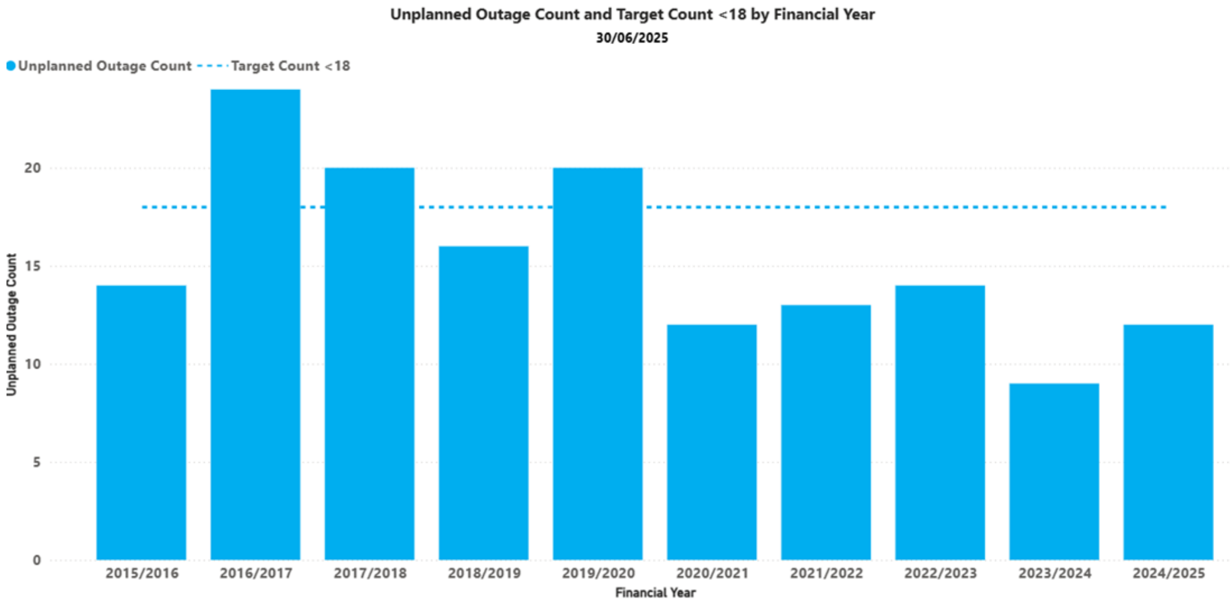


Figure 40: Power transformer performance



Forecast work and capex

The expected quantity and cost of work to be delivered in this portfolio to achieve the levels of risk and asset health noted above are summarised below in Figure 41.

Opex: The opex forecast covers the condition monitoring inspections and maintenance activities outlined in the lifecycle section of this ACP.

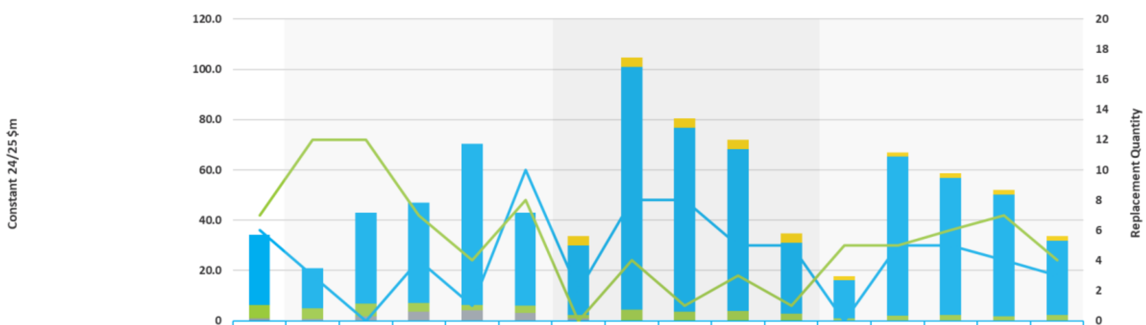
Capex: The forecast capex is based on our approach to extend transformer lives and risk-based replacements. This approach has resulted in an overall reduction in the number of total unit replacements planned, compared with a condition-based replacement programme only.

The bushing replacement programme is expected to reduce significantly in RCP5, as most transformers suitable for this option will have been addressed.

Due to the risk-based investment approach, as load growth changes due to electrification, we expect this might require us to bring forward some investments. We closely monitor the condition of transformers and the consequences of failure to ensure our forward investment plan manages this risk.

Due to global supply constraints, limited suppliers, and increasing customer requirements, we are endeavouring to accelerate procurement for items with long lead times, e.g. transformers and disconnecting circuit breakers, to maintain asset health. We also undertook a review of our spares policy to ensure it still meets our requirements. There has been signifcant inflationary cost pressures across all parts of the supply chain which have had a material impact on the cost of delivering power transformer projects. While volumes begin to increase over RCP4 and RCP5 we have seen a disproportional increase in costs.

Figure 41: Transformer forecast capex and quantities



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Resilience	0.0	0.0	0.0	0.0	0.0	0.0	3.7	3.7	3.7	3.7	3.7	1.8	1.8	1.8	1.8	1.8
Power transformers	27.9	15.8	36.2	40.1	64.1	37.1	27.7	96.6	73.3	64.3	28.3	15.1	63.1	54.6	48.3	29.5
Bushings	5.4	4.5	5.0	3.5	2.1	2.8	1.3	4.5	3.6	3.9	2.7	0.9	2.0	2.2	1.7	2.2
Other (Firewalls, strategic spares, etc.)	1.0	0.6	1.8	3.5	4.2	3.2	0.9	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.1
Power transformer Qty	6	3	0	4	1	10	2	8	8	5	5	0	5	5	4	3
Bushings Qty	7	12	12	7	4	8	0	4	1	3	1	5	5	6	7	4

Indoor switchgear

Indoor switchgear is an integrated assembly of circuit breakers, instrument transformers and busbars that provide switching and control functions for the grid. These functions are essential for limiting safety risk to workers and members of the public, minimising asset damage and ensuring reliability of supply during faults on the power system. We have two categories of indoor switchgear: medium voltage (MV) which covers indoor switchboards operating at 11 – 33 kV and high voltage (HV) gas insulated switchgear (GIS) technology at 110 kV and 220 kV.

Asset class snapshot

Population

HV

65 220kV SF6

9 110kV SF6

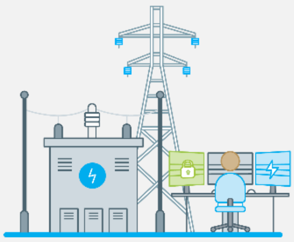
MV

13 Air break - magnetic

10 Bulk oil

183 SF6

889 Vacuum



Capex

RCP4 (Forecast including $60.6m for listed project)

$122.1m

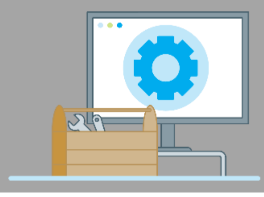
Asset health

- 99.2% Good
- 0.1% Fair
- 0.7% Poor

Work programme

	RCP4
MV Switchboards	5
HV GIS*	1*

*This is a listed project



Asset class strategy

Objective

Safe and reliable operation, at least lifecycle cost.

Measures

- 66-220 kV: No more than one unplanned outage per year of any indoor circuit breaker (excluding protection, SCADA, and human error).
- Below 66 kV: Fewer than nine unplanned outages per year of any indoor circuit breaker (excluding protection, SCADA, and human error). No unplanned outage of any indoor circuit breaker for longer than 7 days.
- SF_6 emissions from all indoor switchgear remain less than 0.3 per cent of their total nameplate quantity per year.

Asset strategy

- Needs are prioritised based on criticality ranking, and analysis of the potential for severe failure modes and site-specific consequences.
- All indoor switchboards with oil circuit breakers to be replaced by mid RCP4.

Investment need is primarily based on risk, replacing MV switchboards that have strategic (such as obsolescence) or safety concerns. We forecast to replace all switchboards that have these identified concerns investigated during RCP4 and replaced early in RCP5.

Beyond RCP4, our replacement forecast is based on a combination of asset health factors, including age, condition, and reliability. This includes assessment of specific factors such as spare parts availability. We are improving our health modelling and forecasting tools to implement a more robust approach to asset investment for older switchgear that has no current safety or strategic concerns.

The life expectancy for each type of MV indoor circuit breakers is generally 35–50 years. The options considered for MV indoor switchgear are retrofitting arc fault containment (where technically feasible), retrofitting arc flash protection, retrofitting with new circuit breakers (if the existing equipment will support this), and full replacement. We undertake a feasibility and risk assessment to determine the most cost-effective approach. If the assessment shows safety improvements cannot be retrofitted, full replacement is often required.

Our approach for HV GIS switchgear is to obtain the maximum possible life from the existing installations, by identifying and managing operational defects. No current life-expectancy criteria have been set. Well-performing HV GIS switchgear is expected to have a life of more than 75 years with regular maintenance and repair. This depends on the ability to source critical spares and manufacturer's support. Options for HV indoor switchgear are refurbishment or component replacement. We use economic analysis and advice from the original manufacturer to determine the most effective approach.

The number of MV indoor switchgear installations has increased as our ODID programme converts our outdoor 33 kV switchyards to indoor switchgear. An emerging trend of customer work has also increased the number of switchgear panels installed and, in some cases, complete switchboards.

Our indoor switchgear population and age profile is shown in Figure 42.

Delivery times for new indoor switchgear is 24–36 months from business case approval to completion, depending on project scheduling and procurement lead times. Design and procurement to be completed within the first 12 months, with the following years allocated for construction.

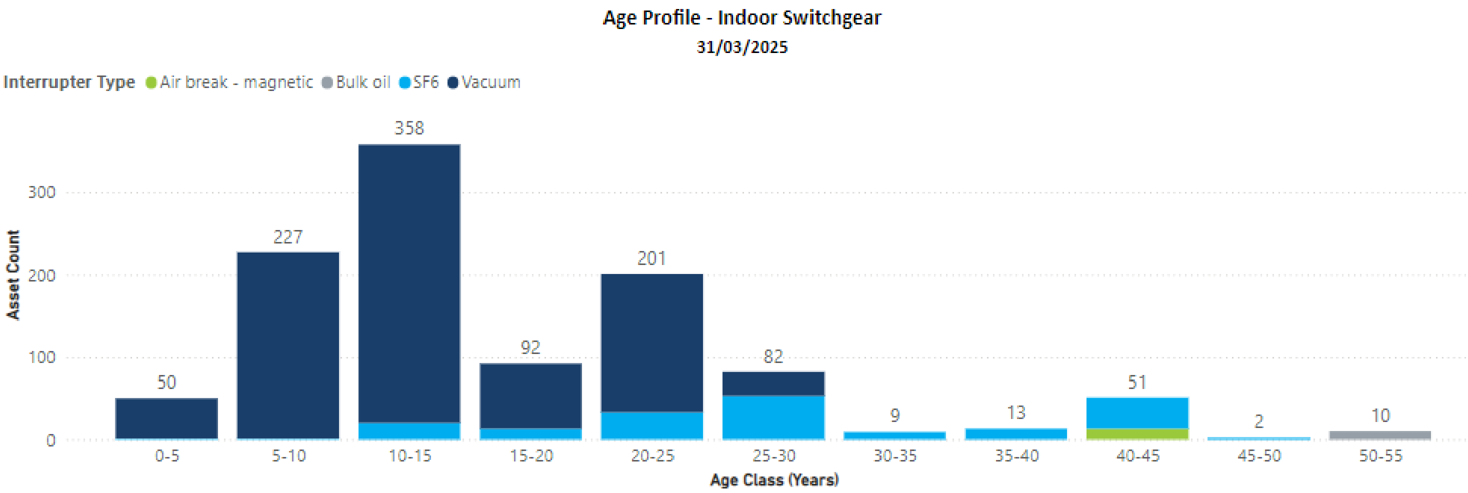
When outages are required to provide a safe environment for employees and service providers to install the new switchboard, we coordinate with the affected customer to minimise disruptions to customers and end users.

We undertake regular condition assessments and planned maintenance in accordance with our standard maintenance procedures. The specific tests and inspections for indoor switchgear are outlined in Table 13.

Table 13: Indoor Switchgear condition monitoring and inspections

Activities	Frequency
Diagnostic inspection and service (frequency based on type)	5- or 10-yearly
External inspection - certificate of inspection for hydraulic accumulators and air receivers	Annually
SF_6 gas moisture test	8 yearly

Figure 42: Indoor switchgear age profile



Lifecycle – deliver, operate, maintain, decommission, and disposal

Our maintenance activities on our indoor switchgear include:

- Replacing components when they have worn out or show signs of deterioration.
- Cleaning the indoor switchgear and room.
- Sealing vermin entry points and rodent control.

We evaluate whether decommissioned equipment can be repurposed as spares to support legacy assets that continue to be operational. Our decommissioning process includes safe worksite management and responsible scrap disposal. In decommissioning SF_6 circuit breakers, we recover SF_6 to avoid emissions into the atmosphere. Disposal of porcelain and oil from bulk oil circuit breakers are managed to comply with hazardous waste regulations.

Asset risk – health and performance

Figure 43 shows the current asset health of our indoor switchgear. Most assets are less than 15 years old, and we are still refining our approach to model degradation of these assets. We will continue to develop our model for indoor switchboard health to ensure appropriate interventions as the fleet ages.

Figure 43: Indoor switchgear current asset health

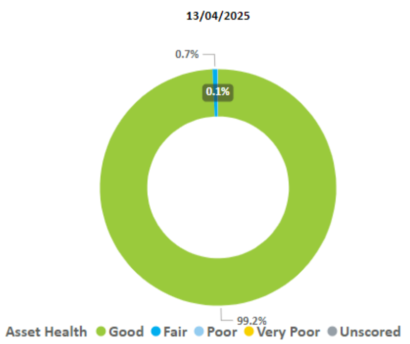
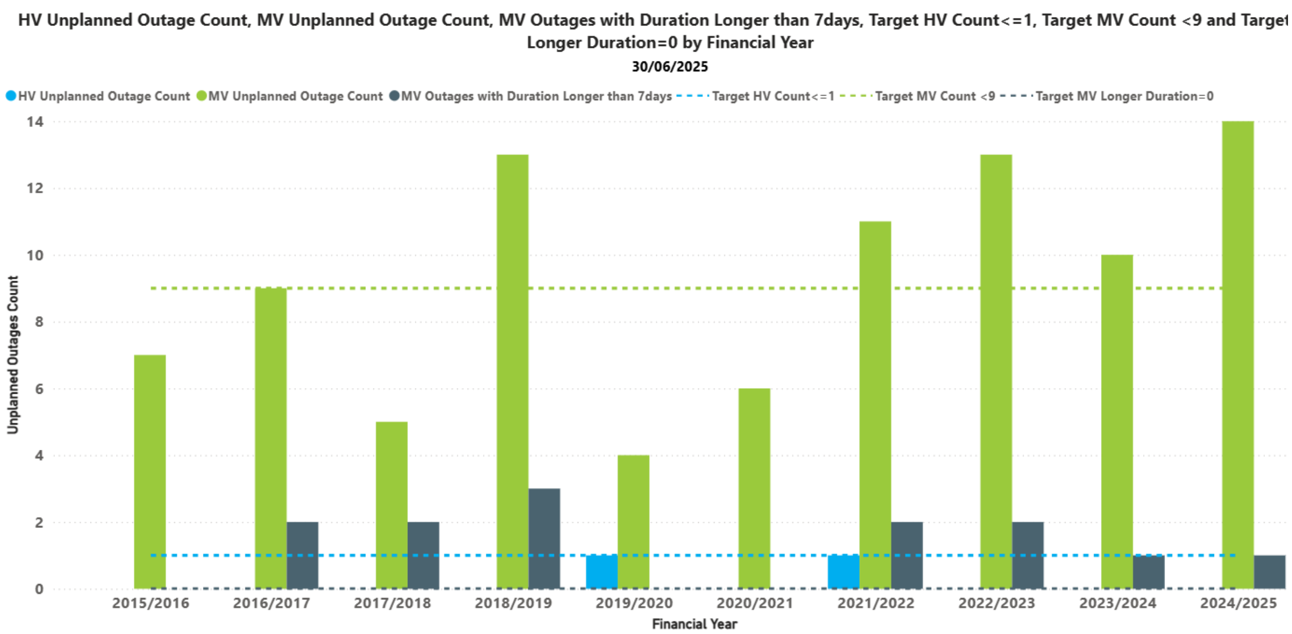


Figure 44: Indoor switchgear performance



The predominant causes for indoor switchgear failure are insulation deterioration, material degradation, mechanical failure, SF_6 leakage, mechanical stress, poor installation practice, inadequate cable support systems leading to early failure of bushings, pests, and vermin. The preventive controls critical to reducing the likelihood of failure are our inspections and maintenance programmes, including condition-based maintenance, and procurement specifications suitable for Aotearoa New Zealand conditions and quality assurance practices during commissioning. We continue to investigate partial discharge testing for ageing and at-risk switchboards, including HV GIS assets to determine how this might be integrated into our asset management approach. Indoor switchgear performance is shown in Figure 44.

Forecast work and capex

Opex: The forecast includes the condition monitoring inspections and maintenance activities outlined in the lifecycle section of this ACP. In addition to this, at-risk HV switchgear will have intrusive inspections and planned SF_6 seal replacements.

Capex: The RCP4 forecast focuses on managing risk with the replacement of the MV switchboards. By mid RCP4 all of the bulk oil indoor switchboards will be replaced. Beyond RCP4, the forecast is based on asset health factors including age and condition. The forecast consists of refurbishments and replacements.

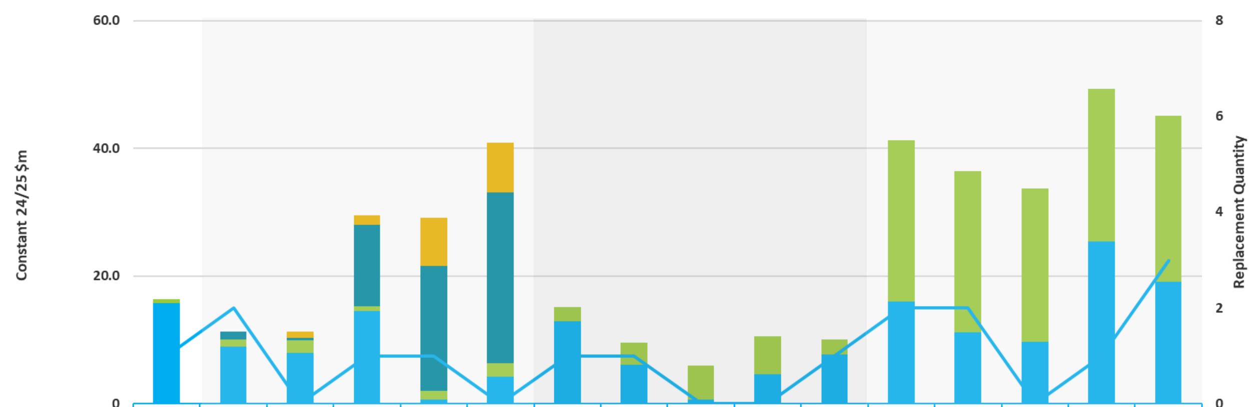
HV GIS strategies for RCP4, RCP5, and RCP6 include life-extension projects and contingency plans to help ensure these assets meet or exceed their life expectancy without undue failure risk. These projects will be scoped following investigation phases. Major expenditure for GIS replacements is allowed for in RCP4 for Rangipo site renewal works and RCP6 subject to further refinement.

Indoor switchgear capex is shown in Figure 45.

RCP4's forecast includes the resilience programme of portable substation assets as a requirement for duty and emergency stand by responisibilities. Currently approved we have one portable switchroom, one portable control room and protection in a box. A second mobile substation has been considered but will require a project reopener from the resilience programme if progressed. RCP4 also includes the Rangipo listed project to undertake site renewal works including HV GIS replacement which makes up a large proportion of the increase in spend. In RCP5 we will be investigating replacement HVGIS and pilot site(s).

We also expect to see a significant increase in capex in RCP6, which is again mostly due to the placeholder for GIS replacement subject to further CA and investigation.

Figure 45: Indoor switchgear forecast capex and quantities by year



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Resilience	0.0	0.0	0.9	1.6	7.5	7.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Listed GIS - Rangipo	0.0	1.2	0.4	12.7	19.6	26.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gas Insulated Switch gear	0.6	1.1	2.0	0.7	1.4	2.1	2.2	3.5	5.4	5.9	2.3	25.2	25.3	23.9	23.9	26.0
Switch boards	15.8	8.9	8.0	14.5	0.6	4.3	12.9	6.1	0.6	4.6	7.8	16.0	11.1	9.7	25.4	19.0
Switch boards qty	1	2	0	1	1	0	1	1	0	0	1	2	2	0	1	3

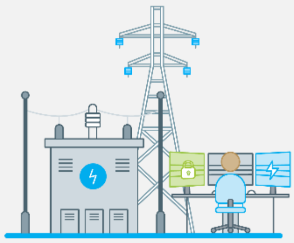
Outdoor circuit breakers

Circuit breakers are used to rapidly disconnect electrical equipment from the grid. Correct operation is vital for limiting safety risk and ensuring reliability of supply. In addition, circuit breakers are used to control the flow of power around the network. This asset class plan includes all outdoor type bulk oil, minimum oil, SF_6, CO_2 and vacuum circuit breakers. It specifically excludes any outdoor circuit breakers associated with the HVDC system, synchronous condensers, and dynamic reactive power installations.

Asset class snapshot

Population

- 71 Bulk oil
- 18 CO_2
- 1 Minimum oil
- 1190 SF_6
- 32 Vacuum



Capex

RCP4 (forecast)

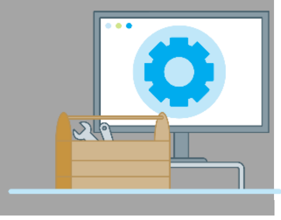
$46.3M

Asset health

- 86.4% Good
- 9.2% Fair
- 0.3% Poor
- 4.1% Very poor

Work programme

	RCP4
Outdoor circuit breakers	100



Asset class strategy

Objective

Safe and reliable operation, at least lifecycle cost.

Measure

- Unplanned outage rate fewer than 1.5 events per 100 circuit breakers in service per year.
- 10-year rolling average rate of explosive failures remains fewer than one (no more than approximately one such failure every 2 years).
- Achieve the net zero emissions target by 2050.

Asset Strategy

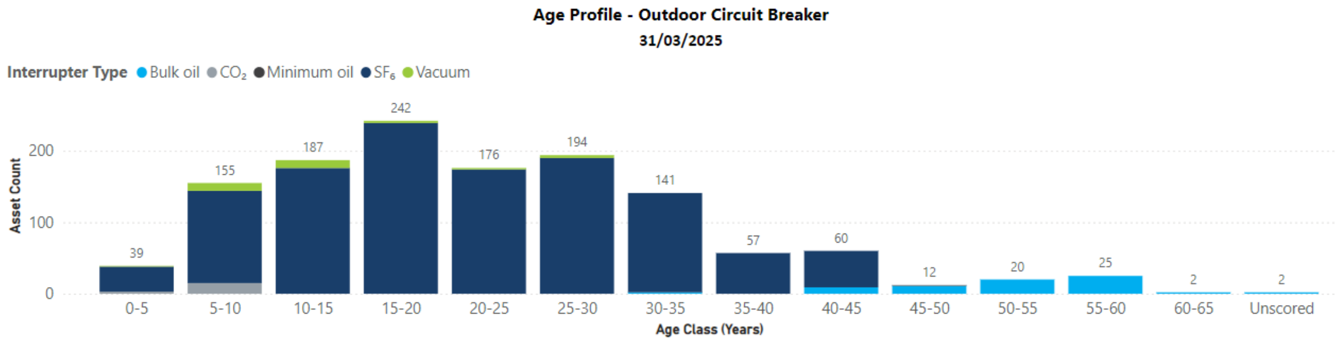
Replace remaining bulk oil circuit breakers by 2030. Replace other circuit breaker types based on condition and asset health modelling. We will use forensic examination of dismantled circuit breakers to provide detailed feedback on asset condition to support decision making about ageing populations.

Outdoor circuit breakers are generally replaced based on asset health. Life expectancy is between 25 and 55 years, dependent on factors such as corrosion zone, duty, and performance. Some breakers are approaching, or are already exceeding, their normal expected life. As we plan replacement on observed condition and not solely on age, this does not automatically trigger replacement.

Approximately 80% of our outdoor circuit breakers use SF_6 interrupters. To achieve our carbon emission reduction targets, as outlined in our Sustainability Strategy, we will extend the lives of SF_6 breakers where possible through activities like pole refurbishment and component replacement. This will enable replacement by SF_6-free alternatives when these technologies become available.

Figure 46 shows our outdoor circuit breaker population and age profile.

Figure 46: Outdoor circuit breaker age profile



Lifecycle – deliver, operate, maintain, decommission, and disposal

The typical delivery timeframe for new outdoor circuit breakers is 24 months from business case approval to completion. Design and procurement are completed within the first 12 months, with the final year allocated for construction. Where procurement lead times extend beyond this window early procurement of equipment is undertaken to meet the 24 month duration.

We plan outages to provide a safe environment for employees and service providers to undertake the work while minimising disruptions to customers and end-users. Older circuit breaker designs often fail today's safer working practice distances to energised equipment. Therefore, additional plant may be required to be removed from service to complete these works.

We undertake regular condition assessments and planned maintenance in accordance with our standard maintenance procedures. The specific tests and inspections for outdoor circuit breaker are outlined in Table 14 .

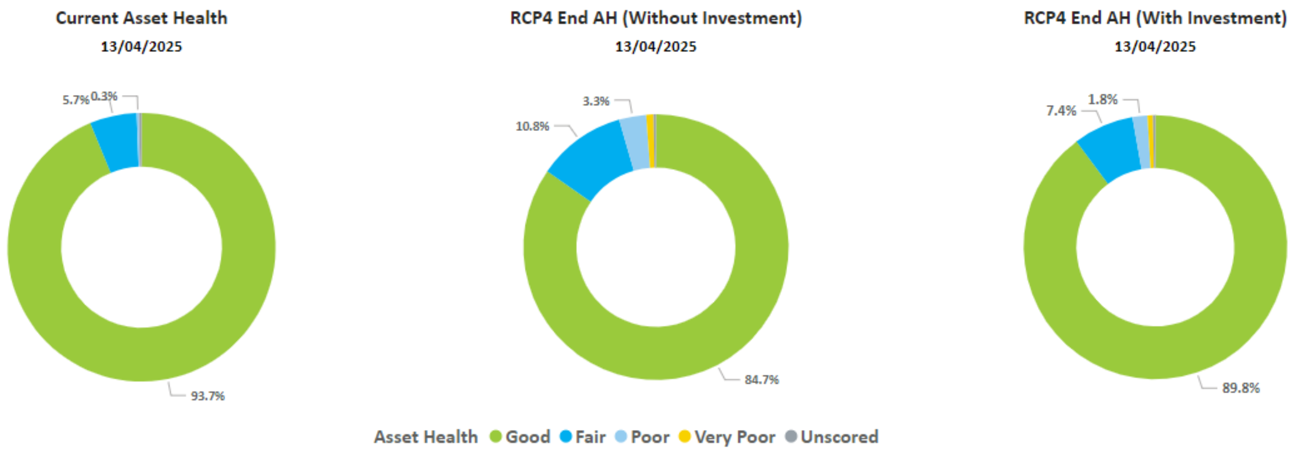
Our maintenance activities on our outdoor circuit breakers include oil filtering or replacement in bulk oil circuit breakers, SF_6 top ups or gas replacement, corrosion control, cleaning of dropper/jumper contacts after thermography, replacement of fasteners, and modifying a part of the circuit breaker, e.g. replacement of the SF_6 filling point.

Our decommissioning process includes safe worksite management and responsible scrap disposal. In decommissioning SF_6 circuit breakers, we recover SF_6 to avoid emissions into the atmosphere. Porcelain and oil from bulk oil outdoor circuit breakers are disposed of in compliance with hazardous waste requirements.

Table 14: Outdoor circuit breaker condition monitoring and inspections

Activities	Frequency
External inspection – certificate of inspection for hydraulic accumulators and air receivers	1-yearly
Time travel and contact resistance tests (high-operation circuit breakers only), unitised compressed air system diagnostic inspection and service	2-yearly
Laboratory gas analysis – SF_6 circuit breakers (high operation circuit breakers only) and GIS maintenance	4-yearly
SF_6 gas moisture test – SF_6 circuit breakers (selected circuit breakers only)	8-yearly
Diagnostic inspection and service (frequency based on type), internal inspection – certificate of inspection for air receivers	4, 5, or 10-yearly

Figure 47: Outdoor circuit breaker asset health



Asset risk – health and performance

Figure 47 shows the current asset health of our outdoor circuit breakers and the impact of our planned RCP4 investment without and with investment.

Figure 48 shows the annualised risk of our outdoor circuit breaker with and without investment.

The predominant causes for outdoor circuit breaker failure are insulation deterioration, corrosion or material degradation, pests and vermin, and mechanical failure. The preventive controls critical to reducing the likelihood of failure are our inspections and maintenance programmes, including condition-based maintenance, and procurement specifications suitable for Aotearoa New Zealand conditions.

Figure 48: Outdoor circuit breaker annualised risk

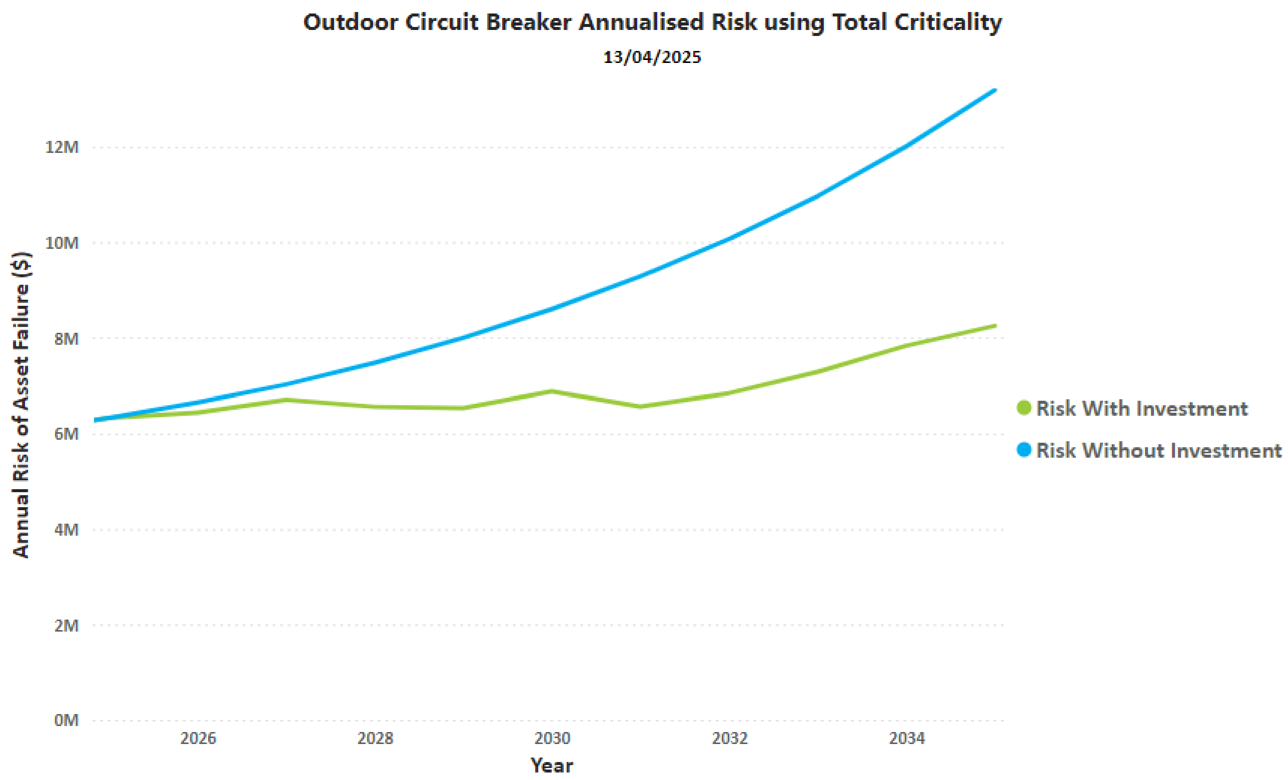


Figure 49 shows the unplanned outages and explosive failures 10-year rolling average. We are tracking within our strategy targets. SF6 leaks in 2023/24 was the main contributing factor for the spike in unplanned outages.

While Figure 47 and Figure 48 show a decline in asset health outcomes for RCP4, we are strategically maintaining ageing 220 kV circuit breakers while we await non SF6 replacement technology.

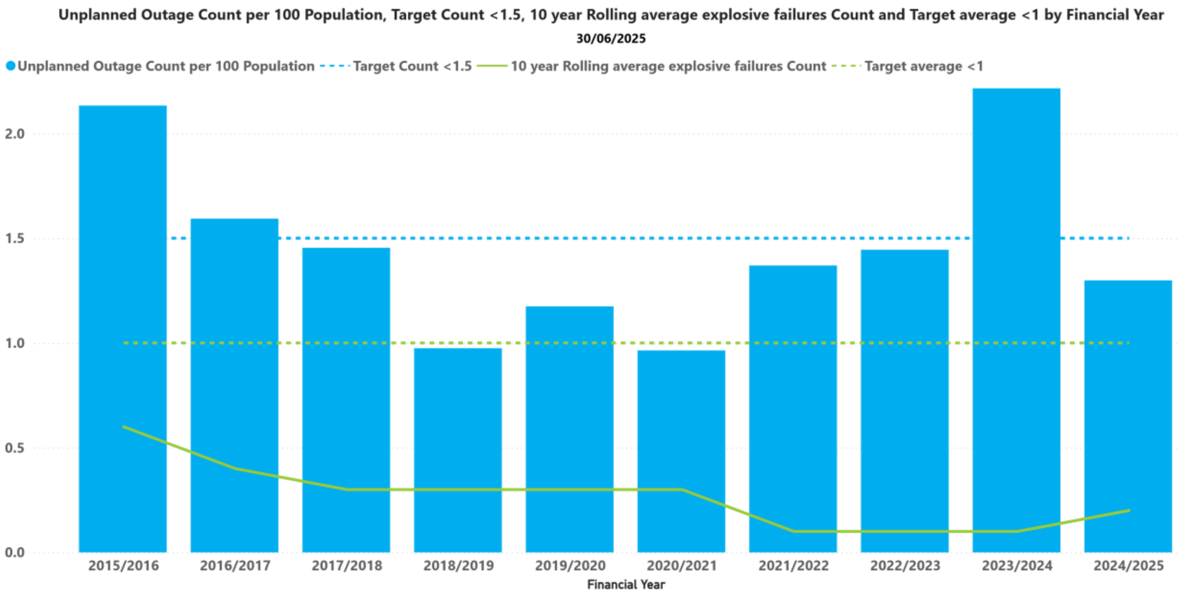


Figure 49: Outdoor circuit breaker performance

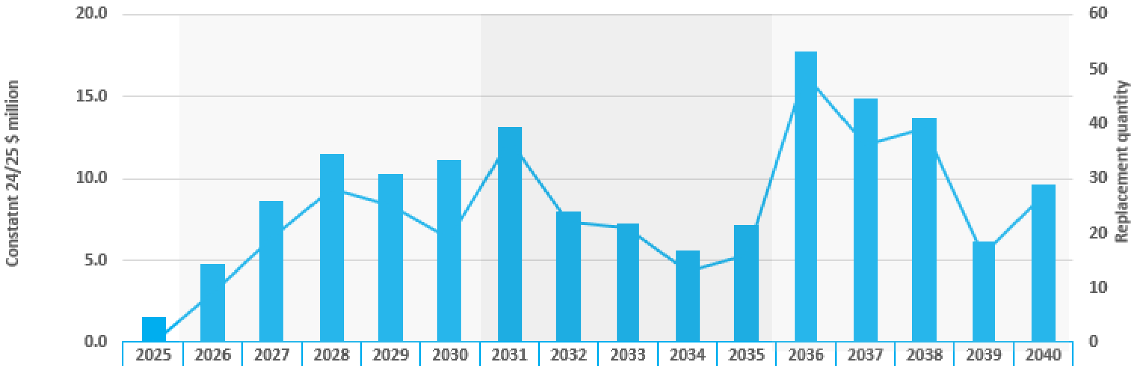
Forecast work and capex

Opex: The forecast opex for outdoor circuit breakers covers the condition-monitoring inspections and maintenance activities outlined in the lifecycle section of this AMP. To meet our long-term goal to achieve our net zero emissions target by 2050, we are proactively undertaking SF_6 circuit breaker pole replacements on known poor performers as part of a mid-life refurbishment programme. This will allow a life-extension opportunity while we await SF_6-free alternatives that are not yet available at all voltage levels.

Capex: Error! Reference source not found. shows the expenditure a nd deliverables forecast.The implementation of our asset health model and the shift in life expectancy from 35 to 45 years for most circuit breakers has continued to reduced the investment need in early RCP4. In **Error! Reference source not found.** we start to see i ncreased asset replacements occurring through RCP4, with the replacement of the remaining bulk oil circuit breakers; however this is dependend on alternative technologies to support the implementation of our SF_6 strategy.

As noted in our opex, we will be undertaking proactive circuit breaker pole replacements in lieu of asset replacements while we are waiting for alternative non-SF_6 circuit breakers to come to the market for our 110 kV and 220 kV network. This has reduced circuit breaker replacements in RCP4 and RCP5.

Figure 50: Outdoor circuit breaker forecast capex and quantities



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Outdoor Circuit breakers	1.6	4.7	8.6	11.5	10.3	11.1	13.1	8.0	7.3	5.6	7.1	17.7	14.9	13.6	6.2	9.7
Outdoor circuit breakers Qty	0	9	19	28	25	19	37	22	21	13	16	49	36	39	16	27

Outdoor instrument transformers

Instrument transformers are essential to the protection and monitoring of the grid. Their purpose is to convert high voltages and currents to lower levels that can be safely measured by power system protection and instrumentation equipment.

Asset class snapshot

Population*

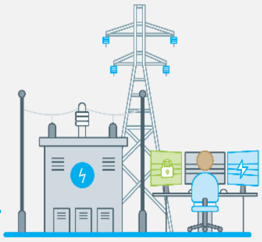
786 Voltage transformer

286 Neutral current transformer

3,474 Current transformer

988 Capacitor voltage transformer

*Made up of a count of each individual single-phase set



Capex

RCP4 (Forecast)

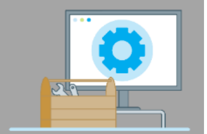
$44.0M

Asset health

- 94.0% Good
- 4.5% Fair
- 1.1% Poor

Work programme*

Transformers:	RCP4
Current	156
Voltage	32
Capacitor voltage	9
Neutral current	6



*Is at the device position level and typically a three phase set of assets.

Asset class strategy

Objective

Safe and reliable operation, at least whole-of-life cost.

Measure

- 10-year rolling average rate of all unplanned outages to be fewer than five events per year
- 10-year rolling average rate of explosive failures to be fewer than one per 10,000 instrument transformer-years (approximately one such failure every 2 years).

Asset strategy

Replace based on health, subject to a nominal life expectancy of 45 years with a tolerance of 5 years either side to enable efficient project bundling or to allow for prioritisation of replacement based on asset criticality.

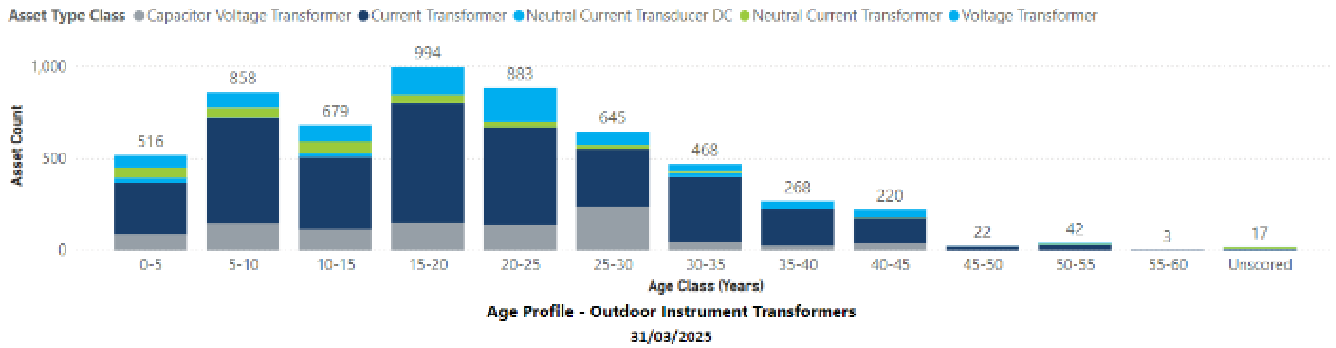
Investment need is primarily based on asset health. We generally expect instrument transformers to have a life of 35–55 years, depending on factors such as manufacturer, model, normal expected life, age, location, reliability, measured condition, and observed condition. We undertake forensic investigations to determine whether life extension can be achieved for models with substantial populations.

Replacement is usually the only option for outdoor instrument transformers as repairs are not viable. Outdoor instrument transformers are typically hermetically sealed units and cannot be inspected internally. Internal repairs are not cost effective due to the low capital cost of replacement. Some external repairs can be cost-effective, and these are considered, where appropriate.

Our specification for seismic resilience is high. We manage this requirement through our procurement specification that requires a high-performance standard which is supported with evidence of compliance from the supplier.

Figure 51 shows the population and age profile of our outdoor instrument transformers.

Figure 51: Outdoor instrument transformer age profile



Lifecycle – deliver, operate, maintain, decommission, and disposal

Delivery times for new instrument transformers is 24 months. This is due to increasing electrification internationally, global demand for primary equipment has increased significantly. We now undertake prepurchase of instrument transformers before business case approval to ensure construction is delivered on time. Business case approval remains 24 months to completion. This enables the design to be completed within the first 12 months, with the final year allocated for construction.

Table 15: Outdoor instrument transformer condition monitoring and inspections

Activities	Frequency
New instrument transformer warranty inspection	4-years (one off)
Diagnostic inspection and service –porcelain insulated voltage transformers	5-yearly
Calibration testing of instrument transformers that are primary inputs to revenue metering installations	8-yearly
Diagnostic inspection and service –all current transformers and non-porcelain insulated voltage transformers	10-yearly

We plan outages to provide a safe environment for employees and service providers to undertake the work. Where possible, this is aligned with other work to minimise disruptions to customers and end-users.

We undertake regular CAs and planned maintenance in accordance with our standard maintenance procedures. The specific tests and inspections for outdoor instrument transformers are outlined in **Table 15**.

Our maintenance activities on our outdoor instrument transformers include checking oil level gauges and inspecting for oil leaks, inspecting bellows for damage or leaks, inspecting insulators for damage, performing insulation resistance tests for both primary and secondary windings, performing capacitance tests (applicable for capacitive voltage transformers only), performing power factor tests and undertaking corrosion control.

We follow a decommissioning process as per our standard that includes safe work site management and responsible scrap disposal. Disposal of porcelain and oil from outdoor instrument transformers is subject to hazardous waste management requirements. To limit our carbon footprint, where practicable, we re-use existing instrument transformer foundations.

Asset risk – health and performance

Figure 52 shows the current health of our instrument transformers and the forecast impact of our planned investment. The very poor assets with investment at the end of RCP4 represent 1.7% of the fleet. The assets are reviewed to understand the cause, and plan actions appropriately to replace the asset or address the cause of data inaccuracies leading to higher asset health scores.

Figure 53 shows the 10-year rolling average of explosive failures per 10,000 population-years. It also shows the trend of unplanned outdoor instrument transformer outages over the last 10 years. Over an 18-month period from 2018, we had five failures of outdoor instrument transformers of the same model and manufacturer. Our risk assessment of those failures resulted in a decision to withdraw all remaining units from service across our network. We have identified an issue with another model of instrument transformer from a different manufacturer. A nationwide inspection programme confirmed serious deterioration resulting in a reduction in life expectancy for this model. The earlier than expected retirement of this model is included in the

Figure 52: Outdoor instrument transformer asset health

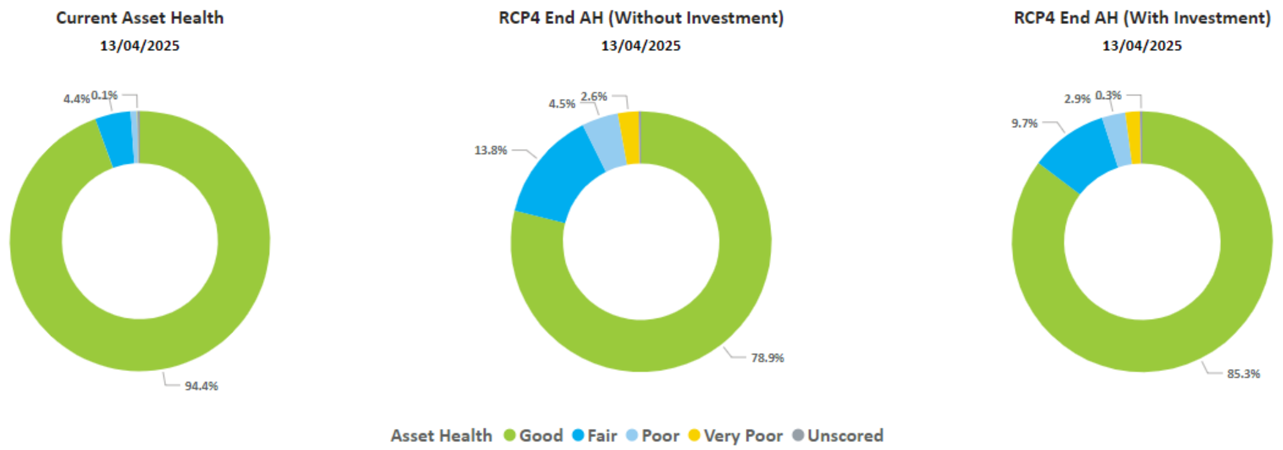
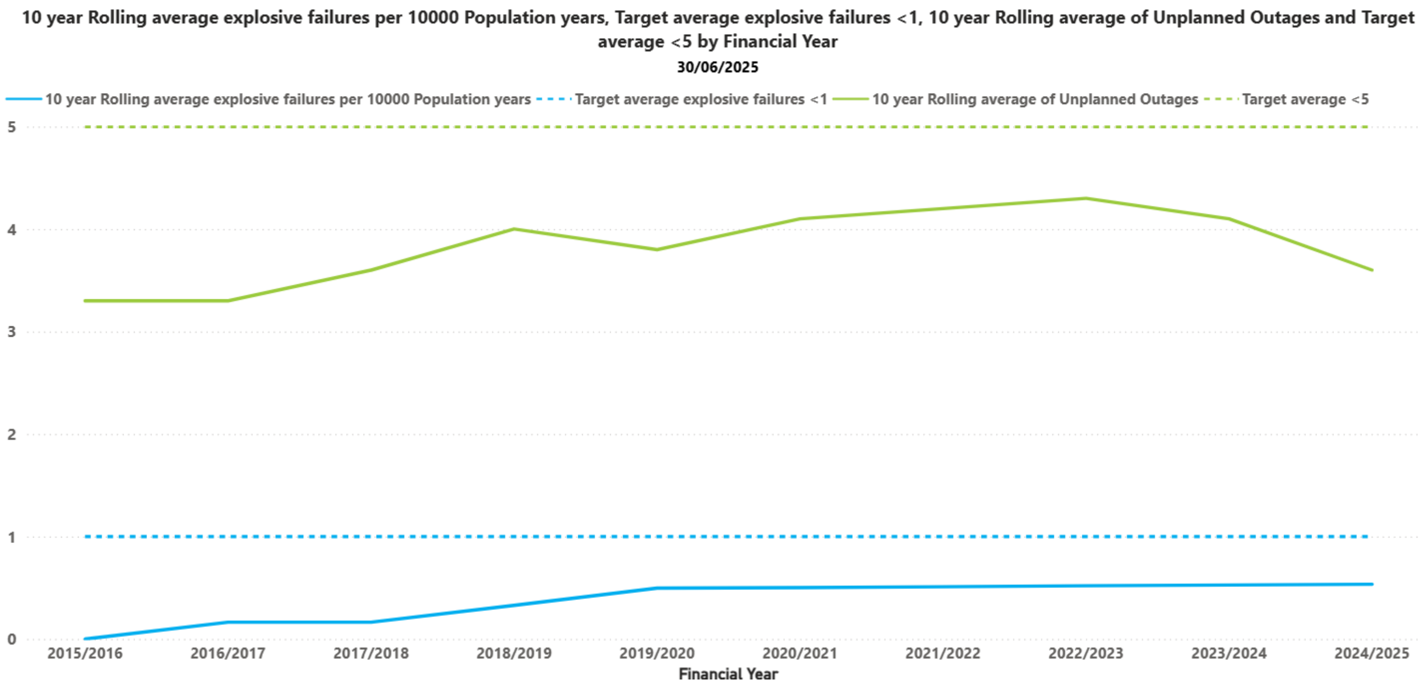


Figure 53: Outdoor instrument transformer performance



The predominant causes for outdoor instrument transformer failure are insulation failure, material degradation or corrosion, mechanical failure, and wildlife encroachment. The three key preventive controls critical to reducing the likelihood of a failure are undertaking inspections and maintenance, procurement specifications and AMS and condition monitoring.

forecast quantities and expenditure predominantly in the early stages of RCP4 as shown in Figure 54.

Forecast work and capex

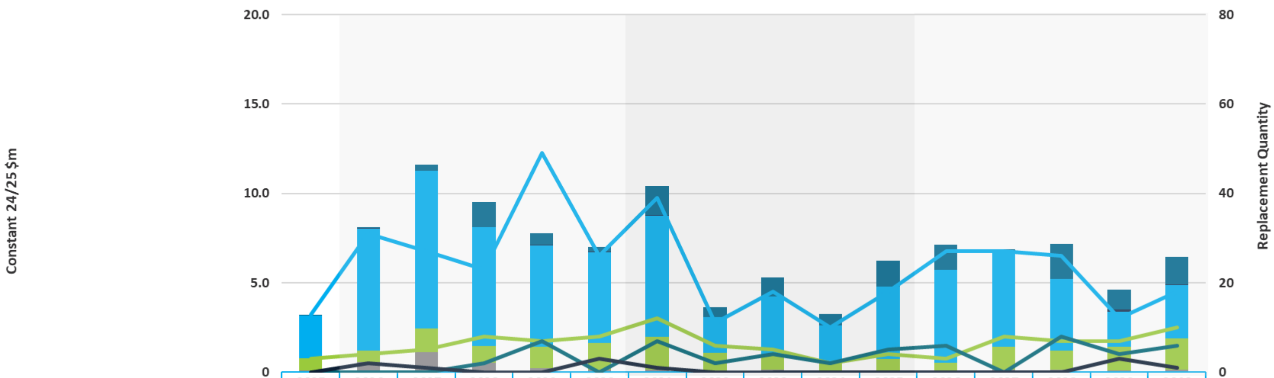
Opex: The forecast opex for outdoor instrument transformers covers the condition monitoring inspections and maintenance activities outlined in the lifecycle section of this AMP.

Capex: Our forecast through to the end of RCP6 is shown in Figure 54.

The forecast focuses on our strategic approach of replacement based on health subject to nominal life expectancy of 45 years and knowledge gained from forensic investigations on decommissioned assets.

The early retirement of assets with known issues will commence at the start of RCP4, which is highlighted by the high peak in the expenditure and deliverables quantities in 2027.

Figure 54: Outdoor instrument transformer forecast capex and quantities



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Capacitor Voltage Transformers	0.0	0.0	0.3	1.4	0.7	0.3	1.6	0.5	1.1	0.6	1.5	1.4	0.2	1.9	1.1	1.6
Neutral Current Transformers	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Current Transformers	2.4	6.8	8.8	6.6	5.7	5.1	6.8	2.0	3.3	2.0	4.0	5.2	5.2	4.0	2.0	3.0
Voltage Transformers	0.7	0.6	1.3	1.0	1.2	1.5	1.9	1.0	0.8	0.5	0.7	0.4	1.3	1.1	1.3	1.8
Other (asbestos, forensics, DGA testing, etc)	0.1	0.6	1.1	0.5	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Current Transformers Qty	13	31	27	23	49	26	39	11	18	10	18	27	27	26	12	18
Voltage Transformers Qty	3	4	5	8	7	8	12	6	5	2	4	3	8	7	7	10
Capacitor Voltage Transformers Qty	0	0	0	2	7	0	7	2	4	2	5	6	0	8	4	6
Neutral Current Transformers Qty	0	2	1	0	0	3	1	0	0	0	0	0	0	0	3	1

Power cables

Power cables transmit electricity from one point to another and are generally installed underground. HV cables provide transmission services in urban areas where the use of overhead lines is not practicable for a range of reasons. Our AC HV power cables have operating voltages from 66 kV to 220 kV. Since 2010, we have installed 76 km of HV cable circuits both buried underground and in tunnels. MV cables are generally used in short lengths (< 500 metres), inside substations, mainly to connect power transformers and indoor switchgear. MV cables have operating voltages between 11 kV and 33 kV. LV cables that operate at voltages lower than 11 kV are not included in this asset class.

The asset management of our HVDC cables are detailed in the HVDC asset class plan.

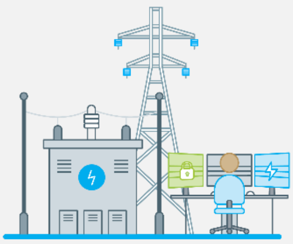
Asset class snapshot

Population

45 HV cable circuits <1km

15 HV cable circuits >1km

872 MV cable circuits <1km



Capex

RCP4 (forecast)

$64.9m*

Asset health

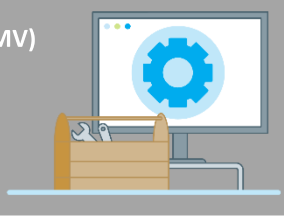
- 95.3% Good
- 0.18% Fair
- 4.6% Unscored

Work programme (RCP4)

7,046 meters (HV and MV)

60 Cable joints

79 Cable terminations



Asset class strategy

Objective

Safe and reliable operation, at least lifecycle cost.

Measure

Fewer than two unplanned outages per annum caused by defects or failures of HV power cables 66 kV and above power cables or supporting infrastructure.

Fewer than three unplanned outages per year for MV power cables below 66 kV.

Asset strategy

Replace based on risk assessment, taking into account the consequences of failure, including the increased worker and public safety risk, load at risk, the availability of specialist skills and parts to undertake repairs, the expected duration of fault repairs, and the potential for common mode failures.

The primary investment driver is asset health and risk. Risk assessment takes into consideration the performance of the cables, accessories, and information on failures of power cables internationally. Options considered are either refurbishment or, more often, replacement. The preferred solution is determined based on reliability and lifecycle cost. Refurbishment options for modern power cables are limited as it is usually impractical to restore degraded cable insulation. To prevent damage to cable insulation we monitor the integrity of the cable sheath. Where degradation has progressed but is not yet impacting the insulation, we can intervene with a repair to prevent a more expensive cable section replacement. This is particularly important on HV cable circuits where replacing a section of cable is very expensive and time consuming, compared with a sheath repair. We prioritise replacements based on the likelihood and consequence of failure and incorporate factors such as load served and physical impact of failure.

There has been one HV termination failure and two HV joint failures since 2018, as well as a number of preventive repairs and replacements undertaken to prevent imminent failure. Forensic work has been undertaken and replacement underway for all joints with a high risk of failure. Operational documentation has been put in place which requires Asset owner approval to switch HV cable circuits. Previously this was used in some circumstances to help with voltage control. This limitation is to minimise the stresses placed on these cables.

We are retrofitting HV fluid filled cable terminations assessed as having a high risk of failure with new click fit designs to remove the failure mechanism. We are also ensuring cable termination installers (cable jointers) are adequately trained and qualified and our installation methodologies are best industry practise.

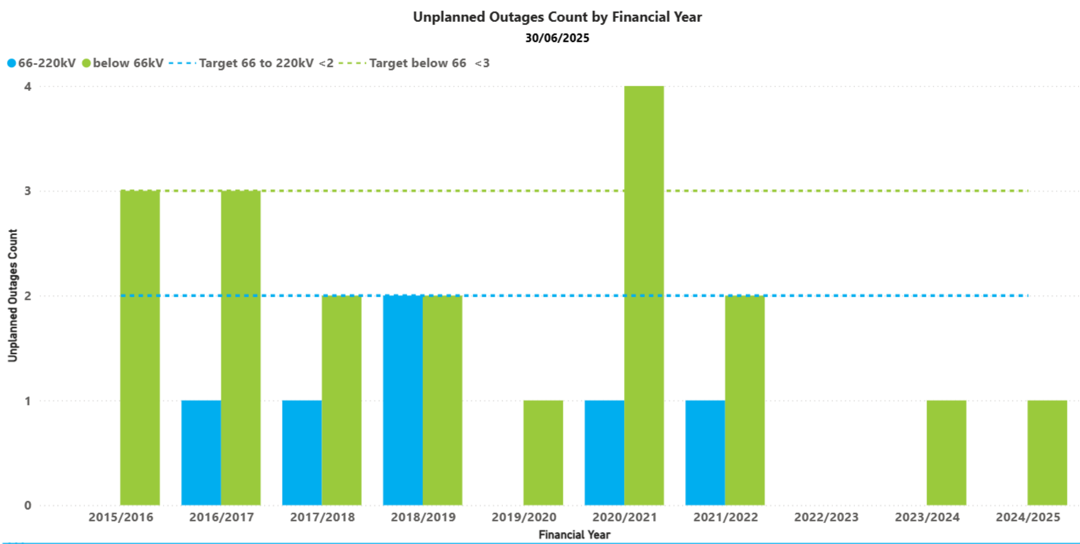
Table 16: Power cable condition monitoring and inspections

Activities	Frequency
Power cables HV cable route patrol	Weekly
Cable tunnel, termination, strategic spares and tooling, external manhole and link box inspections, Power cables HV inspection – significant civil features	1-yearly
Power cables HV partial discharge and cable sheath insulation tests, Oil filled cable oil condition tests	2-yearly
Power cables HV integrity assessment – cable environment	4-yearly
Diagnostic inspection and service (MV cables)	5-yearly

Lifecycle – deliver, operate, maintain, decommission, and disposal

Delivery time for power cables and their accessories varies significantly with voltage. Joints and terminations for MV cables are readily available from local suppliers. Delivery times for HV cable projects is typically a minimum of 2 years and a large project will be much longer. This includes detailed design, easement planning and consenting, procurement, installation and commissioning.

Figure 55: Power cable asset performance



We plan and manage outages in a way that creates a safe environment to undertake the required work, while minimising disruption for customers and end users. Cable works require significant coordination of outages.

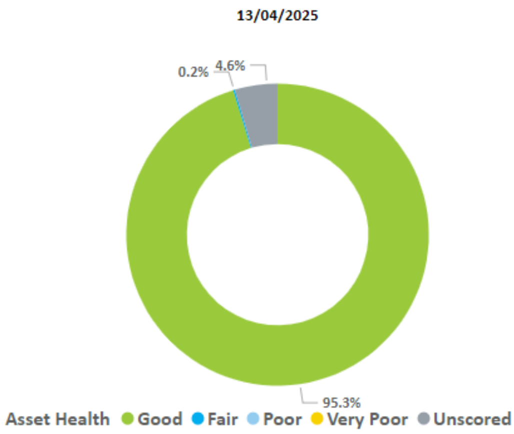
We align different types of work in the same location to happen at the same time whenever possible, to make the most efficient use of our outage windows. Our cables are operated within their calculated current ratings (limits), so their insulation is not damaged by overheating.

We undertake regular patrols, inspections, and maintenance in accordance with our standard maintenance procedures. The specific inspections and CAs for power cables and accessories are outlined in Table 16. In addition to these activities, we are undertaking annual testing of some 33 kV plug-in terminations with a known design issue, to monitor their condition and deterioration to allow intervention prior to failure. Our decommissioned power cables are sold as scrap, so valuable recyclable metals can be reclaimed.

Asset risk, health, and performance

Figure 56 shows the health profile of our power cables.

Figure 56: Power cable asset health



The asset health model includes data across both MV and HV cables. It presently excludes items such as the cable joints, terminations and bonding systems that make up the full cable system. Figure 55 shows the unplanned power cable outages for the past 10 years by category.

The predominant causes for power cable failure are degradation of cable insulation or terminations, external fire and third-party activities such as uncontrolled excavation near cable routes. The key preventive controls critical to reducing the likelihood of a failure resulting from these hazards are as follows.

- Competency management – ensuring cable jointers and installers are qualified, competent, trained, and use best industry practice methodologies.
- Stakeholder and third-party awareness – including warning and security signage, use of BeforeUdig registration of cables so that third parties intending to excavate are alerted to the presence of our assets and we are made aware of their intentions.
- The most critical and exposed cable assets have fire detection and/or passive or active fire suppression.

Although the majority of our HV XLPE cables are quite new, there have been some recent type and installation defects identified that created unplanned outages. This has led to a range of proactive interventions such as greater inspection, maintenance, refurbishment or even replacement programmes, to prevent further failures.

Some HV and MV cables have experienced termination failures relating to moisture ingress and poor installation workmanship. We have instituted inspection and repair, or in some cases replacement, programmes. This, along with a competency and training programme to help address the root cause of these failures, will reduce the risk of failures and unplanned outages.

Forecast work and capex

Opex: The forecast opex for power cables covers the condition-monitoring inspections and maintenance activities outlined in the lifecycle section of this ACP. After the 2018 220 kV oil-filled cable termination failure, we have increased opex (and capex) to allow for inspections, refurbishment, or replacement of all the HV fluid-filled terminations, as well as sheath repair work on both HV and MV cables, which is essential to undertake before the damage degrades into a full cable repair. We also have maintenance of the cable support structures in the Penrose-Vector tunnel, and replacement of link box covers on some HV circuits due to the poor performance of some of the existing covers allowing water ingress.

We still have 21 legacy oil-filled paper-insulated HV cables in service in Bream Bay, Wilton and Rangipo. The condition of the insulating oil in these cables is being tested every 2 years to support on-going maintenance and replacement planning.

Capex: The forecast focuses on managing asset health and risk.

We are continuing HV joint and termination replacement programs in RCP4, addressing those assets most at risk of failing in service. The HV termination retrofit program is now starting to address the 220 kV terminations now that an equivalent dry type technology is available at this voltage. This program will continue into RCP6.

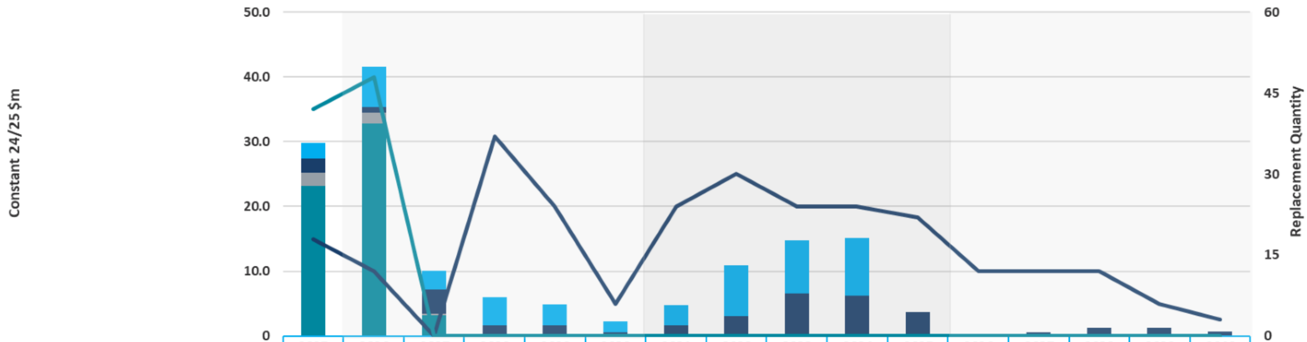
We have capex refurbishment projects in RCP4 to replace ancillary assets that support the oil-filled cables, to extend the life of these assets. The timing of the 21 HV oil-filled paper-insulated cable replacements is dependent on condition, outcomes from these life-extension projects, and intervention planning for the associated switchgear and transformers. These are very interdependent assets. We plan to replace the 220 kV oil-filled cables at Rangipo in RCP4 due to deteriorating condition, age and obsolescence.

A number of our MV cables and terminations have failed ahead of their expected lifetimes. There have also been a significant number of MV cables with poor sheath test results that have not yet been addressed. The forecast includes replacing these cables to reduce the risk of these failing catastrophically. The significant increase in RCP4 and RCP5 capex is to mitigate these early failure methods mentioned above, which were originally unbudgeted for.

We are also purchasing additional spare cable accessories in RCP4 after undertaking a review into our cable spares holdings to determine the most cost-effective assets to hold across our whole cable fleet to minimise return to service times post fault.

Our total volume of planned capex covering MV and HV cables and their accessories for RCP4–RCP6 is shown in Figure 57.

Figure 57: Power cable forecast capex and quantities



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Cables	2.5	6.3	2.9	4.4	3.2	1.6	3.1	7.8	8.3	8.9	0.0	0.0	0.0	0.0	0.0	0.0
Terminations	2.1	0.9	3.7	1.4	1.7	0.6	1.7	3.1	6.5	6.1	3.7	0.3	0.5	1.1	1.0	0.6
Other (testing, spares, etc.)	2.0	1.7	0.3	0.3	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.3	0.3	0.1
Brownhill - Pakuranga B cable repair	23.2	32.8	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Terminations Qty	18	12	0	37	24	6	24	30	24	24	22	12	12	12	6	3
Brownhill - Pakuranga B joint repairs Qty	42	48	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Outdoor disconnectors and earth switches

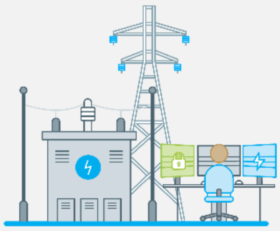
Disconnectors are mechanical switching devices used to provide a point of isolation. They provide isolation zones, which are typically used for maintenance purposes. Earth switches are mechanical devices used to ensure that isolated equipment is safe to work on, by protecting workers from accidental livening of the equipment and induced voltage hazards.

Asset class snapshot

Population

2,713 Disconnectors

981 Earth switches



Capex

RCP4 (forecast)

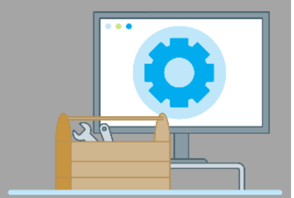
$27.5m

Disconnector asset health

- 66.7% Good
- 9.2% Fair
- 5.7% Poor
- 17.7% Very Poor

Work programme

	RCP4
Disconnectors & Earth switches	36
Disconnector headgear	296



Asset class strategy

Objective
Minimise the safety risk to maintenance switchers associated with operating or maintaining our outdoor disconnectors and earth switches.

Measures
Fewer than 10 unplanned outages per year caused by outdoor disconnectors or earth switches at lowest whole-of-life cost.

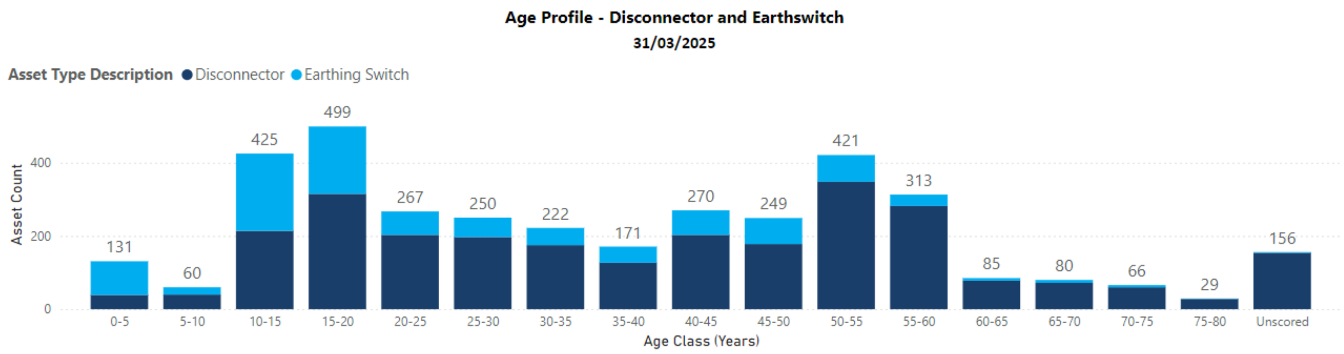
Asset strategy
Extend life using condition-based maintenance activities.

Investment need is based on asset health. Our primary approach is life extension through targeted refurbishment and component replacement. Ongoing maintenance or piece-wise replacement of components generally has a lower lifecycle cost than total replacement of the entire disconnector and earth switch and its support structure. Life expectancy is typically 50–90 years based on make and model. For the small subset of these assets where life extension is not possible, due to equipment quality or because they are part of a small population, we replace the entire unit.

Where technically and economically feasible, we will replace air-break disconnectors and earth switches by utilising disconnecting circuit breakers and earth switches or compact switchgear assemblies. During RCP4 we will begin undertaking motor drive refurbishment or retrofits where appropriate, to ensure sites are brought up to a standard ready to enable remote switching capability. Remote switching could deliver significant benefits and will reduce our carbon footprint and reduce the duration of planned outages and other operational efficiencies.

The age profile of the disconnectors and earth switches is shown in Figure 58.

Figure 58: Outdoor disconnectors and earth switches age profile



Lifecycle – deliver, operate, maintain, decommission, and disposal

Delivery timeframes for new disconnectors and earth switches is typically 24 months from business case approval to completion. This enables the design and procurement to be completed within the first 12 months, with the final year allocated for construction.

We plan outages to provide a safe environment for employees and service providers to undertake the work while minimising disruptions to customers and end-users. These works require significant coordination of outages. We align different types of work in the same location to happen at the same time whenever possible to make the most efficient use of our outage windows.

We undertake regular CAs and planned maintenance in accordance with our standard maintenance procedures. The specific tests and inspections for outdoor disconnectors and earth switches are outlined in Table 17.

Table 17: Outdoor disconnectors and earth switches condition monitoring and inspections

Activities	Frequency
An in-service level 1 inspection involving visual and audible noise observations during routine station inspection	2-Monthly
Contact alignment and re-greasing (problematic switches only)	1-yearly
Diagnostic inspection and service	5-yearly

Maintenance activities include checking alignment, inspecting HV contacts and transition plates, inspecting and cleaning the operating mechanism, inspecting insulators for damage, measuring contact resistances, inspection and operating checks, corrosion control, and external condition assessment.

Our decommissioned end-of-life disconnectors are typically scrapped, however where opportunities exist, we will recover critical components that can be reused and/or refurbished. A CA will be undertaken on those components to ensure the suitability to support our spares policy and life-extension strategy.

Asset risk – health and performance

The predominant failure causes for our outdoor disconnectors and earth switches are misalignment or drive failure, mechanical failure, corrosion, and electrical failure.

Birds, bird-nesting material and bird streaming cause repeated disconnector and earth switch faults. Various trials are currently under way offering different solutions for different species at various problematic sites. An assessment will be made of the trial results early in RCP4. The key preventive controls that are critical to reducing the likelihood of a failure event are our inspections and maintenance programme, procurement specifications, and condition monitoring.

Figure 59 shows the asset health of our disconnectors.

Figure 59: Disconnector current asset health

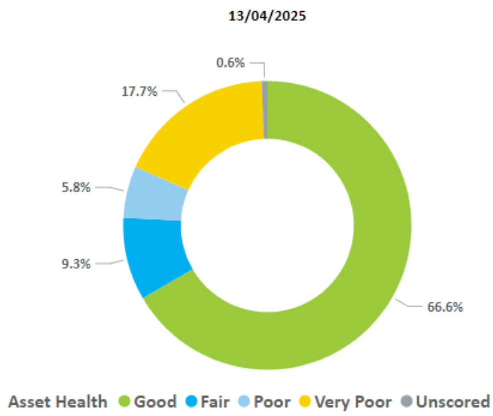


Figure 60 shows the asset health of our earth switches.

Figure 60: Earth switch current asset health

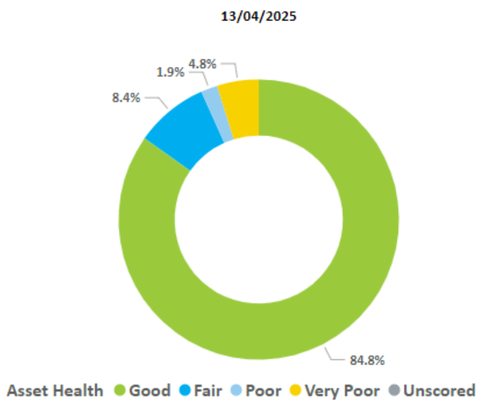


Figure 61 shows the unplanned outage performance for the disconnectors and earth switches by financial year.

Figure 61: Disconnector and earth switch performance

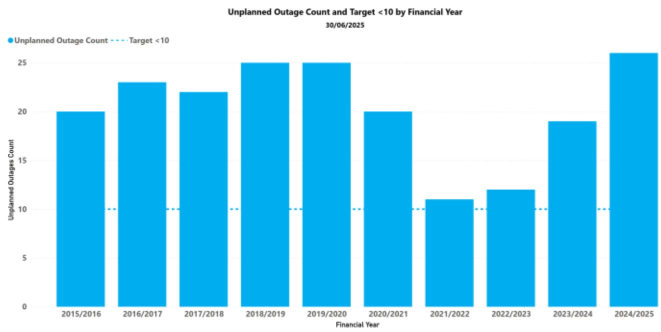
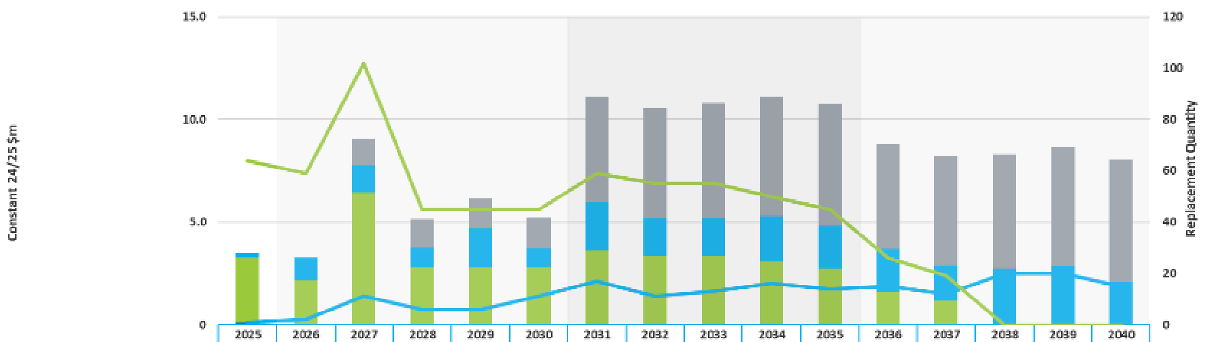


Figure 62: Forecast capex and quantities



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Remote switching proposed	0.0	0.0	1.3	1.4	1.5	1.5	5.1	5.4	5.6	5.8	5.9	5.1	5.3	5.6	5.8	6.0
Disconnectors & Earthswitches	0.3	1.1	1.3	1.0	1.9	0.9	2.4	1.8	1.8	2.2	2.1	2.1	1.7	2.8	2.9	2.1
Disconnector headgear	3.1	2.2	6.4	2.8	2.8	2.8	3.6	3.4	3.4	3.1	2.8	1.6	1.2	0.0	0.0	0.0
Other DS/ES	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Disconnectors & Earthswitches Qty	1	2	11	6	6	11	17	11	13	16	14	15	12	20	20	15
Disconnector headgear Qty	64	59	102	45	45	45	59	55	55	50	45	26	19	0	0	0

Forecast work and capex

Opex: The forecast opex for disconnectors and earth switches covers the condition-monitoring inspections and maintenance activities outlined in the lifecycle section of this AMP.

We continue to invest in our life-extension activities, which covers the development of maintenance documentation, corrective procedures, and training with subject matter expert assistance in the field as part of the headgear restoration workstream. Further review of the maintenance and retrofitting of motorisation and an increased focus with improving competency requirements will continue in RCP4.

Capex: Our expenditure and deliverables forecast through to the end of RCP6 is shown in Figure 62.

The forward investment plan is based on known and forecast asset health and condition issues for those disconnectors and earth switches where life extension is not appropriate. Investment in disconnector headgear life extension restorations commenced in 2024 and will continue to seeing the disconnector headgear restored to as-new condition having been calibrated and returned to the initial factory settings for the HV components during RCP4. We anticipate this programme to restore the full fleet, where applicable, over the next 3 RCP periods.

Investigating disconnector and earth switch remote switching capability development is anticipated for our RCP4 planning and beyond. Outcomes of the investigation will consider future implementation plans which may commence from RCP5.

The remote switching capability investment is required to prepare for our RCP5 proposal.

LVAC assets

LVAC assets provide a reliable source of standard LV electricity to operational equipment at our substations. Correct operation is important for limiting safety risk, ensuring reliability of supply, and maintaining operational equipment within normal operating parameters.

This ACP covers:

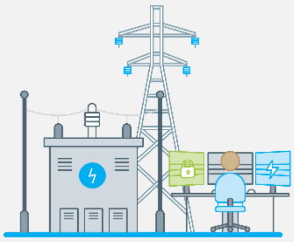
- main switchboards and LVAC source selection equipment
- distribution boards
- mains, submains, and LV distribution cabling.

Asset class snapshot

Population

504 LVAC distribution boards

193 Main LVAC switchboards



Capex

RCP4 (forecast)

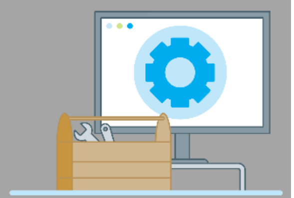
$13.6m

Asset health

- 94.7% Good
- 1.1% Fair
- 1.3% Poor
- 2.9% Very Poor

Work programme

	RCP4
LVAC replacement	34
LVAC refurbishment	13



Asset class strategy

Objective
Safe and reliable operation, at least lifecycle cost.

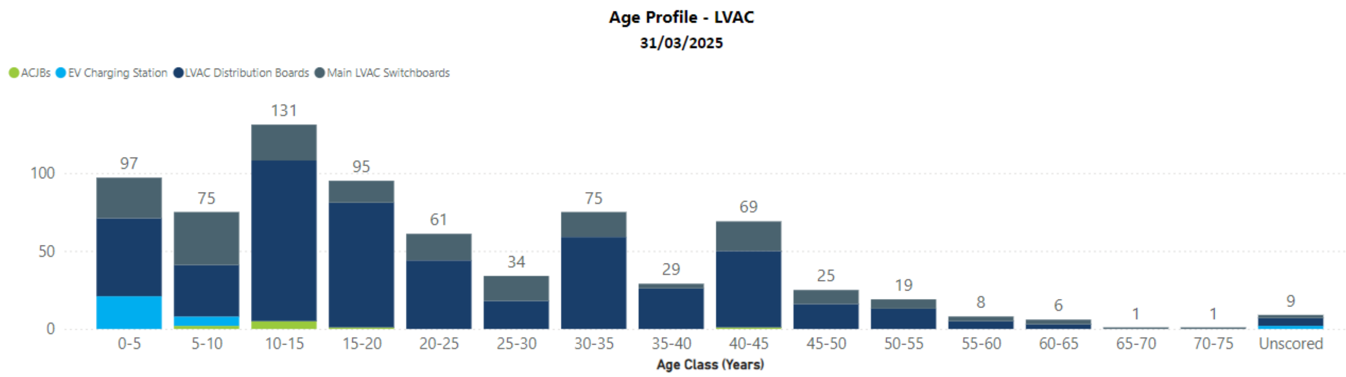
Measures
Zero unplanned outages of primary grid equipment caused by defects or failures of LV distribution systems.

Asset strategy
Replace LVAC local distribution boards based on condition. Where maintenance solutions are no longer effective or economic, replace LV switchboards or cabling based on electrical safety, condition, serviceability, and potential threat to transmission service and other assets.

Investment need is primarily based on risk and asset health. Factors accounted for are safety, obsolescence, risk of damage to other assets arising from failure of LVAC equipment, spare part availability or cost, and ongoing maintenance cost increases of in-service equipment. Replacement options consist of like-for-like replacement or establishing a new switchboard in either a more suitable position or similar position.

Our LVAC population and age profile is shown in Figure 63. New LVAC systems are often installed as part of our ‘ODID conversion’ programme and power transformer replacements. This has resulted in a population with a low age profile.

Figure 63: LVAC age profile



Lifecycle – deliver, operate, maintain, decommission, and disposal

Delivery times for LVAC assets is typically 24 months. This accounts for site surveys, detailed design, procurement, outage planning and coordination with other major works at the site.

We undertake regular CAs and planned maintenance in accordance with our standard maintenance procedures. The specific tests and inspections for LVAC assets are outlined in Table 18.

Table 18: LVAC condition monitoring and inspections

Activities	Frequency
Appliance testing of portable equipment	1-yearly
Diagnostic test	4-yearly

Inspections focus on the visual identification of safety and operational risks. This includes rectifying damage caused by, or presence of vermin or other factors, external damage caused to distribution equipment that may compromise electrical safety, and material degradation of system components.

Maintenance activities include routine visual inspections, earthing continuity checks, insulation resistance tests, supply changeover control check, and CA.

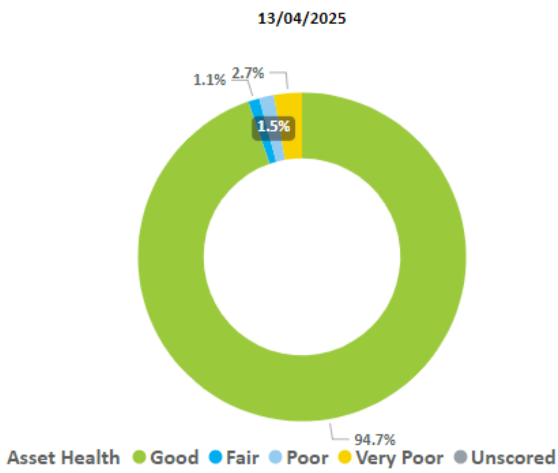
The intent of targeted investment in station LVAC systems is to ensure that connected equipment has the greatest degree of availibility and that isolations of connected equipment can be carried out safely. Outage planning is required when undertaking replacement of main switchboards. This is due to the need to isolate HV supplies to local service transformers and connected mains supplies. Primary outage planning will be instigated during the first 12 months of the 24-month project delivery.

Our decommissioning process includes safe work site management and responsible scrap disposal.

Asset risk - health and performance

Figure 64 shows the current asset health of our LVAC assets.

Figure 64: LVAC current asset health



The predominant failure causes are human element incidents, damage caused by vermin, external damage caused to distribution equipment, and material degradation of system components. The three key preventive controls critical to reducing the likelihood of a failure event are vermin management, the inspection and maintenance programme, and condition monitoring.

Our LVAC assets are reliable. It is uncommon for defects or failures to lead to unplanned outages of primary grid equipment. We have only identified one such instance in the past 20 years.

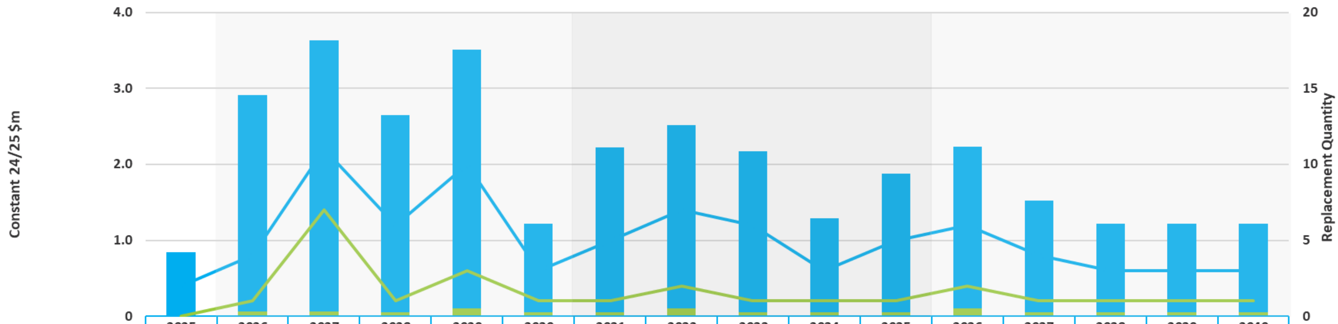
Forecast work and capex

Figure 65 shows LVAC expenditure by year and quantity.

Opex: The forecast for LVAC includes the condition-monitoring inspections and maintenance activities outlined in the lifecycle section of this ACP.

Capex: The forward investment plan focuses on managing risk and asset health. The investment driver for the RCP4 forecast is replacement and enhancement of main switchboards and distribution boards. As this programme of work continues, we expect the overall health of the asset class to be such that a more modest replacement programme is required. We are anticipating expenditure in RCP4 to cover multiple refurbishments to existing sites that have potential reliability issues. Minor remediation of lower capacity equipment is also planned to occur in each regional service area annually.

Figure 65: LVAC forecast capex and quantities



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
LVAC replacement	0.8	2.8	3.6	2.6	3.4	1.2	2.2	2.4	2.1	1.2	1.8	2.1	1.5	1.2	1.2	1.2
LVAC refurbishment	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
LVAC replace Qty	2	4	11	6	10	3	5	7	6	3	5	6	4	3	3	3
LVAC refurb Qty	0	1	7	1	3	1	1	2	1	1	1	2	1	1	1	1

Structures and buswork

Structures and buswork assets provide critical connections within substations as they support, transport, or protect electricity flow between individual components inside an outdoor substation. They enable electricity to flow across to the substation from incoming circuits to where it is needed. Earthwires provide protection to primary equipment from lightning events.

This ACP covers:

- outdoor switchyard structures, including switchyard gantries, bus supports, and concrete supports for disconnectors and earth switches
- outdoor buswork, including associated conductors, fittings, insulators, and associated attachments
- outdoor substation tie lines, including tie line structures, conductors, insulators and the associated fittings and attachments
- substation earthwires, earthwire hardware and associated attachments.

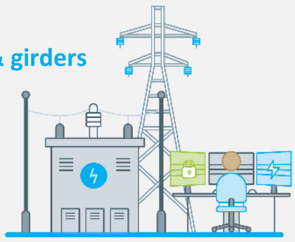
Asset class snapshot

Population

5,614 Substation structures & girders

1,414 Outdoor bus section

1,339 Earthwires & hardware



Capex

RCP4 (forecast including one $44.6m listed project)

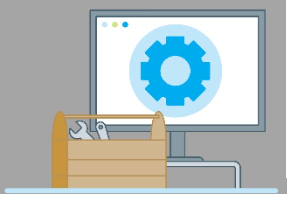
$94.6m

Asset condition

Wide range of condition from as new to requiring replacement.

Work programme (RCP4)

Condition based investments in line with strategy, resilience work, and listed project.



Asset class strategy

Objective
Safe and reliable operation, at least lifecycle cost.

Measure
Fewer than five unplanned outages per year arising from defects or failures of structures and buswork assets.

Asset Strategy
Plan major interventions based on forecast condition. Maintain assets to ensure acceptable safety and reliability performance.

Investment need is primarily based on condition and coordination with other works. Refurbishment and replacement are the two intervention options for the asset types in this ACP.

Replacement is the most viable option for insulators, conductor and bus hardware, substation earthwire, earthwire hardware and associated attachments.

Intervention options we consider for lattice gantries are protective coating of galvanised surfaces; recoating of previously painted surfaces; steel and bolt replacements; staged refurbishment including addition or bypass of structure bays; or total replacement. Site-specific constraints and condition characteristics of the structures have a significant influence on the preferred options. We have a standard approach to planning and managing painting works, consistent with our environmental stewardship objectives.

Options considered for concrete support structures are replacement (including foundations), minor repair only, and repair and coat with a protective coating system.

Our structures and buswork assets are an ageing population impacted by natural degradation and corrosion. Additional maintenance work is planned over the next 15 years to maintain asset condition.

Lifecycle – deliver, operate, maintain, decommission, and disposal

Work is scheduled according to need and resource availability while accounting for other work at the same location and outages. New installation or refurbishment works generally use standard off-the-shelf hardware and componentry items. Most of these are stored in and available from our warehouses. Sometimes specific hardware is produced, usually fabricated replacement steel, with minimal lead-time.

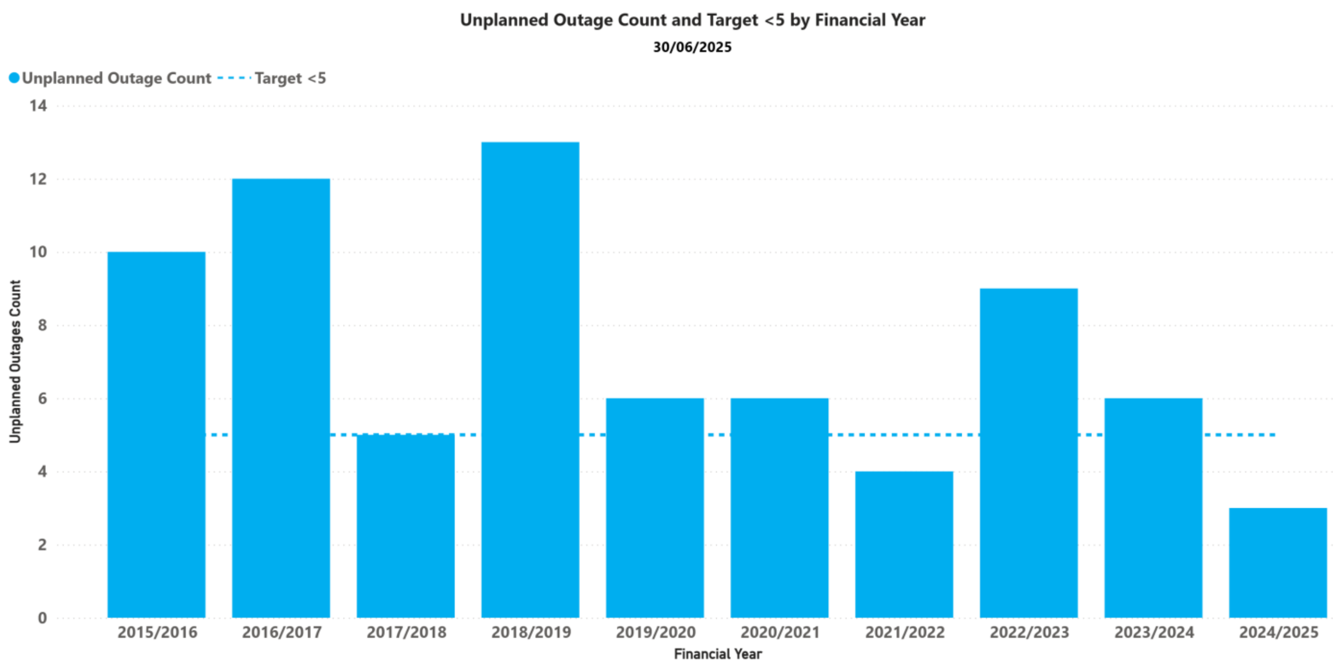
There are no specific operational or outage planning strategies specifically for structures and buswork.

We are undergoing a step change in asset management of structures and buswork with the implementation in 2024 of a nationwide condition assessment program on a four-year cycle. Our routine condition monitoring tests and inspections are set out in Table 19.

Table 19: Structures and buswork condition monitoring and inspections

Activities	Frequency
33kV insulator acoustic survey (selected sites only)	1-yearly
Condition assessment, utilising drones, for all station structures and buswork assets	4-yearly
Bus tie line condition assessment	4-yearly

Figure 66: Structures and buswork performance



Maintenance activities on our structures and buswork include structure footing refurbishment and corrosion repair, steel and bolt replacement for lattice gantries, corrosion repair on structures, insulator cleaning, bird control, and replacement of bus hardware and components as per our service specifications or as required due to condition.

We maintain and follow an appropriate decommissioning process that includes safe worksite management and responsible scrap disposal.

Asset risk – health and performance

Structures and buswork assets are generally in fair condition. There is a range of newer assets in good condition, and a number in poorer condition that are planned for replacement or refurbishment over the next 15 years. This varies from asset to asset and is often a function of the assets age and the environment it is built in. During RCP3 we have redefined our condition assessment approach and asset information to support better long-term planning. We have also included a listed project related to possible reconfiguration of the 110kV double bus at Haywards to reduce risk.Figure 66 shows structures and buswork performance. The main causes of unplanned outages are birds, asset health, and asset failure. The key preventive controls to reduce unplanned outages are asset information and bird deterrents. This includes asset and condition data, asset maintenance, and asset implementation management such as ensuring the design, procurements, installation, and commissioning process meets local and international standards.

Overhead earthwires can cross multiple substation buses resulting in a high consequence if the earthwire drops onto the bus. A significant number of earthwires were removed after such a failure in 2006. Our resilience programme plans on further reducing this risk by replacing any remaining high risk earthwires with alternatives.

Forecast work and capex

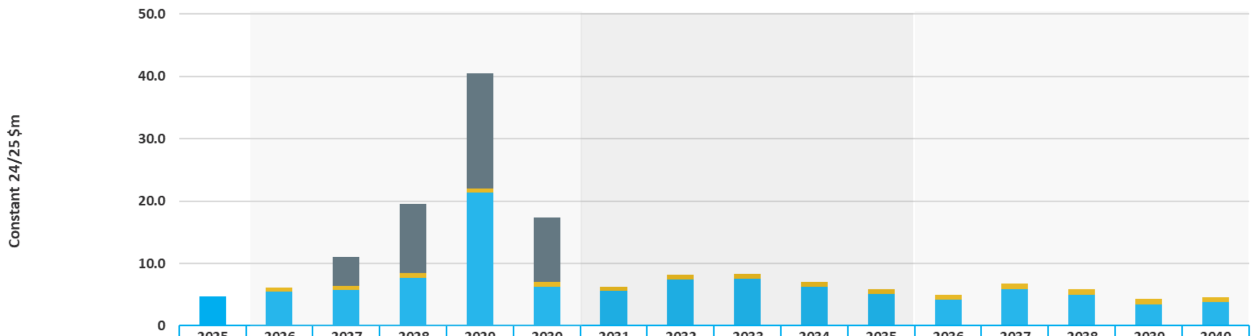
Figure 67 shows structures and buswork forecast capex.

Opex: The forecast opex for structures and buswork covers the condition-monitoring inspections and maintenance activities outlined in the lifecycle section of this ACP. A large proportion of our operational spend within structures and buswork is on steel and bolt replacements and concrete post minor repairs, which both act to delay eventual capital replacement activities driven by corrosion-based degradation.

Capex: The forecast capex is primarily focused on the management of concrete posts, bus insulators and the life-extension activities for our steel lattice gantries. As we continue to improve our condition data through drone-based inspection, we will continually refine our investment to target the highest priority assets.

We have included a listed project related to the Haywards 110kV Bus reconfiguration that aims to reduce safety and operational risks.

Figure 67: Structures and buswork forecast capex



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Listed structures & buswork	0.0	0.0	4.6	11.1	18.5	10.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Resilience	0.0	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.9	0.9
Structures & buswork	4.7	5.5	5.7	7.7	21.3	6.2	5.6	7.5	7.6	6.3	5.1	4.2	5.9	5.0	3.4	3.7

Other substation equipment

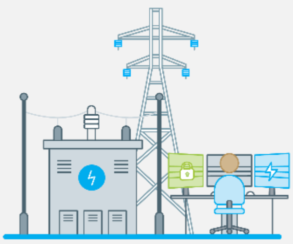
Other station equipment assets are essential for supporting the operation of other primary assets, maintaining reliability of supply to customers, delivering environmental outcomes, and ensuring public and site safety. This ACP consists of a diverse range of assets which do not warrant an individual asset class or fit naturally within any of the existing ACPs. The asset types covered by this ACP are as follows.

- **Oil containment and interception systems**: Critical for minimising our impact on the environment and mitigating oil fire risk.
- **Cable trenches:** Protect high voltage HV cable routes at substations being contained in covered subsurface trenches.
- **Air compressor systems:** Supply compressed air for mechanical operation of HV switchgear.
- **Cranes and lift gear:** Required to lift equipment for maintenance and repairs on heavy grid critical assets such as transformers, circuit breakers, etc.
- **Earth grids:** Ensure safety for personnel and damage mitigation to other assets both in and around the switchyard by dissipating power system fault currents into the ground.
- **Neutral earthing resistors (NER):** Protect power transformers by limiting over voltages during a fault event.
- **Outdoor lighting:** Provides sufficient outdoor switchyard lighting for inspection and work when needed.
- **Outdoor fire hydrants:** Provide outdoor switchyard water supply access for firefighters in the event of a fire.
- **Roof and wall bushings:** Provide electrical insulation between conductor and building to pass safely through a conducting barrier.
- **Surge arrestors (SAs):** Devices that supply protection to grid critical assets through limiting voltage by discharging the surge current.

Asset class snapshot

Population

2,876 Surge arrestor
379 Neutral resistor
3336 Earth grid
182 Oil containment



Capex

RCP4 (forecast)

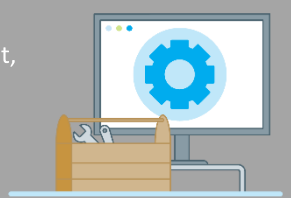
$20.1m

Asset health

Majority of assets are in good condition

Work programme

Focus on managing oil containment, safety hazards and condition management of other assets.



Asset class strategy

Asset class strategies are applicable only to oil containment and earth grids.

Objectives

- Minimise oil contaminants and discharges into the environment and restore the natural environment around our assets.
- No measured instance of water content exceeding the lower number of any resource consent or regional plan requirements, or 15ppm.

Asset strategy

- For oil containment assets, our asset strategy is to manage the potential environmental and safety hazards to personnel and the public associated with oil-filled equipment exceeding 1,000 litres. This includes oil storage, and oil processing and filling of our equipment. Work is planned to retrofit existing oil containment systems to minimise oil discharges into the environment while managing hot oil in an oil fire event.
- For earth grids, our asset strategy is to verify safety performance periodically, using remote injection testing and modelling. Also, to mitigate identified risks, including upgrading and extension of earth grid assets where these are in poor condition, or unacceptable step and touch or transferred potential hazards are identified.

The Oil Containment and Interception Asset Class Strategy will be impacted by recent decisions to accept the trade-off of cost and risk of a pool-fire and oil loss in low probability occurrences. The design standard for Substation Oil Containment Systems is being revised to reflect this decision and changes to the strategy document are expected.

The investment driver for the other asset types in this ACP is condition, with assets being either maintained or replaced with the objective(s) of ensuring public and site safety, maintaining reliability of supply to customers and/or delivering environmental outcomes.

Table 20 details the population and age of this group of assets.

Table 20: Other Substation Equipment age profile

Asset type description	Minimum age	Maximum age	Average age	Asset population
Bushing (wall/roof)	1	43	21.6	106
Cable Trench	N/a	N/a	N/a	2010
Centralised high pressure circuit breaker air compressor	5	44	29.71	21
Crane	13	82	45.44	28
Earth grid	1	40	17.65	336
Oil containment	1	52	17.75	182
Neutral resistor	1	72	17.92	379
Surge arrester	1	45	17.99	2,876
Washing system	35	35	35.0	3
Total				**5,955**

Lifecycle – deliver, operate, maintain, decommission, and disposal

Installations of new or replacement equipment are usually minor works and are often integrated into a wider programme schedule that accounts for other works at the same locations using common resources.

We undertake regular inspections and CAs to ensure these assets are maintained in an appropriate condition and operate as required as shown in Table 21.

In addition to the routine inspections and CAs, we also obtain condition information for these assets from special surveys, the asset feedback register and maintenance activities.

Maintenance activities include cleaning of surfaces on SAs, bushings and NERs, replacement of outdoor switchyard lighting where needed, maintenance/replacement to sections of earth grid where required, bunded area sealing testing, oil / water containment tank inspection, and lubrication of moving parts on cranes and lift gear.

Outages are required for work on SAs, NERs, and roof and wall bushings. We plan and manage outages to safely maintain equipment while minimising the disruption for customers.

Decommissioning and disposal for the assets in this ACP is undertaken in accordance with our standard processes.

Table 21: Other Substation Equipment condition monitoring and inspections

Activities	Frequency
Station compressed air system air compressor minor service	3-monthly
Oil containment, interception facilities, oil storage tanks and treatment areas, wall and roof bushings washing system maintenance, overhead crane diagnostic inspection and service including certificate of inspection, station compressed air system diagnostic inspection and service plus certificate of inspection [external] and dew point moisture content	1-yearly
Oil containment, interception facilities, oil storage tanks, and treatment areas discharge water testing, and station compressed air system air dryer desiccant replacement	2-yearly
Station air compressor – certificate of inspection for air storage receivers (internal)	3-yearly
Station oil services internal diagnostic inspection and service (drainage sumps and gravity interceptors), station compressed air system certificate of inspection (internal), and wall and roof bushings diagnostic inspection and service	4-yearly
Station earthing system inspection and testing, power system resisters (NERs), air-cored reactor and surge arrestor diagnostic inspection and services	5-yearly
Station earthing system diagnostic tests, power system resisters (NERs) HV testing, and air-cored reactors impedance test	10-yearly

Asset risk – health and performance

We do not have asset health model outputs for the assets within this ACP. Overall, the majority of the assets in this ACP have performed well and are in good condition. A small number of asset-specific issues have been identified. These are set out below.

Cable trenches.
There have been occurrences of structural damage to our cable trenches caused from vehicles driving directly over them. To mitigate this in RCP4, additional designated vehicle crossings will be installed where needed and existing ones that are not to standard will be brought up to standard. This expenditure is covered in the Buildings and Grounds ACP to be combined with existing trench lid work.

Outdoor lighting.
Lighting levels at some sites have been found to be inadequate, with installation of additional lighting needed. Lighting at all other sites will now be assessed and remedial work recommended.

Fire hydrants
We have a substation building fire resilience improvement programme in place to capture missing condition data. The outcome from this will determine fire protection upgrades.

Roof and wall bushings
Bushings need regular attention to monitor corrosion and deterioration. These are cleaned to remove environmental build-up. In general, this asset class is in good condition.

An asset health model for roof and wall bushings has been recently developed; however, data is still being collected to populate it. This will provide performance data of the assets, allowing more targeted maintenance and/or replacement investment decisions.

Surge arresters.
Current CA is visual only. A pilot investigation is currently under way to consider new condition-monitoring techniques available on the market. There have been model specific failures of surge arrestors with a common mode of failure.

Forecast work and capex

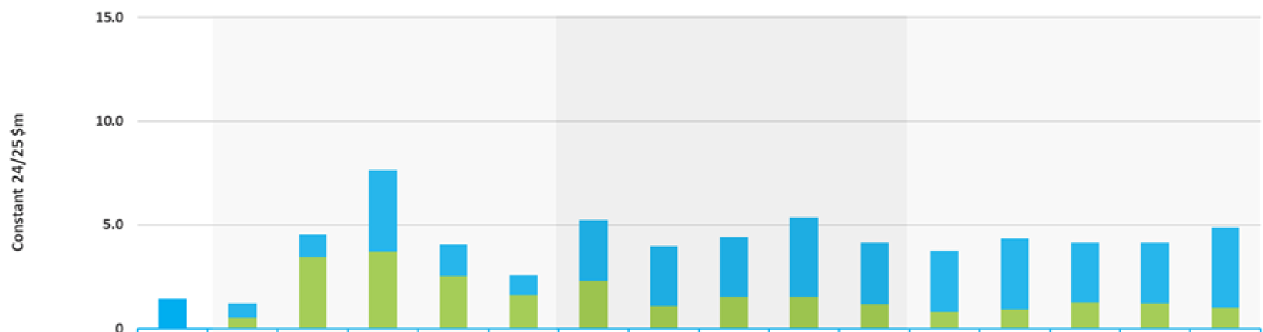
The forecast is shown in Figure 68.

Opex: The opex forecast covers the routine inspections, CAs, and maintenance activities outlined in the lifecycle section of this AMP.

Capex: The forecast investment plan focuses on managing the potential environmental and safety hazards associated with oil-containment assets, and condition management of the other asset types within this asset class. The investment timing may change as we bundle work into other projects for efficiency.

Oil-containment work was planned to retrofit existing oil containment systems to minimise oil discharges into the environment while managing hot oil in an oil fire event. This included retrofitting existing bunds and other upgrades. Changes have been made to the oil containment design standard with greater tolerance of the very low risk of oil fire. Focus is now on mitigating the risk of oil discharges by installing new oil separator systems at a limited number of sites. There is a separate project for upgrading and refurbishing the Otahuhu oil-containment system. The forecast also includes wall and roof bushing replacements to avoid risk of failure due to manufacturing flaws and lack of spares and parts through obsolescence.

Figure 68: Other substation equipment forecast capex



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Oil containment	1.4	0.7	1.1	3.9	1.5	0.9	2.9	2.9	2.9	3.8	3.0	2.9	3.4	2.9	2.9	3.8
Other equipment	0.0	0.5	3.5	3.7	2.6	1.6	2.3	1.1	1.5	1.5	1.2	0.8	0.9	1.2	1.2	1.0

Outdoor 33 kV switchyards: ODID conversion

Outdoor 33 kV switchyards provide an interface point between our HV transmission network and MV distribution customers. All our outdoor 33 kV switchyards were constructed before 1985. Since then, there has been the availability of safer, more economical, and reliable alternatives, such as indoor switchgear or busless transformer feeder arrangements.

In 2008, we commenced a nationwide programme for the conversion of most of our outdoor 33 kV switchyards to indoor switchgear, to mitigate safety hazards, improve reliability, and achieve least lifecycle cost associated with outdoor 33 kV switchyards. This is known as our ODID programme.

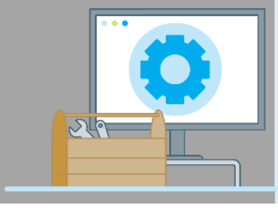
Our ODID programme is well advanced, and we expect to complete the few remaining sites by the end of RCP5. The remaining outdoor 33 kV switchyard sites are installations with appropriate clearances where the hazards of close approach to live equipment can be effectively managed or are N-security sites where safe access for maintenance is achieved during a total shutdown. As part of the programme, some outdoor switchyards are also planned for divestment to customers where they build and own the replacement indoor switchboard.

As there are only a few remaining sites we have stopped managing ODID as a separate programme of work.

Asset class snapshot

Work programme

	RCP4
ODID conversions	6



Capex

RCP4 (forecast)

$23.7m

Asset class strategy

Objective
Safe and reliable operation, at least lifecycle cost.

Measure
Number of fault and forced outages caused by outdoor 33 kV equipment reduced to less than five per annum by 2025.

Asset strategy

- Convert outdoor 33 kV switchyards that do not meet current expectations for safety in design or reliability to modern equivalent indoor switchboards.
- Decommission all outdoor 33 kV structures that have inadequate safety clearances and reliability characteristics and replace with a modern equivalent indoor switchboard.
- Switchyards with small safety clearances, complicated structures and buswork, and aged bulk oil circuit breakers are priorities for conversion.

Investment planning for ODID is based on using a combination of asset health and site-specific consequence modelling to establish the total risk from each site. This is then compared with cost estimates to complete the ODID projects, which allows all sites to be ranked in terms of risk return on investment. This prioritised list is then reviewed to ensure other factors such as synergies with other work and customer plans have been considered in determining the final plan.

The asset health of outdoor circuit breakers in outdoor 33 kV switchyards is considered a starting proxy for the overall outdoor 33 kV switchyard condition and feeds directly into the ODID prioritisation model. However, sometimes the health of other equipment, such as concrete pole condition, will be a larger driver for prioritisation of ODID. The other main drivers for conversion are safety clearance and performance.

Lifecycle – deliver, operate, maintain, decommission, and disposal

An ODID conversion usually takes 36 months from inception to commissioning. This is a 12-month investigation phase followed by a 24-month delivery phase. The civil and electrical work is tendered on a project or site basis. We may bundle other minor works at the site with the ODID conversion, such as local service transformer replacement, or LVAC system upgrade.

Cutover of new indoor board can have a significant impact on customers and end-users. To ensure the safety of our workers and continuity of supply to customers, we negotiate long duration outage windows and use a staged cutover, including bypass cables and parallel supply.

As ODID is a capital programme of solutions, maintenance activities are not relevant to this ACP, as the maintenance requirements for each individual asset is planned for in the relevant asset class plan. Maintenance activities such as inspections, testing, and defect repairs undertaken on outdoor 33 kV switchyards provide key inputs into the ODID prioritisation process.

The outdoor 33 kV switchyards to be converted to indoor switchboards include a small number of 33 kV circuit breakers and other equipment that is of modern design, in good condition, and could provide many further years of useful service. This equipment is recovered for re-use or sale to distribution network companies. Where re-use or sale of the equipment is not appropriate, we ensure all demolition, recovery, recycling, and disposal work includes safe work- and site-management processes.

Remaining equipment is sold to scrap merchants who salvage and recycle all the metalwork, and the oil is recovered by an oil regeneration company. The SF_6 gas is recovered and re-used.

For sites where divestment is likely, the project forecast cost will be decreased to only cover the reduced scope. When existing outdoor 33 kV switchyards are divested or decommissioned, the asset status information is updated to reduce the risk of data anomalies in our asset information systems.

Asset risk – health and performance

There is no asset health model for the entire outdoor 33 kV switchyard system given it is a collection of many asset classes. The equipment in many of our outdoor 33 kV switchyards is nearing end of life with many assets beginning to show signs of poorer health.

The predominant causes for an outdoor 33 kV switchyard failure are insulation failure, including breach of MAD, mechanical failure, and material degradation. The key preventive controls critical to reducing the likelihood of a service failure event are lifecycle strategy, planning, and management; industry and Transpower safety standards and practices; and maintenance activities such as inspections, testing, and defect repairs. Condition and test information provide key inputs to the prioritisation process and help prevent major failures within the remaining outdoor 33 kV switchyards before conversion is completed.

Outdoor 33 kV switchyards have a much higher rate of planned and unplanned outages than equivalent indoor switchboards owing to environmental factors leading to corrosion, the effects of wind-blown debris, birds, and small insulation clearances leading to increased risk of electrical failure in the outdoor environment. Many of the existing circuit breakers are bulk oil types, with typically higher rates of unplanned outages than modern SF_6 circuit breakers, and many of the outdoor 33 kV switchyards do not have bus zone protection or bus section circuit breakers. This means that any insulation fault in any of the busbar equipment, or any individual 33 kV circuit breaker failure, will lead to a total loss of supply.

Circuit breakers are the leading cause of unplanned outages over the 10-year period. This supports the use of circuit breaker asset health as a proxy for the condition of the entire switchyard. Ageing disconnectors are the second most common cause and have been a significant cause of outages in recent years.

The population of outdoor switchyards has been decreasing since 2008, but with only a slight reduction in the number of unplanned outages of the remaining population. This is due to the decreasing reliability of the remaining assets.

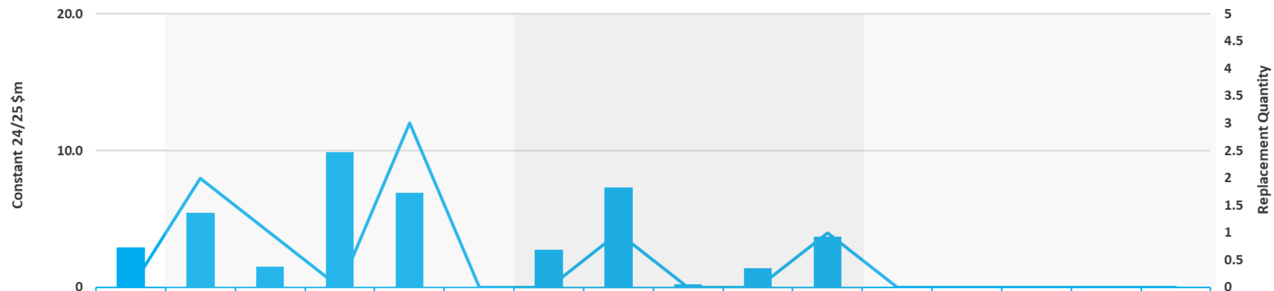
Forecast work and capex

Opex: As the ODID portfolio consists of solutions instead of assets there is no opex component, with all works being completed as capital projects.

Capex: Figure 69 shows the forecast capex and deliverable quantities through to the end of RCP6. The majority of our ODID projects will be completed by the end of RCP3.

There are two ODID projects planned for RCP5, which will bring the programme to a conclusion.

Figure 69: ODID forecast capex and quantities



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
ODID	2.9	5.4	1.5	9.9	6.9	0.0	2.8	7.3	0.2	1.4	3.7	0.0	0.0	0.0	0.0	0.0
ODID Qty	0	2	1	0	3	0	0	1	0	0	1	0	0	0	0	0

Buildings and grounds

Buildings and grounds assets provide the accommodation, services, and physical security for the critical grid equipment that facilitates the ongoing operation of the grid. Assets include buildings, fences site infrastructure, building services, and accessways to our sites. The asset class covers AC substations, warehouses, leased depots, and National Operating Centres. Table 22 shows the asset types and population covered by this ACP.

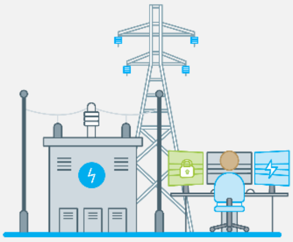
Table 22: Buildings and grounds population

Type		Total
Site buildings	Number includes stores, communications, and other station site buildings	672
Substations	Number of substations, excluding the two HVDC substations	174
	Warehouses	3
	National Grid Operating Centres (NGOC'S)	2
	National Coordination Centre (NCC)	1
Building services	Air-conditioning systems (HVAC)	827
	Fire alarm systems (not part of integrated security alarm systems)	223
	Fire suppression systems	34
	Electronic access control & security systems	171 sites
	Standby generators	17
	Uninterruptible power systems	3 sites
Site infrastructure	Roading	642,814m^2
	Water supplies, storm water, and foul drainage systems	170 sites
	Switchyard metalling	1,417,415 m^2
Fencing	Switchyard and equipment fencing	246,353 m^2
	Boundary and non-security fencing	108,024 m

Asset class snapshot

Population

672 Site buildings
0.64km² Roading
0.25km² Switchyard fencing
108km Boundary fencing



Capex

RCP4 (forecast)

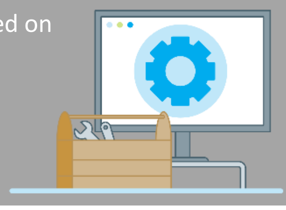
$129.2m

Overall asset condition

- 30% Excellent
- 51% Good
- 15% Average
- 3% Poor
- 1% Very poor

Work programme

Investment is primarily based on condition and is targeted to optimise lifecycle costs.



Asset class strategy

Objective
Achieve a high level of reliability and mitigate safety hazards, at least lifecycle cost.

Measures

- Zero unplanned outages of grid equipment arising from failures of buildings and grounds assets that occur within the design envelope for natural hazards.
- .

Asset strategy

- Replace major asset types based on forecast condition by employing a condition-forecasting model to predict when replacement will be required.
- Maintain buildings and grounds assets to a standard that will ensure continuing acceptable levels of safety and reliability.

There are also two focus areas for improving resilience related to the buildings and grounds assets.

- Seismic: Seismic assessment and strengthening programme for grid-critical and occupied buildings
- Fire: Mitigation of building fire risk through standardised detection and suppression

Investment need is primarily based on condition and is targeted to optimise lifecycle costs. Options to address the identified needs are developed based on good industry practice in the buildings and grounds and facilities management sector. We address localised deterioration with repairs and minor replacements to enable deferral of major investment until maintenance is no longer an economic solution. In the case where specific hazards are identified, mitigation programmes are put in place.

Our approach is to maintain resilience in substation buildings and grounds to make outages less likely in the event of a major hazard event and improve restoration times when outages do occur.

Our oldest substation buildings that are still in service were constructed in the 1930s. Most of our substation buildings were built in the 1950s to 1970s. Since the early 1980s there have been only a few new substation sites established, and these have generally only required a single building, including those required to replace outdoor 33 kV switchyards with indoor switchgear.

The age profile of site infrastructure follows a similar profile.

Many large air conditioning systems were installed during 2008/09 to improve the reliability of protection, SMS electronic equipment, TransGo panels, and batteries. These installations are now coming up for replacement.

The earliest constructed fences with reinforced concrete structure posts were installed between the 1930s and 1950s. With a base life of 50 years, many of these are nearing the end of their useful life. Where these fences exist in benign and low corrosion zones, we can maintain the assets to address deterioration and extend life until it is no longer economic compared with replacement. Later designs in the 1980s and 1990s moved to steel structure posts, with a shorter base life of 25 years.

The cardax building access systems are our first line of defence for physical and site operational security threats. The system is being updated to bring it in line with the latest specification to improve this defence. A total replacement of our cardax security system earlier in RCP3 has led to minimal funding requirements in RCP4, with only minor works required.

Lifecycle – deliver, operate, maintain, decommission, and disposal

Replacements and refurbishments of complex building and grounds assets are individually scoped and priced, while more routine works is scoped and priced using condition data and Transpower specific unit rates. They are scheduled according to need and resource availability, while accounting for other work at the same location. The programme is managed internally to ensure our objectives are met, but the full end-to-end delivery of individual projects is outsourced to a specialist service provider.

Transpower maintains assurance and oversight through our asset management framework.

There are no specific outage planning strategies for our buildings and grounds assets.

Assets are condition assessed based on International Infrastructure Management Manual assessment scale for building and infrastructure assets

Table 23 outlines the specific condition monitoring activities that we undertake.

Monitoring of our electronic access control and security systems, fire alarm systems, temperature and humidity monitoring systems, and emergency power supplies is undertaken in real time.

Table 23: Buildings and grounds condition monitoring and inspections

Activities	Frequency
Automatic gates – diagnostic inspection and test, fall arrest, fixed ladder, and guard rail inspection	6-monthly
Buildings, grounds, and facilities – maintenance activities and servicing	1-monthly
Pest control management	2-monthly
Maintenance of water, sanitation, and emergency water supply system at NGOC, forced air ventilation, and standby generator functional check (test run)	3-monthly
Performance, quality inspections, security/access system, air-conditioning system, roller doors, stock fencing, power fencing, automatic water backflow preventer, water servicing, emergency showers and burn kit diagnostic inspection, leased depot inspection, leased/non-leased land inspection, fall restraint anchor system certification, standby generator inspections and service, road and sealed area maintenance, bridge inspections, and building warrant of fitness process	1-yearly
Substation facilities CA, building exterior washdown, high/flat roof inspection, drainage sumps, and gravity interceptors' internal diagnostic inspection and service, waste-water servicing, and bridge engineering assessments	3-yearly
Fire alarm, extinguisher, sprinkler system and gas flooding diagnostic inspection and services as per NZS 4512	1 or 3-monthly or 1, 2, 4 or 10-yearly
Transformer traverser track, trolley, and turntable inspection and standby generator prime mover minor service	4-yearly
Communication and repeater facilities condition assessment and asbestos management survey	5-yearly

Asset risk - health and performance

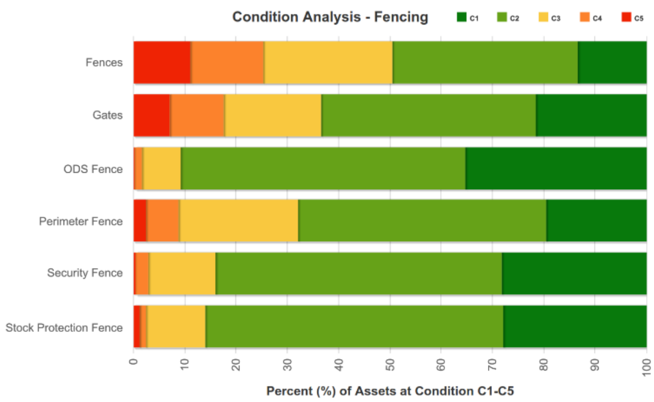
Our buildings and grounds assets are in good condition overall. Condition is assessed over a rolling three-year period and is a key input to our expenditure forecast. Asset condition is collected at component level, but not all components are critical to the operation of the grid. Overall asset condition is illustrated below in Table 24.

Table 24: Buildings and ground asset condition

Condition	Percentage of assets
Excellent (C1) – As new condition (C1)	30%
Good (C2) – Asset still in good physical condition (C2)	51%
Average (C3) – Some signs of deterioration. No performance loss	15%
Poor (C4) – Severe deterioration. No performance loss.	3%
Very Poor (C5) – Deterioration to the point of performance loss	1%

The most critical data for assessing the overall condition of this asset class relates to fences (security of our sites) and roofs (prevention of water ingress). A summary of fence and roof condition from SPM Assets is shown in Figure 70 and Figure 71 Investment is focused on the worst-condition assets (C4 and C5) in RCP3 and RCP4. Proactive inspection and maintenance of roofs helps to keep our buildings watertight and avoids more costly repairs. Roofs are replaced when maintenance is no longer adequate and where possible flat butynol roofs are replaced with pitched colour steel. Figure 72 shows the number of unplanned outages caused by buildings and grounds asset failures over the last 10 years.

Figure 70: Fence condition by type



The probability of severe building failure is low. The predominant failure causes for buildings and grounds assets are unauthorised third-party interference, substandard construction, overloading of cable trench duct covers, and natural hazards. The key preventive controls critical to reducing the likelihood of a failure event are security access control and monitoring system, security fence and power fence alarms, procurement specifications in line with the Building Code and NZ Standards, cable trench duct cover specification and procurement plan, seismic assessment programme and condition monitoring.

Figure 71: Roof condition by type

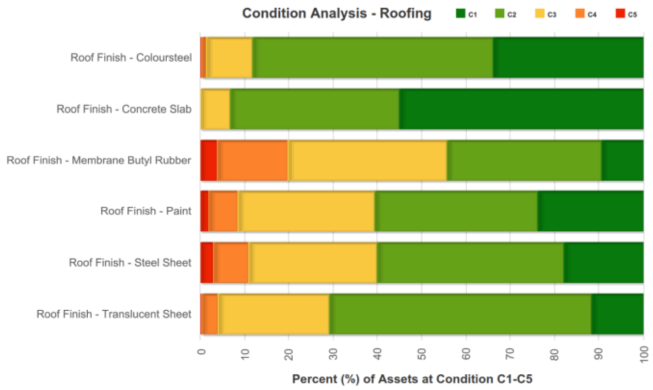
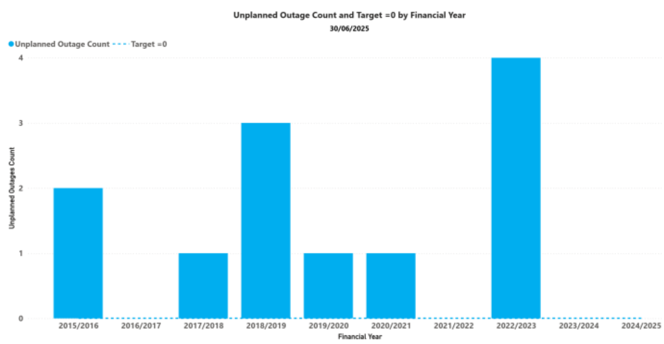


Figure 72: Building and grounds asset performance



Forecast work and capex

Opex: Maintenance activities have been grouped into programmes of work for efficient delivery. During RCP3, we have undertaken warehouse improvement projects, investigations into flooding and water ingress issues and switchyard metal top-ups. Some projects originally planned for capex replacement have been deferred through opex life-extension work. Likewise, projects originally planned for opex maintenance work have been capitalised due to increased scope, cost, and replacement.

We are forecasting an increase in opex expenditure moving into RCP4 and RCP5. The increase is related to leased building upgrades, remediation of water infrastructure defects and roof access compliance which is in addition to condition based opex interventions such as painting.

Capex: The investment drivers for buildings and grounds for the balance of RCP3 and into RCP4 are as follows.

- Resilience. Mitigation of seismic risk and building fires risks are the areas of focus of our resilience programme for our buildings and grounds assets and form part of our wider proactive resilience investment programme. We have completed seismic assessments of select buildings across

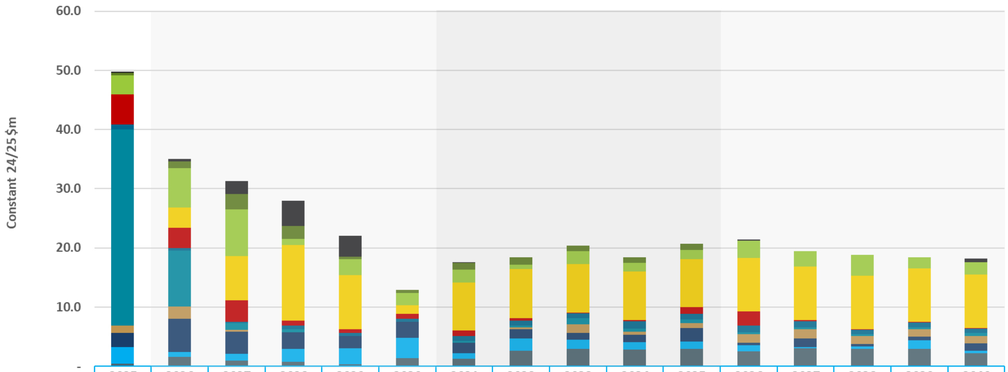
RCP3, resulting in strengthening required to meet our seismic policy. Prioritisation is guided by life safety considerations and the need to minimise risk to grid assets.

- Warehousing. The acceleration of large capital investment within RCP3 was driven by an audit of our warehousing facilities. Some of this investment brought forward work that was originally scheduled for RCP4. The majority of the storage capacity increase will be completed within RCP3 with the commissioning of a new warehouse building at Bunnythorpe and a new facility at Rolleston to replace the Addington warehouse which will now be completed in early RCP4.
- Fencing. A programme of work has been developed for the ongoing maintenance and replacement of fences including stock fencing upgrades in land subleased for grazing, update of the fencing standard to provide clearer guidance when implementing new site fencing and replacement of boundary fencing around Transpower owned properties along significant areas such as the Auckland transmission corridor.
- Prevention of building water ingress. We have a significant number of flat roofs planned to be replaced with pitched roofs to eliminate water ingress; we have delivered a programme of work through RCP3 which will see the remaining critical buildings being re-roofed by the end of RCP4.
- Air-conditioning. An increase in air conditioning expenditure is seen through RCP4 and continues into RCP5 as many of the systems installed throughout RCP1 and RC2 reach end of life.
- Trench duct covers. Replacement of deteriorated cable trench lids was expected to remain at similar levels to RCP3; however, recent analysis of condition data has observed lids taking longer to reach their intervention point than expected leading to a reduction in forecast expenditure. Targeted maintenance will be undertaken up until this point.
- Water infrastructure. Several sites where infrastructure related to potable, sewage, and wastewater needs to be upgraded due to age, capacity, condition, integrity, and level of resilience. A further development of our three waters data collection processes is planned to be delivered via the Buildings and Grounds strategy update to provide standardisation to our data collection and condition assessment methods across all sites to ensure these assets are being managed appropriately to maintain site functionality, resilience, and compliance with the Resource Management Act.

In the event that the forecast capital intervention is no longer the most cost effective whole of life solution, additional opex may be sought to extend the life of an asset.

Figure 73 shows the forecast capex by year and asset type.

Figure 73: Buildings and grounds forecast capex and quantities



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Seismic R&R	0.3	0.4	2.2	4.3	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.6
Fire protection	0.5	1.2	2.6	2.2	0.4	0.5	1.2	1.2	0.9	0.9	1.0	0.0	0.0	0.0	0.0	0.0
Buildings & Security	3.1	6.6	7.8	1.0	2.6	2.1	2.1	0.8	2.2	1.5	1.5	2.9	2.6	3.5	1.9	2.1
Resilience	0.0	3.5	7.5	12.7	9.2	1.5	8.2	8.3	8.2	8.2	8.2	9.0	9.0	9.0	9.0	9.0
Roofing	5.1	3.3	3.6	0.9	0.7	0.8	0.9	0.4	0.1	0.2	1.1	2.4	0.2	0.2	0.2	0.2
Air conditioning	0.9	0.5	0.2	0.6	0.5	0.6	0.8	0.9	0.9	1.2	0.9	1.1	1.1	0.7	0.7	0.7
Warehouses	33.2	9.4	1.2	0.5	0.0	0.0	0.3	0.3	1.1	0.5	0.7	0.3	0.3	0.3	0.3	0.6
Cable duct/cover	1.2	2.1	0.3	0.0	0.0	0.0	0.0	0.3	1.4	0.5	0.8	1.5	1.6	1.4	1.3	1.2
Water infrastructure	2.4	5.6	3.8	2.8	2.1	2.7	1.7	1.6	1.2	1.3	2.2	0.4	1.5	0.4	0.6	1.2
Fencing	2.7	0.8	1.1	2.2	2.7	3.4	0.9	2.0	1.6	1.2	1.3	1.0	0.2	0.4	1.4	0.4
Roading	0.5	1.6	0.9	0.7	0.3	1.3	1.3	2.6	2.9	2.8	2.9	2.5	3.0	2.9	3.0	2.2
Total	49.8	35.0	31.3	28.0	22.0	12.9	17.5	18.3	20.4	18.4	20.7	21.4	19.4	18.8	18.4	18.2

Transmission lines

Transmission lines transport electricity from the sources of generation, across the country to where it is required. Our transmission lines include all assets on lattice tower and pole structures, the conductors and earthwires between structures, and associated hardware.

Our Transmission Lines portfolio incorporates six asset classes.

- Conductors
- Insulators
- Paint
- Structures
- Foundations
- Accessways

The largest portion of our transmission line assets were commissioned between the 1950s and 1980s and are spread across the country in varying environmental conditions, which can have significant influence on the condition and life expectancy of the assets.

Over time, the design and construction of our transmission line assets have changed, resulting in multiple designs and configurations to manage. For example, our towers consist of numerous designs, which include the original ones designed to support the 110 kV lines built in the 1920s, the flat-top structures designed to support the 220 kV lines built in the 1950s, through to the double-circuit 220 kV tower designs in use since the mid-1960s.

The primary driver for investment across this portfolio is asset health. Assets are planned for replacement considering their asset health score and the bundling of related or similar maintenance or replacement activities together where economic to do so. This enables us to minimise landowner interruption, prevent multiple planned outages, and reduce our carbon footprint by undertaking multiple works on a site at the same time. Factors such as the risk and criticality of assets are also considered in order to prioritise work as constraints arise.

We are constantly exploring innovative ways to improve our asset management. One of the main improvements we have implemented recently is the use of drones to provide superior condition assessment (CA) for our conductors which has allowed us to refine and reduce our expected future investment in our conductor assets.

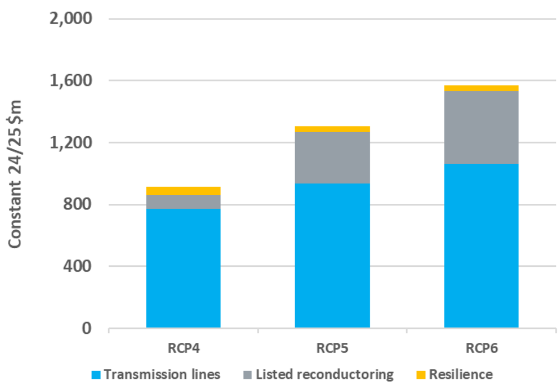
In preparation to meet the demands of New Zealand's energy future, we consider a range of options, such as thermal uprate of lines, building new lines, and line capacity reviews to improve the resiliency and capacity of our transmission lines assets. This includes specific consideration of the impact that natural hazard events have on our transmission line assets. These include volcanic ash deposits, ground slips and braided rivers. We are developing resilience-y plans together to address these risks.

The Data and Analytics programme is supporting a review of our tower paint economic intervention model and has previously reviewed the corrosion degradation rates we apply within our asset health modelling. We are investing in the analysis of drone and machine learning data to quantify current and future risk supporting our reconductoring need.

Opex is being used where appropriate through maintenance projects to extend asset life.

Figure 74 shows the capex investment profile over the RCPs. Overall, there is a steady increase in expenditure forecast for transmission line assets, primarily due to the increase in number of assets reaching end of life.

Figure 74: Transmission lines forecast capex incl resilience



The key investments relating to lines assets are described below.

Conductors

Our conductor portfolio represents a significant proportion of ongoing expenditure across, RCP4, RCP5, and RCP6. We have a long-term challenge to address transmission lines built between the 1950s to 1980s, that are approaching the end of their useful life.

Our improvements in CA by the use of drones have seen an enhancement in our asset health modelling. This has seen promising results during RCP3, allowed the safe deferral of some investment, and provided a more realistic reconductoring view for RCP4 and beyond. As we inspect more of the grid, we expect to further refine our forecasts.

Tower painting

As the network continues to age and degrade, the number of towers requiring painting and life extension increases. We see a need to gradually increase volumes based on the condition of the assets, towards a long-term steady state of regular recoating.

In 2019, we undertook a tower corrosion challenge, which identified an alternative approach from painting, to managing a portion of our towers that does not compromise long-term asset health or risk. We have now adopted a tower-to-pole strategy to manage a subset of our ageing towers rather than using painting as our sole maintenance method to address tower corrosion. We will continue to refine the designs, and the optimal intervention timing for this programme, during RCP4. In RCP4, we are also placing significant emphasis on addressing all MADs on towers that we paint.

Poles, insulators, and attachment points

Our pole portfolio includes untreated hardwood poles installed between 1920 and 1970. Subsequently, treated hardwood, concrete, and steel poles have been incorporated into the grid. Under RCP4, we are forecasting an uplift in pole replacement, as we systematically replace aging poles across the network, which will result in higher expenditure, compared to RCP3.

Our insulator sets in service across our transmission network are of various voltages and configuration types. Significant improvements in corrosion mapping from our Data and Analytics programme have been incorporated into our insulator health model. Results from this work show there will be an increase in insulator replacements for RCPs 5 & 6, compared to RCP4. The replacements are required to maintain the asset health of the asset class, due to an increasing number of insulators forecasted to be in poor condition. Replacements also includes the re-insulation on lines which are susceptible to volcanic ashfall, as part of the resilience programme, with suitable insulator types. Expenditure has also increased due to building block rate increases, consideration of opportunities to undertake live-line work which reduced outages on the grid, and stronger design and -building processes.

Attachment points are present on all types of transmission line structures to support conductors, earth wires, and aerial communication cables, either directly or indirectly via insulators. Their size and complexity vary considerably depending on the specific structure configuration. During RCP3, an increased number of complete attachment point replacements were observed, prompting a shift in accounting treatment from operating expenditure (Opex) to capital expenditure (Capex), as replacement activities extend the remaining service life of the structure. This adjustment is reflected as an increase in the capital forecast for RCPs 4, 5, and 6.

Transmission line major hazards, resilience, and sustainability

Our transmission line assets face many vulnerabilities and major hazards. To address this, our resilience programme includes specific strategic approaches to volcanic ash, seismic events, severe wind, land slips and washouts, and braided rivers. This approach considers both the vulnerability of the assets and their criticality to prioritise our resilience investment.

Consolidated simplified bow-ties

We have developed two transmission line consolidated simplified bow-ties (transmission line bow-ties). The transmission line bow-ties shown in Figure 75 and Figure 76 inform us of the most likely causes of failure across our transmission assets, along with the most likely resulting consequences of the failure.

Our risk modelling has identified which preventive and mitigative controls are to be used to reduce the likelihood of a significant initiating risk event occurring on our transmission line assets and to reduce the consequential impact of that event. We have used the bow-tie analysis to inform our design, planning and procurement standards and specifications; the type of CAs we undertake; our ongoing maintenance activities such as installing climb deterrents, bird proofing, and vegetation management; our routine inspections such as contamination checks; and routine patrolling of accessways to identify any immediate action required.

We have also used the bow-tie analysis to inform our design, planning and procurement standards and specifications (including warranties and indemnities) and the warning and security signage to be installed; and to ensure good condition records and defect reporting are held within our AMS. Additionally, we work with landowners and local councils, to improve management of third parties within our transmission corridors.

Each of our transmission line asset class plans advise the predominant likely causes of each asset class failure and the key controls that we have to implement to reduce the likelihood and resulting impact of a failure.

Figure 75: Transmission line circuit consolidated simplified bow-tie

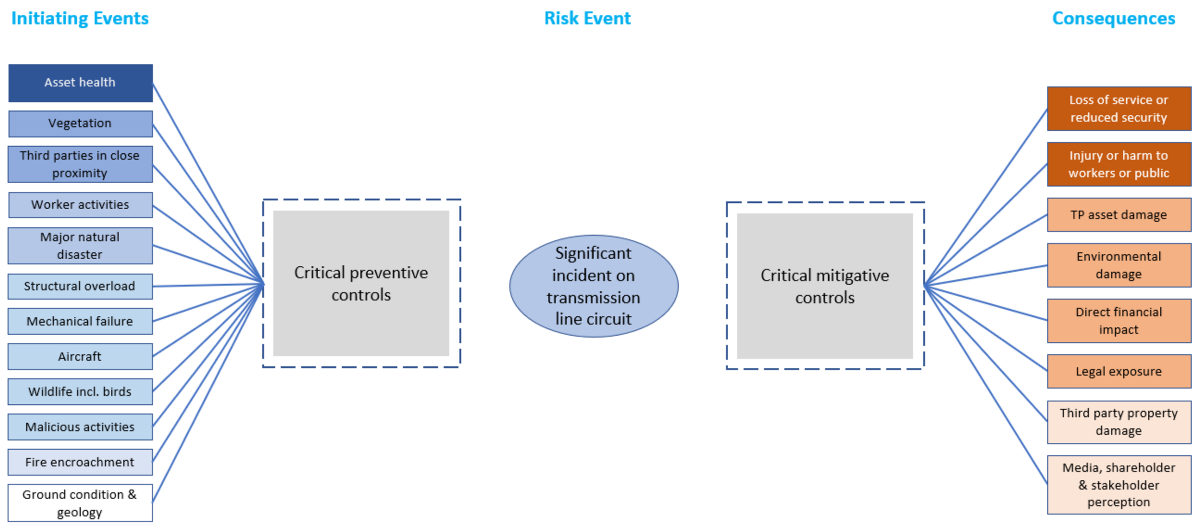
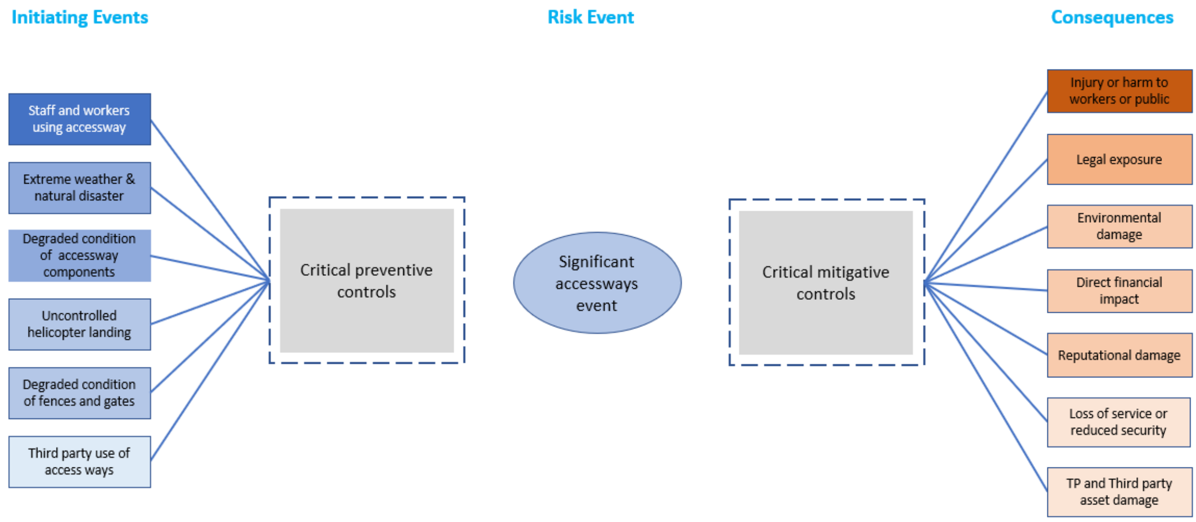


Figure 76: Transmission line accessway consolidated simplified bow-tie



Maintenance – patrols and inspections

We use a combination of patrols and CAs inspections to inspect our transmission lines. Regular CAs give a good indication of the condition of individual assets and the asset class, enabling the optimisation of maintenance and replacement works. Line patrols are performed annually to manage safety, structural integrity, and operational reliability risks. Patrols focus on identifying defects that are expected to deteriorate significantly within the next year and include observable structural damage, vegetation encroachment, animal interactions and incompatible corridor use.

The CA programme monitors and records the condition of transmission line structures, foundations, conductors, and hardware. The assessment produces a score for various components on a scale from 100 (new) to 20 (replacement or decommissioning criteria) to 1 (where failure is likely under everyday conditions). It applies a consistent approach to assessment of line components and allows extrapolation of the assessed condition into the future.

The frequency of CA visits is based on the structure/span health and criticality. New assets will first be assessed prior to the end of any defect liability period. Thereafter, each tower and pole structure have assessments that are performed at 4-yearly intervals for tower lines that are in high wear/corrosion zones, 6-yearly for all wood poles that are in severe to extreme corrosion zones or have high public safety criticality, 8-yearly intervals for tower lines that have high public safety criticality, and 12-yearly intervals for tower lines that are in moderate to benign corrosion zones. In addition, partial assessments are undertaken every 4 years for tower lines and every 3 years for pole lines that are below CA50 and have a high degradation rate.

Table 25 shows our line patrols and condition monitoring undertaken.

Table 25: Line patrols and condition monitoring

Activity	Type / Criteria	Frequency		Description
Patrol	Security and right of Way	6 months/1 year		Security patrol and right-of-way assessment, special warning sign inspections, bridge and culvert annual inspection, slip/wash-out/ground movement inspections – aerial inspection, and temporary and emergency response structures - custodianship, emergency kits, storage, inspection, and maintenance
	Fault	As required		To investigate transient, permanent, or other fault events or unusual occurrences
	Pre-commissioning	As required		Inspects for safety or security hazards that may have arisen since the line/circuit(s) was constructed, last patrolled, or energised
	Special purpose	As required		Scoped according to need. For example, after a storm or earthquake
CA inspection	CA 50 or above	Tower lines	4-yearly (high-wear/corrosion zones)	To verify the make-up and assess the condition of all components that make up a transmission line. CA information is used to support cost-effective long-term asset management decisions
			8-yearly (high public safety criticality)	
			12-yearly (moderate to benign corrosion zones)	
		Pole lines	6-yearly (all wood poles, severe to extreme corrosion zones or high public safety criticality)	
			12-yearly (moderate to benign corrosion zones)	
		Tower lines 4-yearly		

	CA below 50 and a high degradation rate	Pole lines 3-yearly	
Detailed CA inspection	Special	As required	To quantify condition in more detail as assets approach end of life, close aerial surveys, Cormon testing and sampling are carried out as required
Engineering inspection	Accessways – bridges and culverts	3-yearly	Engineering assessment to assess condition and ensure water crossings are compliant with regulatory requirements. The information is used to support cost-effective long-term asset management decisions

Risks and uncertainties

One of our expenditure risks relates to the future conductor replacement and repair work. As we collect more condition data for our conductors, this may allow us to refine the scope and timing of some of the planned reconductoring work. We also have uncertainties relating to future insulator expenditure that are impacted by costs associated with live line work, outages and the type of insulator replacement. This may result in increases or decreases to both the capex and the opex depending on the results.

In RCP4, we are planning to paint 100% of the MAD areas of the towers we paint. This is a significant step change from the approximately 60% of MADs we are currently painting. A key risk in achieving this milestone is the ability to obtain outages that align with suitable painting weather windows, as this is work that has to be done de-energised.

Another uncertainty element across all transmission lines work considering the uplift from RCP3 into future years is the resource availability to deliver the work. We are continually reviewing deliverability to manage this uplift in work and ensuring there is sufficient flexibility in the forward plan to maximise the utilisation of resource.

Asset class plans

The following sections describe in more detail our asset management approach for each of the asset classes. These ACPs describe the strategy, asset characteristics, management approach and expenditure profile for each asset class. The expenditure covers the capital requirements, along with any specific maintenance projects to be undertaken.

Conductors

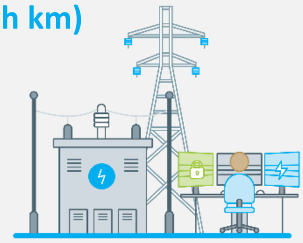
Conductors and their associated hardware enable electricity to flow from generators to consumers along transmission lines. This ACP covers conductors, earthwires, joints, spacers, and dampers.

Asset class snapshot

Population (circuit length km)

16,391 conductors

3,396 earth wires



Capex including listed projects

RCP4 (forecast)

$223.9m*

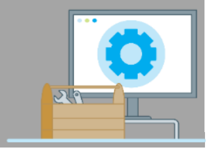
*including $91.2m for listed project

Asset health span status -

- 98.99% Good
- 1.01% Intervention required

Work programme, including Listed Project in RCP4

	RCP4
Conductor circuit kms	247.8
Earthwire circuit kms	46.5



Asset class strategy

Objective

Achieve a high level of reliability and mitigate safety hazards, at least lifecycle cost.

Asset strategy

- Plan and package work by considering site-specific factors that balance the competing interests of landowners, cost efficiency, resource availability, and outage constraints.
- Aims to ensure component failure does not cause significant environmental damage (such as bush fires) and/or third-party property damage.
- Extend the life of conductors by incorporating the learnings of the ICON project into our standard approach to managing conductors.
- Further enhance processes for investigation of circuit faults, asset failures and incidents, to improve consistency and usefulness of data.
- Continued improvement in consistency and reliability of CAs by using emerging tools such as drones to undertake DVDC.

Investment need is primarily based on asset health, under-clearance risk, and existing and future network requirements.

Most of our network was built between the 1950s and the 1980s, with more than 60% of conductors installed during this time. Ten per cent of our conductors were installed before the 1950s. Our current estimates show that approximately 40% of the North Island and 25% of South Island conductors may have sections reaching end of life and will require replacing in the next 30 years. Our replacement forecasts have reduced from those in our RCP3 submission following significant investment and focus to improve our CA and innovative forecasting techniques. This is primarily based on high-quality imagery from close aerial surveys using drones and extensive laboratory testing. Our revised models still show an increasing volume of reconductoring work over the next 15-20 years but a reduction in the peak workload around the 2040 period.

The options considered for large conductor projects include like-for-like replacement, capacity upgrades and downgrades, dismantling, system reconfiguration, undergrounding, and continued repairs and maintenance. Like-for-like replacement options are typically selected for hardware, earthwire, and small sections of conductor replacement. Options to address under-clearances include work on structures and insulators, earthworks, and relocation of others utility's assets. We undertake extensive investigations and use economic analysis to determine the most cost-effective approach. Smaller scale hardware replacements are often integrated into a wider programme that accounts for other works at the same locations using common resources.

Figure 77 shows the population and age profile of our conductors and Figure 78 the population and age profile of our earthwires.

Lifecycle – deliver, operate, maintain, decommission, and disposal

Delivery times for reconductoring can take approximately 4 to 5 years from need identification through to works completion. This includes substantial investigation and design prior to the physical work on site. Other works within this ACP can generally be delivered at shorter notice, with timeframes of 12-24 months.

Conductor works require significant coordination of outages. We align different types of work in the same location to happen at the same time whenever possible, to make the most efficient use of our outage windows.

We undertake an annual aerial survey programme to ensure we have up-to-date models of our lines as a key input to design and investment decision making. This enables us to analyse clearances beneath our lines and loading on structures, which subsequently informs our under-clearance rectification plan and replacement designs.

Minor condition issues identified during transmission line patrols and inspections are addressed through maintenance as required. Condition inspection of the conductors themselves are undertaken using high-resolution images taken with drones. These are then analysed and used to inform repair options and long-term reconductoring needs. Maintenance activities include joint testing and repairs, conductor testing and repair, and the installation of dampers and spacers. We expect our investment in maintenance to increase to extend conductor life and avoid a significant peak in expected reconductoring work.

When conductors reach end of life, we follow an appropriate decommissioning process. Requirements for recycling and disposal work include safe work and site management and environmental management processes. Conductors that are not recycled are sold as scrap.

Figure 77: Conductor circuit length km age profile

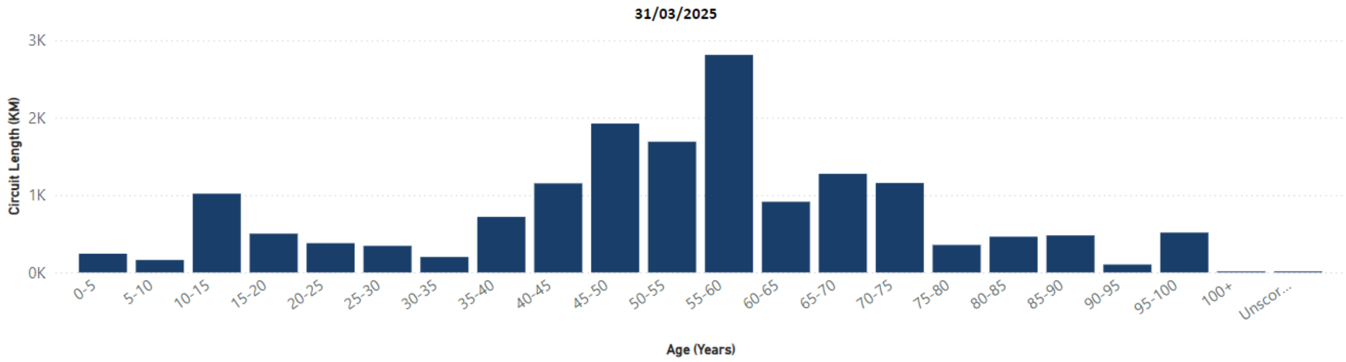
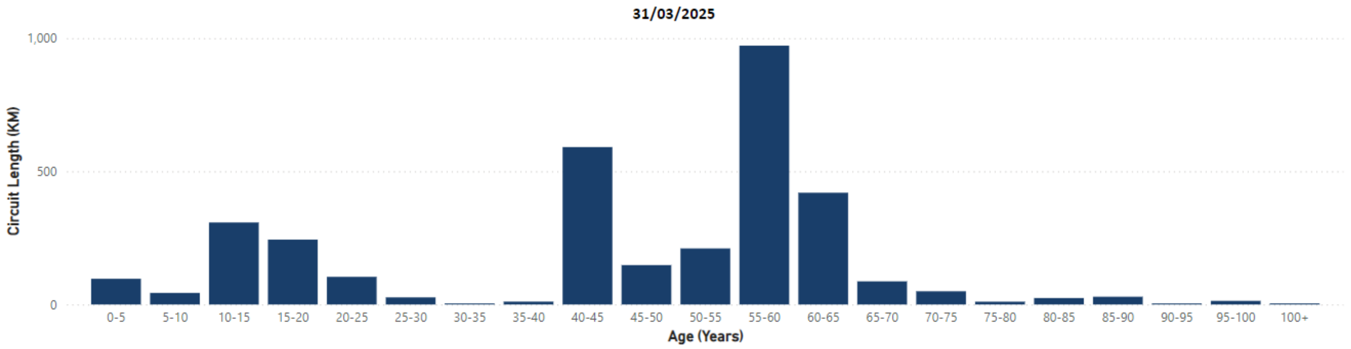


Figure 78: Earthwire circuit length km age profile



Asset risk – health and performance

Figure 79 shows the health profile of our conductor population. We are currently forecasting approximately 3.5% of our conductors (570 cct km) requiring intervention at the end of RCP4. This is an indication of the forward work programme into RCP5 that will require reconductoring or targeted defect repairs. As we gather more condition information through close aerial surveys and sample tests, we will continue to refine our forecast of forward wiring work.

In the last 10 years, the predominant causes of conductor failure were adverse weather (including snow/ice, wind or lightning), contact with vegetation, and joint failure. Less common causes are birds or debris, conductor deterioration, mechanical failure, and damaged/deteriorated hardware.

The key preventive controls critical to reducing failures are good procurement specifications, condition monitoring, and vegetation management including inspections. We also work with local councils to improve management of third parties within our transmission corridors.

Figure 79: Conductor asset health

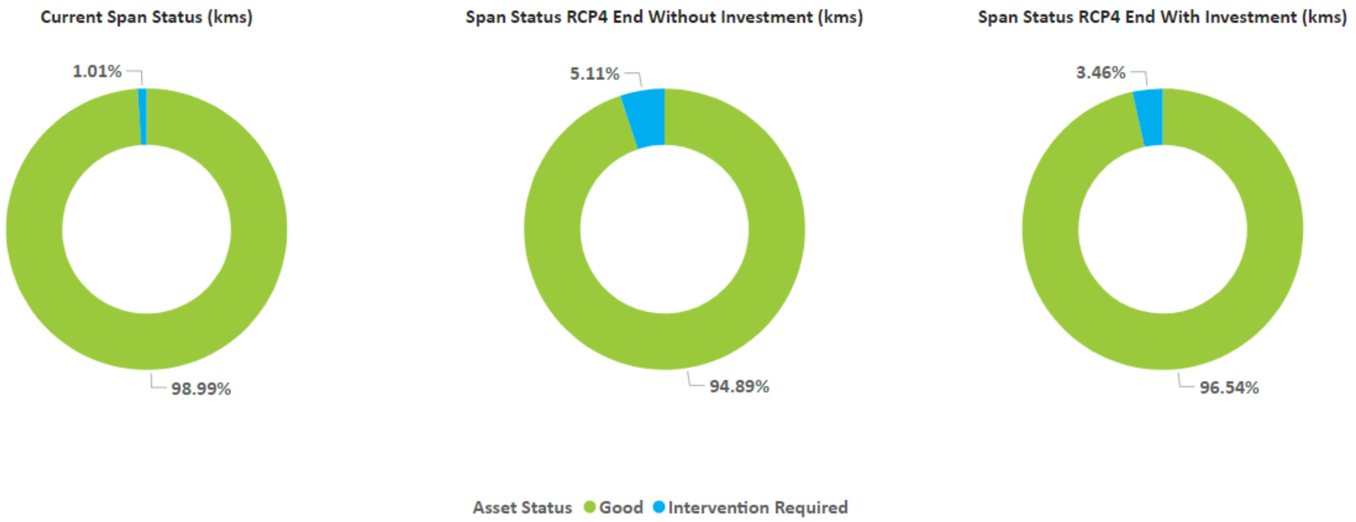


Figure 80 shows the count of conductor unplanned outage per 100 circuit kilometres. Over the last 10 years, we have seen an improvement in performance owing to improved CA and asset management of the various components of the conductor system.

Figure 80: Conductor performance

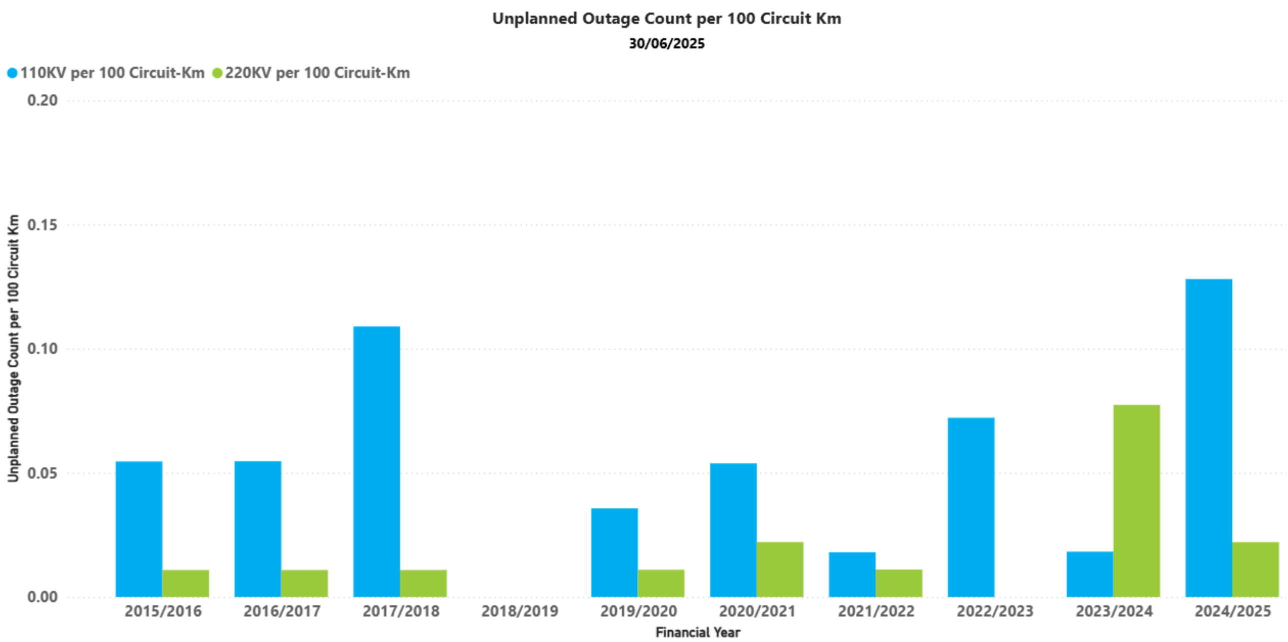
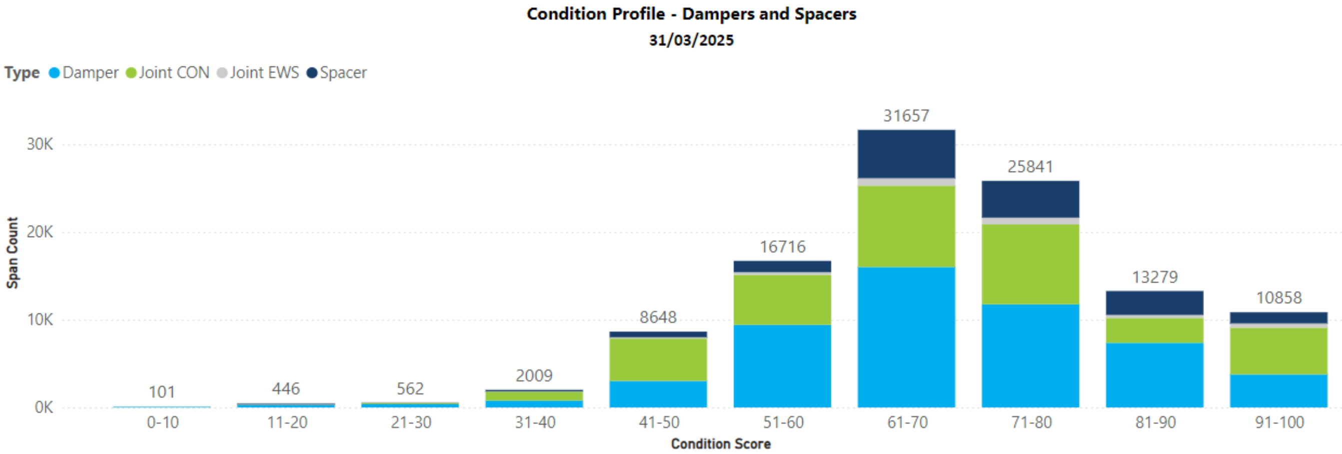


Figure 81: Damper and spacer condition profile



The inspected condition of spacers and dampers is shown in Figure 81. CA score 100 is the as-new condition and CA20 is the condition score that triggers replacement. Joints are managed through an annual programme of joint testing and repairs, and the replacement of spacers and dampers is generally undertaken as part of our maintenance programme based on the CA information collected during routine condition inspections.

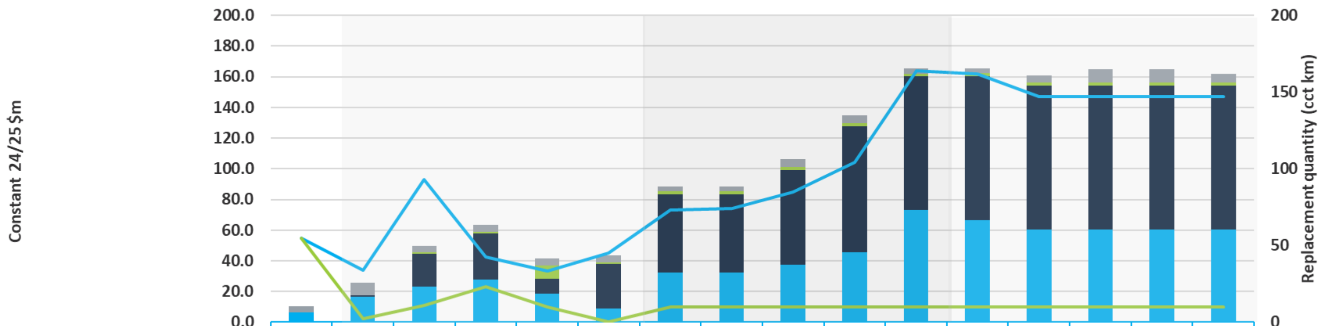
Forecast work and capex

Opex: The forecast covers joint testing, conductor inspections and repairs, conductor assessments, conductor hardware replacement, close aerial surveys, and some under-clearance rectification work. We forecast an increase in opex in the remaining years RCP4, driven by an increase in inspection, testing and repairs to manage and inform the condition and operational risk associated with our ageing conductors, as explained in the previous section. The opex forecast is covered in the Maintenance ACP.

Capex: The forecast consists mostly of reconductoring. The reconductoring activities from RCP4 to RCP6 are summarised in Figure 82. The split between Base and Listed reconductoring projects for RCP5 and RCP6 will be refined and adjusted as more information on conductor condition, costs and uncertainties are known. Other capex activities include earthwire replacements, aerial laser surveys, and under-clearance rectifications.

We continue to identify opportunities to improve the tools and processes that support our asset management decision-making for conductors. We now have an improved conductor condition identification and defect management approach, which has improved our forecast confidence. With the resulting improved asset health model, and an increased investment in drone inspections and defect management, we can assess the need and timing of conductor replacements and consequently significantly reduce our planned volume of reconductoring.

Figure 82: Conductor forecast capex and quantities by year



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Under clearance and other	3.7	7.8	3.9	4.8	4.4	4.6	3.2	2.9	4.9	4.8	3.4	3.2	4.7	9.0	8.6	5.7
Earthwire	0.1	0.3	1.1	0.8	8.6	1.2	2.0	2.0	2.4	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Listed Conductor	0.0	0.9	21.6	30.1	9.7	28.9	51.0	51.0	61.5	82.1	87.3	93.7	93.7	93.7	93.7	93.7
Base Conductor	6.4	16.5	23.2	27.9	18.6	9.1	32.3	32.5	37.4	45.8	72.9	66.8	60.4	60.4	60.4	60.4
Conductor Cct km (base & listed)	55	34	93	42	34	45	73	74	85	104	164	162	147	147	147	147
Earth Wire Cct km	55	2	11	23	10	0	10	10	10	10	10	10	10	10	10	10

Insulators

The primary function of insulators is to support and separate electrical conductors from the supporting structure, without allowing current through themselves. This ACP covers:

- Insulators of different material types (glass, composite and porcelain) used on our overhead transmission lines.
- Phase conductor and earthwire clamps and associated hardware.

Asset class snapshot

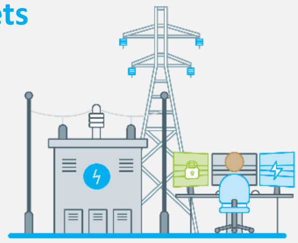
Population – insulator sets

11,192 Composite

33,627 Glass

7,173 Porcelain

10,171 Earthwire hardware



Capex

RCP4 (forecast)

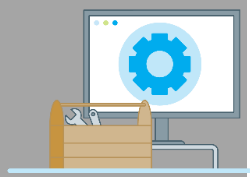
$54.3m

Asset health 2025

- 80.4% Good
- 16.2% Fair
- 2.1% Poor
- 1.0% Very Poor

Work programme

	RCP4
Insulator sets	5,708



Asset class strategy

Objective
Achieve a high level of reliability and mitigate safety hazards, at least lifecycle cost.

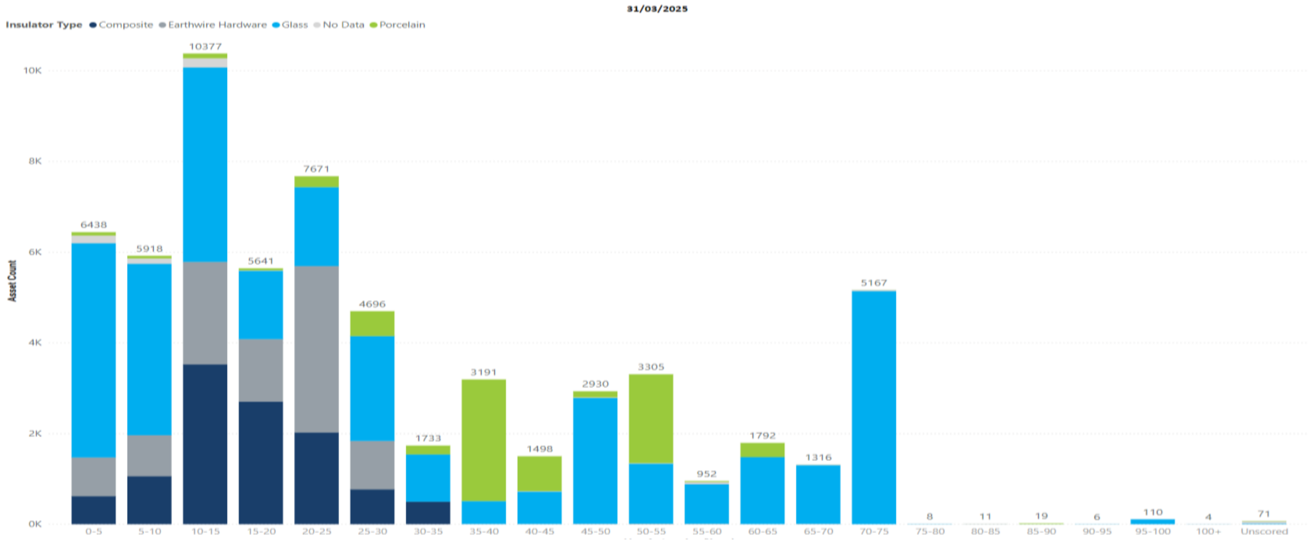
Measure
Average annual unplanned outage rate (expressed in events for each 100-cct km each year) less than 4.0 for 110 kV lines and 1.5 for 220 kV lines.

Asset Strategy

- Replace glass and porcelain insulators and fittings when their condition reaches replacement criteria (CA 20).
- Replace composite insulators and fittings based on life expectancy, which varies between corrosion codes, or sooner where condition dictates.
- Install composite insulators in extreme and very severe corrosion areas, and in sensitive areas where audible noise is an issue. Install glass cap and pin insulators in all other areas due to longer reliable life and electrical and mechanical performance.

Investment need is primarily based on asset health. However, when it is deemed cost effective to do so, re-insulation work is bundled with any works where conductor lifting is done, e.g. reconductoring, pole/cross-arm replacement, or attachment point replacement. While this results in some insulators being replaced before end of life, this is an approach consistent with our strategy and removes future costs associated with re-accessing the site, design, and project management. It also minimises landowner interruption and provides greatest economic benefit. Additionally, if defects are identified during line patrols, e.g. gunshot damage to the insulator skirts, this is done as maintenance works as required. System growth projects also drive the need for further investment.

Figure 83: Insulator age profile



Insulator health is influenced by the corrosiveness of the environment and, as such, their life expectancy can vary greatly. While annual re-insulation numbers are currently stable, this is expected to change over the next few RCPs as we undergo continuous calibration of our health model and make improvements to our corrosion zone mapping, which will enable improved asset health forecasting. Figure 83 shows the population and age profile of our insulators.

In accordance with the strategy, insulators do not have a refurbishment option. Once the replacement criteria are reached, the insulator is replaced. This work is undertaken as volumetric capex work.

Lifecycle – deliver, operate, maintain, decommission, and disposal

Delivery times for insulator replacements are typically 12-24 months with the detailed design and planning occurring in the year preceding the work delivery, where possible. At times, due to poor condition, some aspects of this process are accelerated to ensure components are replaced within suitable timeframes.

The outage requirements for insulators are dependent on the specific task involved. These can be, for example, the number of insulators to be changed on a line, whether it is a strain set or suspension that needs replacement, whether the structure type is a pole or tower, and whether it is a HVDC/HVAC re-insulation. We also have the option of reinsulating structures (220kV and HVDC) under live-line conditions where this is required.

We have programmes of work that address asset condition issues identified during transmission line patrols, inspections, and CAs. Examples of such works are insulator washing or replacing insulator hardware in bulk. Both are not routine and not forecasted but completed as required. Where a part of an insulator set requires replacement, this will be undertaken through maintenance as required. This can be, for example, when only the hot- or cold-end hardware requires replacement but not the insulator itself. Insulator fittings, such as armour rod repair/replacement is done as maintenance when not replaced with the full insulator set. In cases where only the jumper insulator of a strain set requires replacement; this too is done as maintenance.
We follow an appropriate decommissioning process. Requirements for recycling and disposal work include safe work and site management, and environmental management processes. Insulators that are not recycled are sold as scrap.

Asset risk – health and performance

The overall health of the insulator asset class is good due to the volume of re-insulation work that takes place annually. Insulators not yet at replacement criteria are also replaced with other workstreams such as under-clearance fixes or pole replacements. In the interest of economic efficiency, insulators requiring replacement within the same RCP are also brought forward to align with attachment point replacement where viable to do so. We use the asset health model to forecast future work. Figure 84 shows the current asset health of our insulators and with and without investment.

The predominant causes of failures for insulators are corrosion to metal pins of the insulators, third-party acts causing interference or damage, (e.g. gunshot damage), contamination and pollution that result in flashover, and adverse weather events such as lightning strikes (particularly on composite insulators).

The three key preventive controls that we have implemented to reduce the likelihood of a failure include routine condition inspections including contamination checks, bird proofing, and predictive modelling. The quality of CAs has improved over time, which has enabled better health modelling. More recently we have completed an exercise to recalibrate asset health models using historic data sets compared against actual delivery, an exercise known as back-casting. We have also undertaken corrosion zone mapping improvements which have further improved the confidence in our health modelling.

Figure 85 shows the unplanned outages for the last 10 years. It shows how unplanned outages have decreased over time, following improved asset management efforts.

Insulator failure can be either mechanical or electrical. Mechanical failure is largely attributable to steel pin corrosion and will generally drop the conductor unless the insulator set comprises some redundancy (multiple strings). Electrical failure of insulators is typically caused by pollution, either by bird droppings, salts, or other contaminants, which can lead to flashover. Non-technical failures include issues such as vandalism, bird strikes, or extreme weather.

Figure 84: Insulator asset health

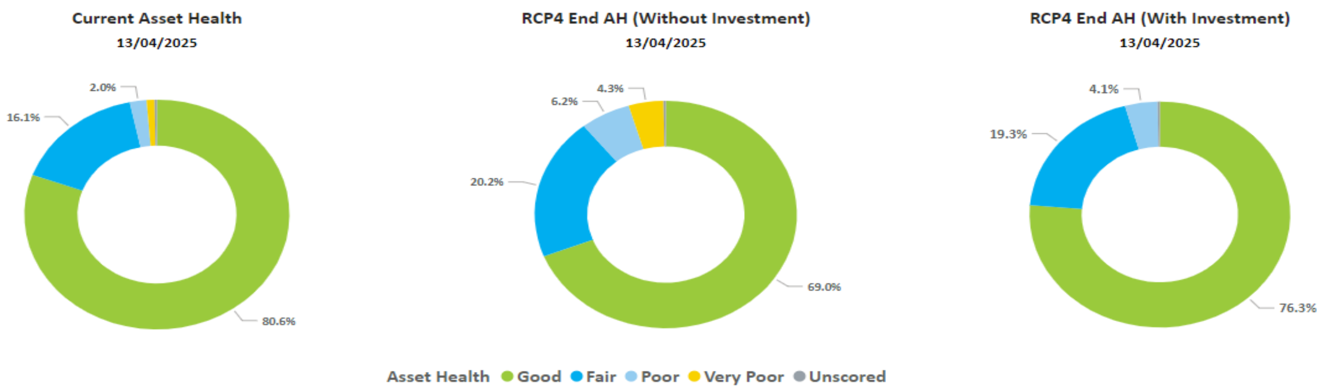
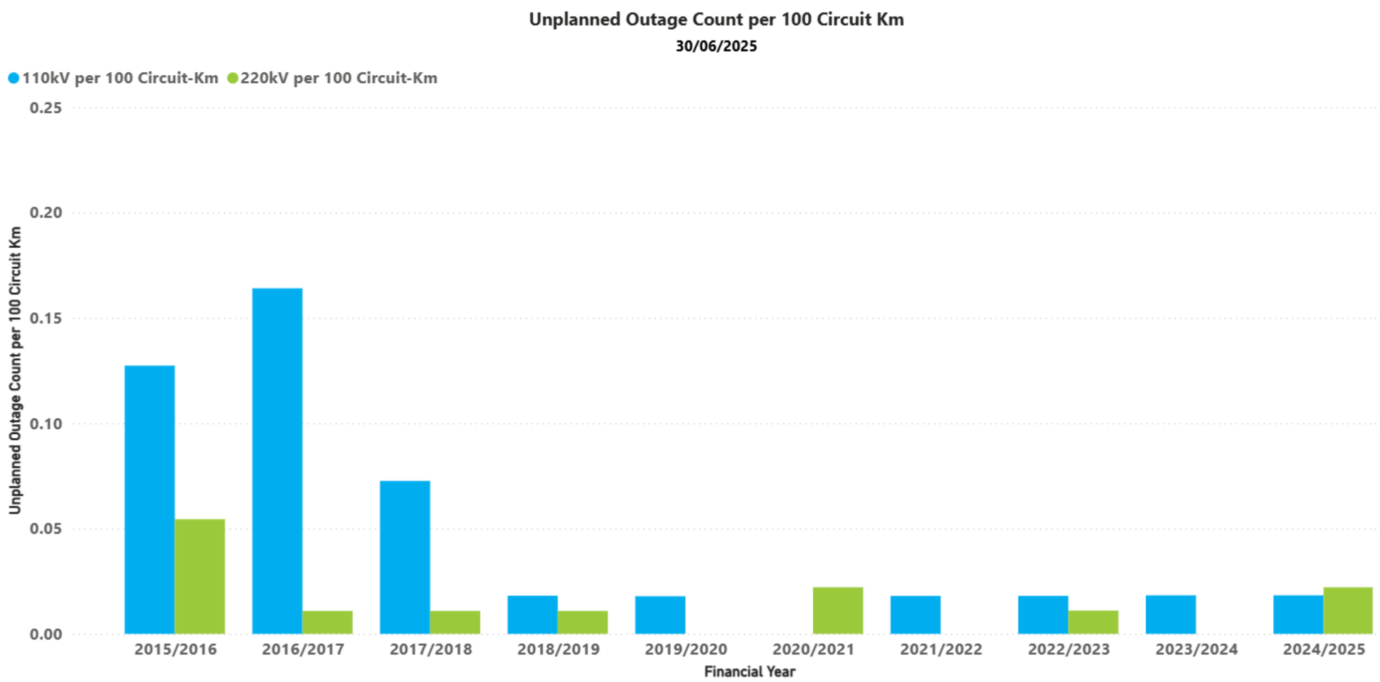


Figure 85: Insulator performance



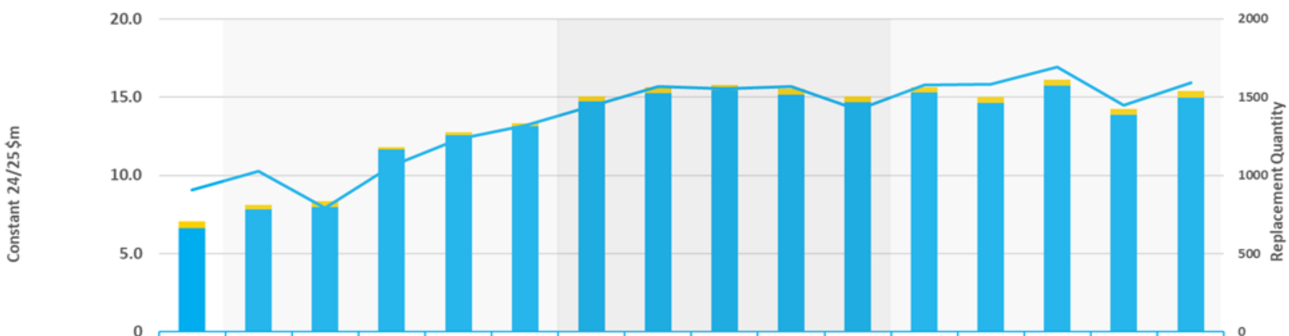
Forecast work and capex

Health modelling is used to forecast the quantity of strain and suspension insulators of the various voltage levels that would require intervention in subsequent years. The exact scope of work is determined closer to the time based on the latest available condition data. The TEES building block rates are then applied to these quantities to determine an uninflated expenditure forecast.

Opex: Re-insulation is funded through capex, and no associated work is done through opex work other than replacement of components. Replacement of any component portions of an insulator set, such as hot- or cold-end hardware, only jumper (including jumper hardware) or part of the insulator string will be funded through predictive maintenance work.

Capex: The forecast capex and volumes for RCP4 to RCP6 are shown in Figure 86. Significant recalibration of the health models and corrosion zone updates have been done over the past years, which is showing an increase in volumes from the RCP4 period. To maintain the asset health of the fleet due to an increasing number of insulators forecasted to be in poor condition in the future, more replacements are planned. This includes the re-insulation to harden the insulators, which are susceptible to volcanic ashfall, as part of the resilience programme.

Figure 86: Insulator forecast capex and quantities by year



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Resilience	0.5	0.3	0.4	0.2	0.2	0.2	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Insulators	6.6	7.8	8.0	11.6	12.6	13.1	14.7	15.3	15.4	15.2	14.7	15.3	14.6	15.7	13.8	14.9
Insulators Qty	908	1028	794	1062	1235	1318	1446	1570	1554	1568	1419	1577	1583	1695	1450	1592

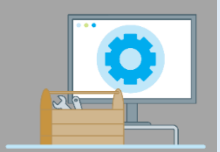
Paint

Our approach to maintaining the structural integrity and performance of our steel transmission towers is primarily through our paint programme, with the alternative tower-to-pole replacement programme emerging during RCP4. Paint coatings help protect steel from the corrosive environment. The alternative approach is to replace small towers with poles when practical and cost effective. This section discusses the tower paint programme.

Asset class snapshot

Work programme

	RCP4
Towers painted	2,864
Minimum approach	4,318



Capex

RCP4 (forecast)

$345.2m

Asset class strategy

Objective

Our overarching objective for towers and poles is to maintain them in perpetuity, with a high level of safety, resilience and reliability, at the least lifecycle cost.

Asset strategy:

- First paint towers based on the economically optimal point.
- Repaint structures when the undercoat shows through the topcoat.
- Use the asset health model to plan interventions. Complete all actions required to implement the widespread use of poles to replace towers.

We have a well-established tower painting programme. Towers are identified for painting primarily by asset health. Delivery considerations such as landowners, property boundaries, site access, seasonal constraints and maximum resource availability are also accounted for in the investment planning.

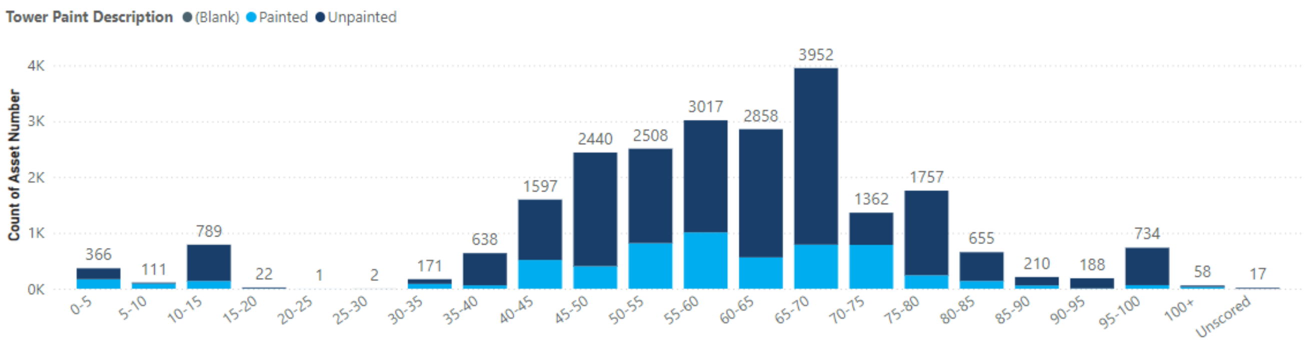
To ensure the structural integrity and performance of towers are not adversely impacted we focus on completing full tower painting, recoating previously painted structures, and the painting of the backlog of now due towers. Full tower painting includes painting the MAD areas of the tower. Our strategy is to recoat painting prior to any coating system failure, and new paint to be completed prior to the onset of significant rusting of steel members.

Figure 87 shows the population and age profile of our painted and unpainted towers. Table 26 shows the percentage of towers painted in each corrosion zone.

Table 26: Tower paint profile by corrosion zone

Corrosion Zone	Tower Painted	Tower Unpainted	% Painted in Zone
Extreme	154	56	73.33
Very Severe	1579	200	88.76
Severe	2565	1041	71.13
Moderate	1647	10955	13.07
Low	13	3590	0.36
Benign	1	1655	0.06
Unknown	0	2	0.00
Total	**5959**	**17499**	**25.40**

Figure 87: Tower age profile



Lifecycle – deliver, operate, maintain, decommission, and disposal

Painting utilises specialist resources and work is delivered through a mixture of selective source and open tender to maintain and develop suitable service provider resources and competencies, while maintaining a competitive pressure on prices. We scope a programme of projects 12-36 months ahead of delivery, ensuring time for finalising delivery scope details. This enables efficiency opportunities aligning resources, land use and system operational requirements, while maintaining a continuous year-round painting programme. This also ensures changes can be effectively managed without compromising safety, asset health, structural integrity, or performance objectives.

During delivery stages, all practicable steps are taken to minimise impact on the surrounding environment, with sustainability considerations under ongoing review.

Most tower painting work does not require an outage, but some of the work cannot be undertaken with lines in service. Painting within the MAD on all structures requires an outage. As such, our approach is to seek outages (including additional ones), where possible, and use these periods to prepare and paint the area within the MAD on as many of the structures as possible within the outage period. Where an outage is required, we plan them to provide a safe environment for employees and service providers to undertake the work while minimising disruptions to customers and end-users.

All inspection requirements for our towers are covered in the Transmission Lines Structures ACP. There are no specific maintenance activities associated with the paint programme.

However, painting of towers does have significant benefits in addressing minor structure maintenance tasks such as steel and bolt replacements, earth plate installations, signage replacements, and addressing any identified or emerging defects.

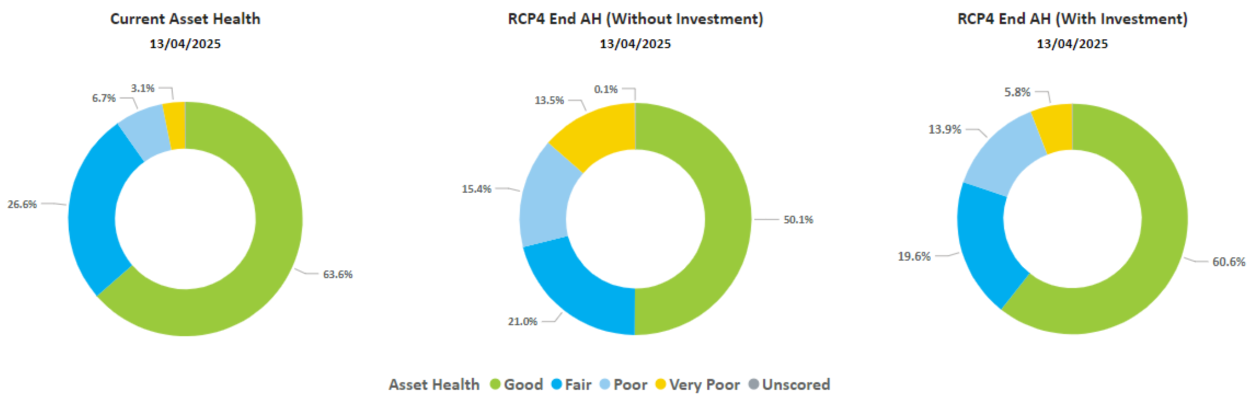
Decommissioning and disposal do not apply to our paint programme.

Asset risk – health and performance

Figure 88 shows the current asset health of our total tower population's protective coating and also forecast asset health at the end of RCP4 with and without investment.

Asset health scores reflect the expected remaining life of the tower steel protective coating for unpainted structures, or the remaining life of the paint coating for painted structures. Application of the paint strategy ensures painted towers are maintained prior to coating system failure and ensures unpainted structures do not deteriorate beyond paintable condition thus requiring a more costly replacement strategy. The increasing percentage of the protective coating in the fair to poor asset health bands is reflective of the tower-to-pole strategy, as these towers are managed through to replacement with a pole as per the Transmission Line Structures ACP.

Figure 88: Tower protective coating asset health



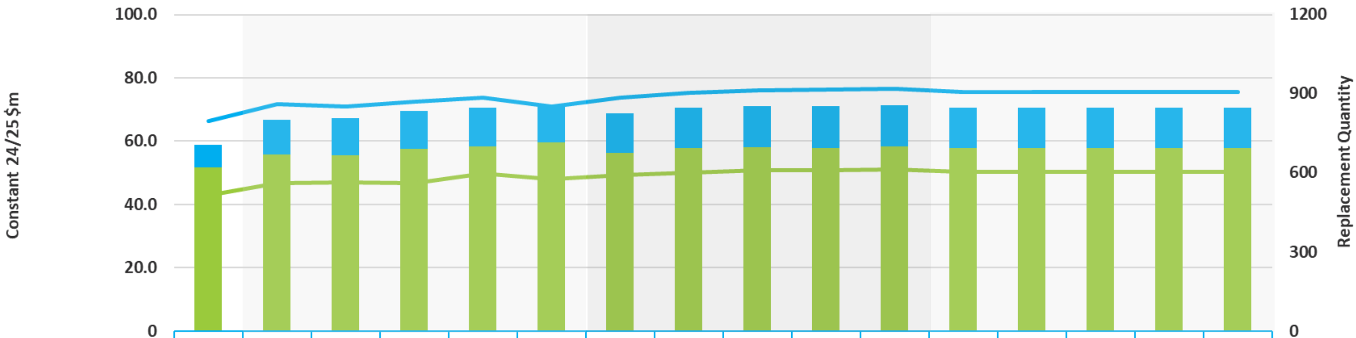
This portfolio workstream is an intervention programme before degradation has reached a point where failure is possible.

Performance of tower structures is historically good with very few failures. No failures are attributable to protective coating condition. We have not identified any specific asset performance measures applicable to this programme of works.

Forecast work and capex

Work volumes increase as we recoat an increasing quantity of painted structures and undertake painting of new towers each RCP. Coupled with the growth in MAD paint completion, the forecast expenditure increases during RCP4 and then remains fairly consistent across RCP5 and RCP6. This is despite the reduction in painting from future replacement of older, smaller towers structures with poles. The Transmission Line Structures ACP outlines the expected expenditure on the tower to pole replacement programme over the next three RCPs. Figure 89 shows the forecast work volumes and expenditure until RCP6.

Figure 89: Paint forecast capex and quantities



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
MAD painting	7.2	11.1	11.8	11.8	12.2	11.5	12.6	12.8	13.0	13.0	13.1	12.9	12.9	12.9	12.9	12.9
Tower painting	51.6	55.7	55.5	57.6	58.4	59.7	56.3	57.8	58.1	57.9	58.3	57.7	57.7	57.7	57.7	57.7
Towers painted Qty	516	562	565	561	599	577	590	602	609	611	614	605	605	605	605	605
MAD painted Qty	797	861	852	870	885	850	884	903	913	916	920	907	907	907	907	907

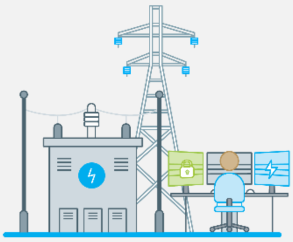
Structures

Transmission line structures consist of steel lattice towers; concrete, wooden and steel poles; and components including attachment points. They are used to physically support conductors, earthwires, and aerial communications cables. Painting of towers is covered in the tower paint ACP.

Asset class snapshot

Population

13,146 Poles
23,453 Towers
64,278 Attachment points



Capex

RCP4 (forecast)

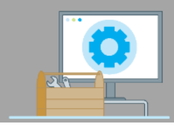
$149.2m

Pole asset health

- 86.6% Good
- 12% Fair
- 0.6% Poor
- 0.8% Very Poor

Work programme

	RCP4
Poles	1,314
Towers	1
Tower to pole	86
Attachment points	2,280



Asset class strategy

Objective
Our overarching objective for towers and poles is to maintain them in perpetuity, with a high level of safety, resilience and reliability, at the least lifecycle cost.

Measure

- Number of storm events resulting in a major tower failure of ≤ 0.1 per annum, and major pole failure of ≤ 0.75 per annum, on a 10-year rolling average
- Zero major tower or pole failures directly attributable to loads imposed that are less than their design criteria

Asset strategy

- Repair or replace structures that have degraded to a point where they can no longer support their structural loads.
- Replace attachment points at the onset of section loss (CA 20) or before the fastener threads seize up (CA 30).
- Replace steel components where deemed necessary and cost-effective.

Investment need for poles is primarily based on asset health. Life expectancy of poles is typically 50-80 years, depending on the construction material. These structures are managed through to replacement. They are replaced with steel or concrete poles and steel cross-arms subject to design, location, and sustainability considerations. Individual pole or cross-arm replacements are only completed where this is a least lifecycle cost solution for the structure.

Investment need for maintaining towers includes tower painting, tower replacement in full or in part, conversion to poles, attachment point replacement, and steel and bolt replacement. Options analysis considers the overall tower condition, the corrosion zone, and plans for the line or specific towers in determining which option is most appropriate.

Figure 90: Pole age profile

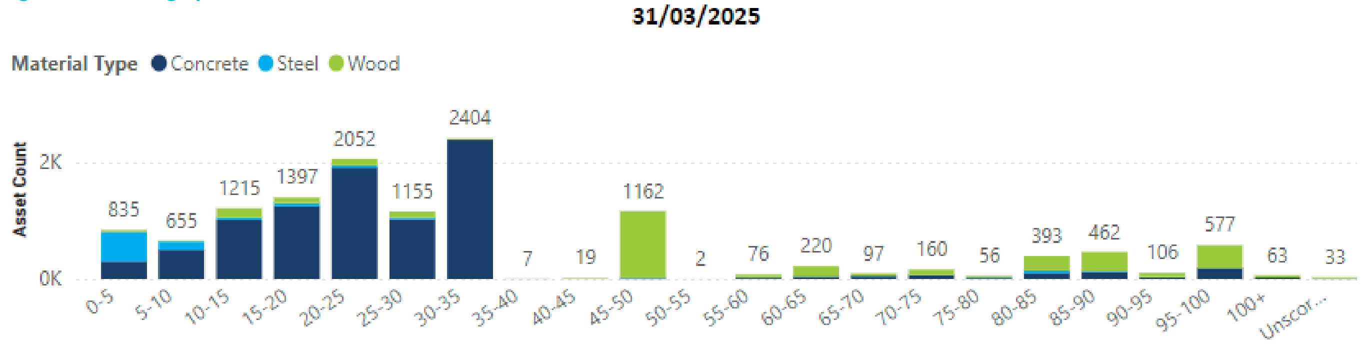


Figure 91: Tower age profile

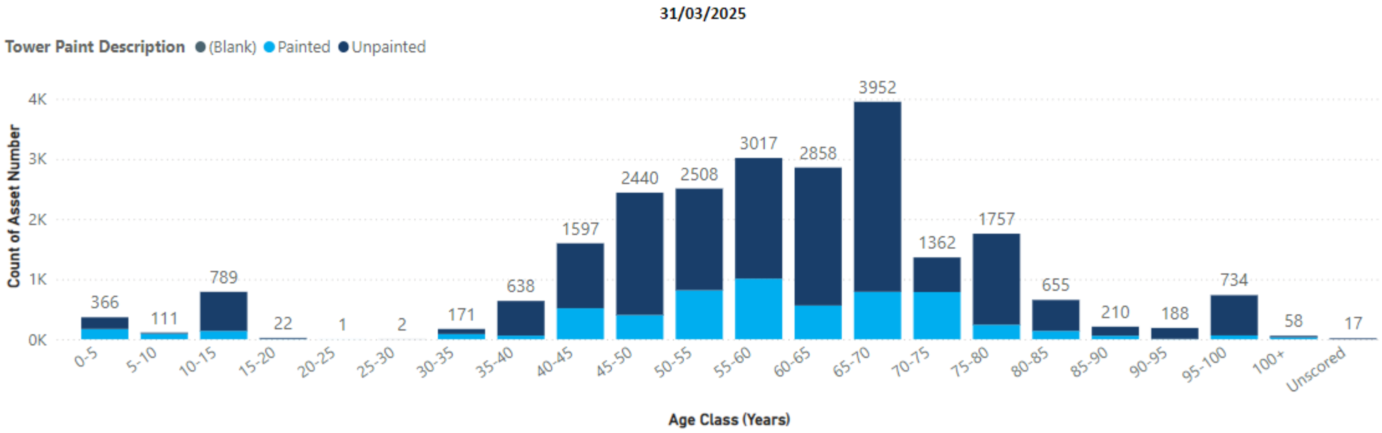


Figure 90 and Figure 91 shows the population of our poles and towers. Life expectancy for unpainted towers ranges from 18 to 120 years depending on the corrosion zone.

Our tower-to-pole initiative is an emerging solution for managing the future replacement needs of many of the smaller/lightly loaded older towers. In many locations new steel poles can be cost-effectively installed to meet all design and operational requirements for these smaller towers. Planned intervention with steel and bolt replacements will ensure towers remain fit for purpose through to replacement with a pole.

Unplanned tower replacements typically result from major hazard events, such as environmental events or third-party interaction.

Attachment points supporting the insulation assemblies and phase and earthwire conductors are subject to corrosion and wind-related degradation. These components are managed by replacement with interventions completed prior to major degradation of the items and before unacceptable risk of failure under design loads are exceeded.

Lifecycle – deliver, operate, maintain, decommission, and disposal

Delivery times for pole replacements and attachment point projects are typically planned on a 12-24-month horizon with the detailed design and planning occurring in the year preceding the work delivery, where possible. At times, due to poor condition, some aspects of this process are accelerated to ensure components are replaced within suitable timeframes.

In addition to the transmission line patrols, inspections and CAs, we undertake defect rectification, fault response, attachment point component replacement, steel and bolt replacement and EPR mitigations.

We rarely decommission a tower or pole site. However, where it does occur, consistent with our environmental objectives, our decommissioned sites are reinstated to integrate with their surrounding environment, and in some cases, to their original natural forms to allow the land to recover.

All decommissioned items are removed from the site and recyclable components are sustainably disposed of.

Asset risk – health and performance

Figure 92 and Figure 93 show the asset health of our poles, and attachment points.

Figure 92: Pole current asset health

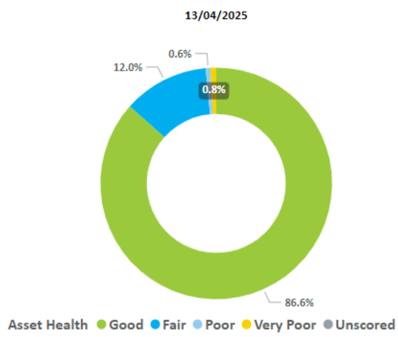


Figure 93: Attachment point asset health

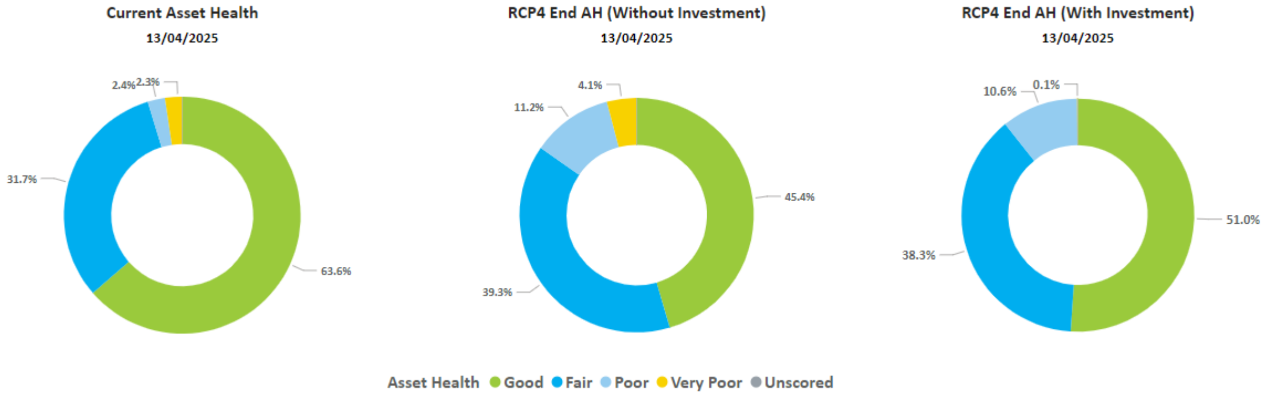


Figure 94 and Figure 95 respectively, show our pole structure and tower failure performance against the strategy objectives.

Figure 94: Pole performance

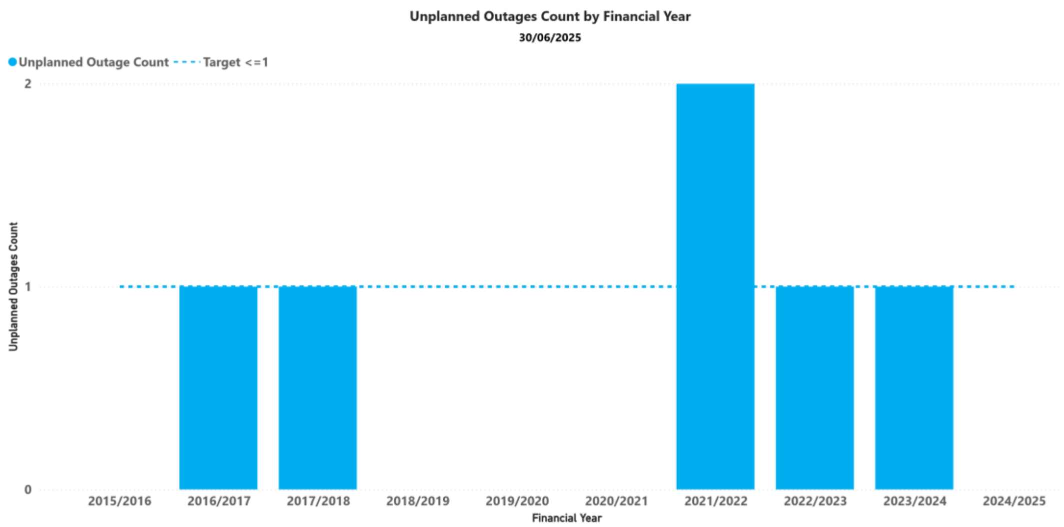
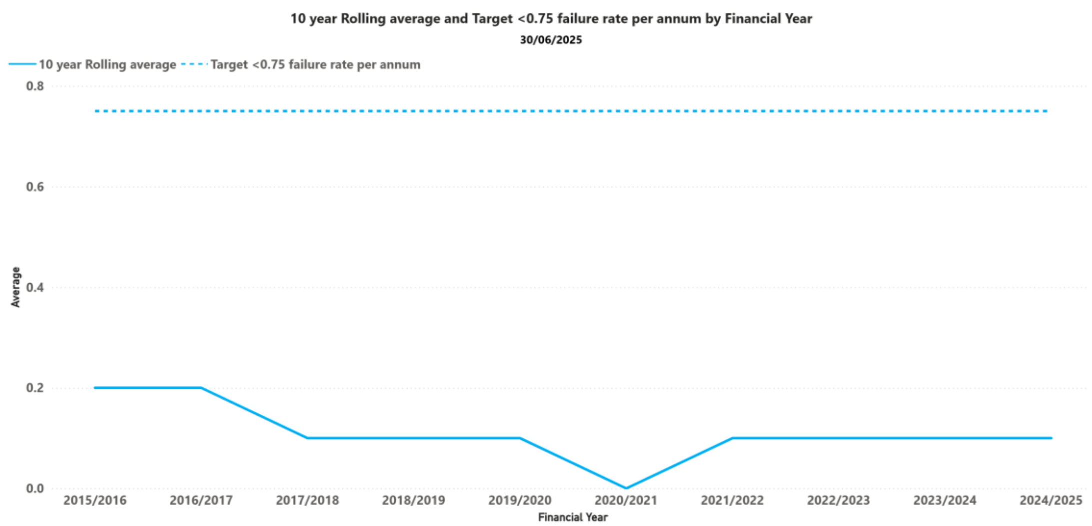


Figure 95: Tower performance



Forecast work and capex

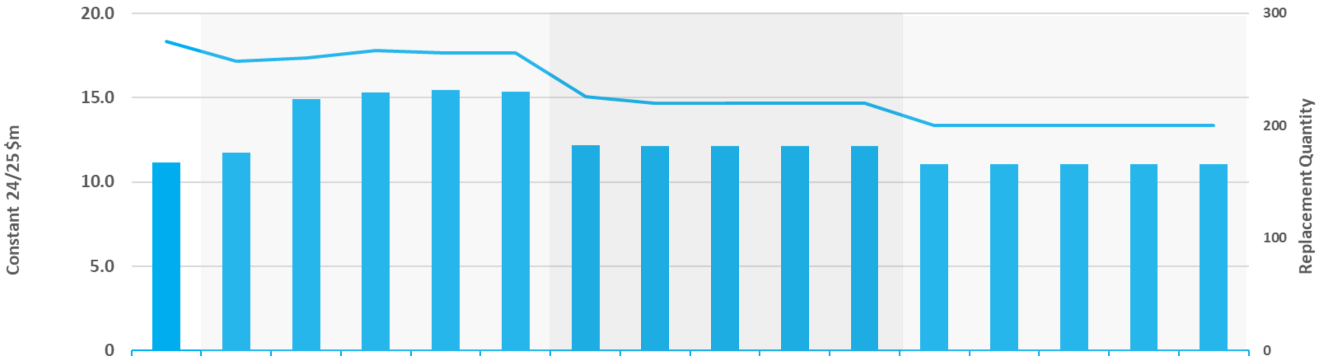
Opex: The forecast includes steel and bolt replacement, attachment point component replacement, signage, earth potential rise mitigations, bird deterrent installation and climb deterrent installation.

Capex: Figure 96 shows that pole replacements are forecast to continue at or slightly above the historical volumes for RCP4 and then drop back for RCP5 and RCP6.

Figure 97 shows the tower forecast. Historically, we have replaced two towers per year under this workstream. We have continued forecasting unplanned tower replacements at this quantity, ensuring visibility of this workstream remains.

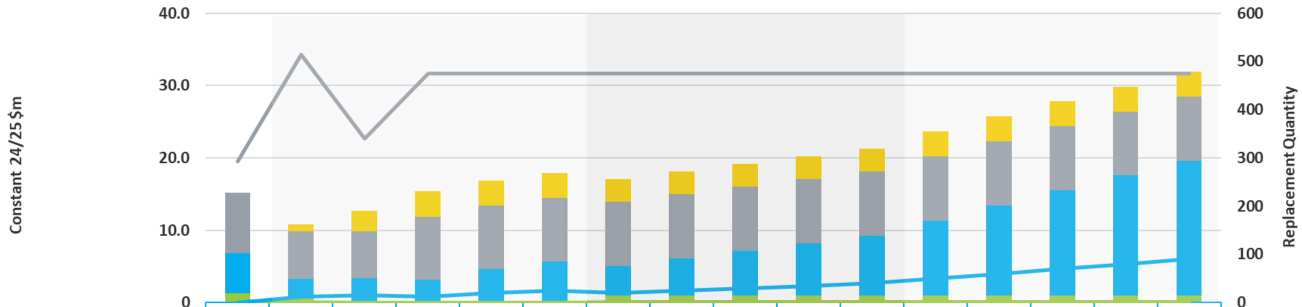
Following proof of concept. the tower-to-pole programme commences in RCP4 and increases over the following RCPs. We expect this will continue beyond RCP6.

Figure 96: Pole forecast capex and quantities



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Poles	11.2	11.7	14.9	15.3	15.5	15.3	12.2	12.1	12.1	12.1	12.1	11.1	11.1	11.1	11.1	11.1
Poles Qty	275	257	260	267	265	265	226	220	220	220	220	200	200	200	200	200

Figure 97: Tower forecast capex and quantities



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Resilience	0.0	1.0	2.9	3.5	3.5	3.5	3.2	3.2	3.2	3.2	3.2	3.5	3.5	3.5	3.5	3.5
Attachment points	8.3	6.5	6.5	8.7	8.7	8.7	8.8	8.8	8.8	8.8	8.8	8.9	8.9	8.9	8.9	8.9
Tower to Pole	5.6	2.8	3.3	3.1	4.7	5.7	4.2	5.2	6.2	7.3	8.3	10.4	12.5	14.6	16.6	18.7
Tower replacement	1.2	0.5	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Towers Qty	3	1	0	0	0	0	2	2	2	2	2	2	2	2	2	2
Tower to Pole Qty	0	13	16	12	20	25	20	25	30	35	40	50	60	70	80	90
Attachment points Qty	293	515	340	475	475	475	475	475	475	475	475	475	475	475	475	475

Foundations

The performance of foundations is critical to ensure the structural integrity, reliability, and public safety of the overhead structures and conductors they support. Most of our foundations are used to support steel lattice towers, but we also have a small number of larger steel pole (monopole) foundations. This ACP also includes the foundation interface, which is the connection between the buried foundation and the above-ground structure.

The type of foundation and interface used varies depending on design loads, soil type, and the preferred construction practices of the time in which they were installed.

Asset class snapshot

Population

8,578	Steel grillage
49,514	Concrete over grillage (CoG)
9,391	Concrete plug
527	Other tower foundations
100	Pole foundations

Capex

RCP4 (forecast)

$116.5m

Grillage asset health

- 69.9% Good
- 23.5% Fair
- 5.4% Poor
- 1.2% Very Poor

Work programme

	RCP4
Concrete over grillage	755
Cathodic protection	571
New foundations	4
Slope stability & river piling	49
Marine foundation strengthening	4

Asset class strategy

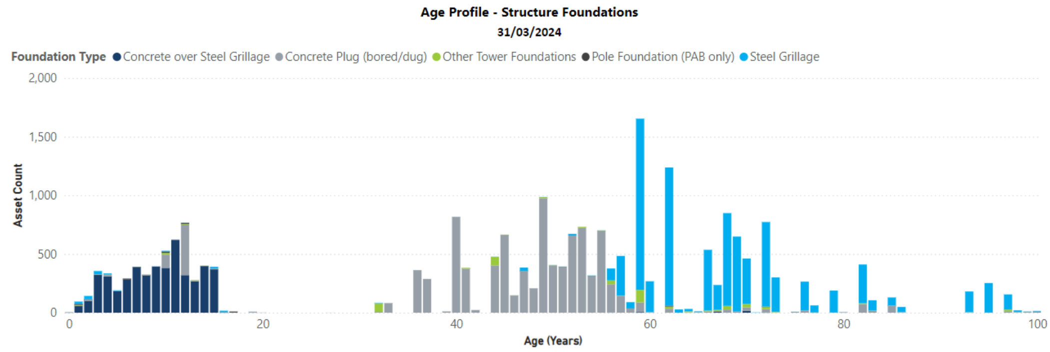
Objective
Maintain our transmission line foundations in perpetuity at least lifecycle cost to ensure the integrity resilience and reliability of the overhead structures and conductors they support.

Measure
No more than one major foundation failure every 5 years and none on highly critical foundation assets.

Asset strategy

- Strengthen, refurbish, and disassemble foundations with a focus on sustainability and minimal impact on the environment.
- Develop our whole-of-life asset information for the foundations fleet.

Figure 98: Foundations age profile



Investment need is primarily based on asset health. Timely refurbishment of grillages is required to avoid deterioration to a point where higher-cost tower propping and major steel replacement is required. Other key drivers are replacing poor condition foundations, undertaking waterway protection work on foundations in or adjacent to riverbeds, and remediating slope stability issues.

Options considered are refurbishment or replacement. To determine the preferred option, inputs such as foundation loads, constructability, and plans for the line are considered along with an economic assessment to ensure least lifecycle cost.

Concrete encasement of buried steel foundations (CoG) and Cathodic protection (CP) are now the preferred grillage intervention options. Where an asset is forecast to remain in perpetuity, we will consider CoG as the preferred option, with CP as an alternative where CoG cannot be delivered in a cost-effective manner. CP is considered as the primary intervention where the structure is to be decommissioned. In these finite-life considerations, CP can maintain the foundation through to the end of its required life. However, CP is not a viable option in some locations due to soil resistivity, proximity to substations, and proximity of buried services. In these situations, CoG is most likely to be the intervention option selected.

Grillage foundation refurbishments are based on the condition of the interface; this is when the grillage is at CA 40 for all structures except low- to medium-level criticality suspension structures, where the intervention point shall be CA 30.

Concrete foundations are long-life assets with the objective to ensure they remain fit for purpose. Interface maintenance interventions are asset health driven with proactive refurbishment prior to the onset of significant rusting. Complete replacement of a concrete foundation is rare and is managed individually when the need arises.

Figure 98 shows the population of transmission line foundations by age and type.

Lifecycle – deliver, operate, maintain, decommission, and disposal

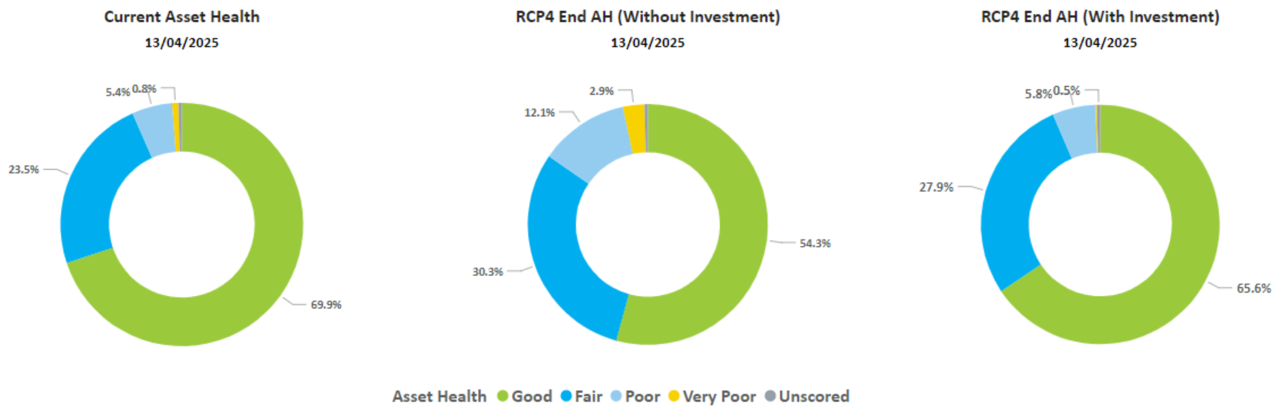
Delivery times for foundation work is typically 24 months with the detailed design and planning occurring in the year preceding the work delivery, where possible.

There are no specific outage planning requirements for foundation works, and work can often be undertaken without an outage. The only exception is significant foundation strengthening activities where outages are generally required to enable the large construction equipment to operate beneath the line.

We complete planned maintenance on our foundation interfaces in accordance with our standard maintenance procedures. For our interface maintenance, this involves a combination of cleaning, painting, and grouting.

Decommissioned foundation sites are reinstated to integrate into their surrounding environment and, in some cases, to their original natural forms to allow the land to recover.

Figure 99: Grillage Foundation asset health



Asset risk, health and performance

Figure 99 shows the health profile of our grillage foundations. The forecast asset health aligns with our strategy of intervening prior to major steel deterioration but with slight differentiation by asset criticality. Assets in 'Very Poor' health and approaching intervention in 'Poor' health will be significantly reduced at the end of RCP4, with an increase in percentage of assets in 'Fair' condition. This results in a well-managed risk profile, as shown in Figure 100 due to the application of criticality in our investment planning.

Figure 100: Grillage foundations annualised risk

Structural failures of foundations are rare. Predominant causes for foundation failures are deteriorating foundation condition, deteriorating interface condition, and overloaded foundations.

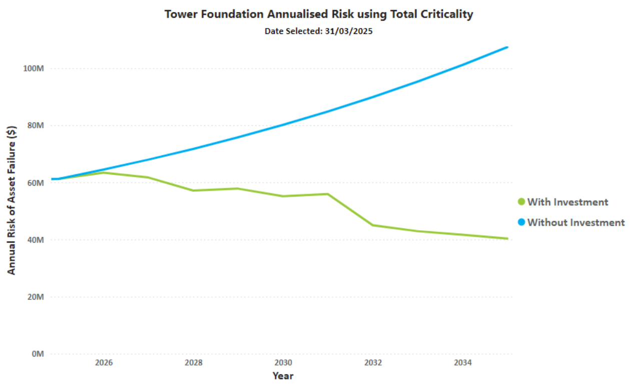
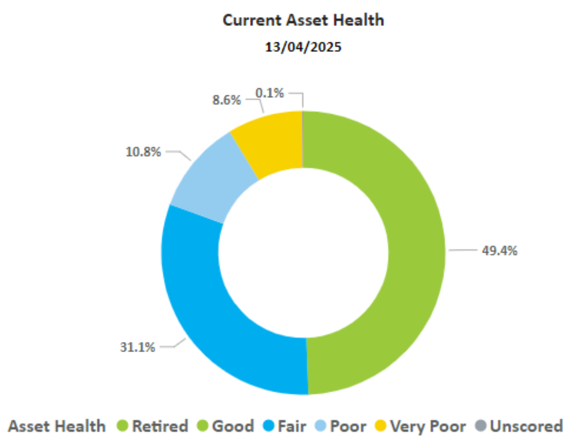


Figure 101 shows the health profile of our foundation interfaces for all foundation types.

Figure 101: Foundation interface asset health



Failures can also be as a result of erosion, landslides and flooding. The three key preventive controls critical to reducing the likelihood of a service failure event are operational and maintenance procedures and standards, foundation integrity and remediation review, and appropriate foundation design based on geotechnical analysis. Other areas of focus for continued risk management include monitoring after environmental events for foundations with known issues, regular monitoring of critical foundations and proactive hardening of foundation assets at risk through the two separate workstreams. .

There have been three major foundation failure events since 2012. This was due to river scour in the 2019 Rangitata River flood event, a landslide causing an unplanned outage in Northland and erosion around a pole in Coleridge.

Forecast work and capex

Opex: The forecast opex for foundations covers, interface refurbishments, CP maintenance (commencing in RCP5), river protection and slope stability maintenance.

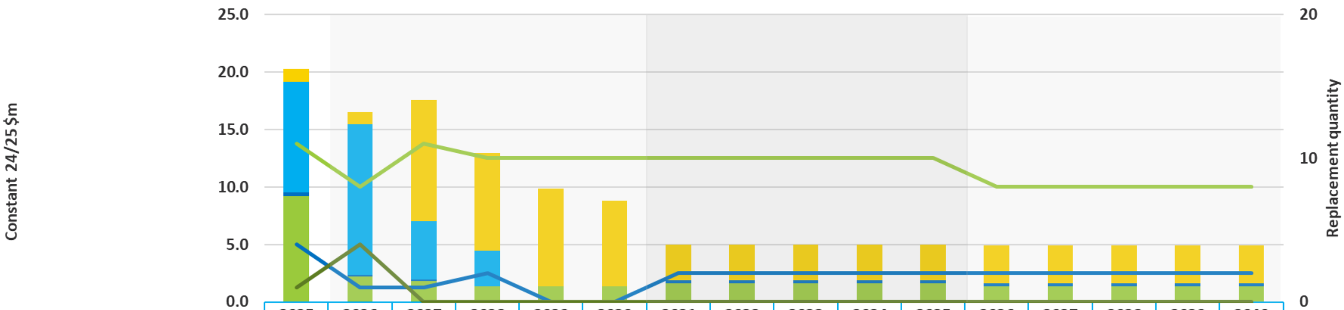
Interface refurbishments are forecast to ramp up in RCP4, RCP5, and RCP6 respectively. This is due to asset health and emerging needs from CoG interface refurbishments and grillage with CP all requiring refurbishment.

Slope stability maintenance includes risk assessments, retaining wall repairs or slope protection works. This is forecast to continue in a steady state in RCP4.

Capex: Figure 102 shows the foundation capex forecast (excluding grillage). The predominant expenditure in RCP4 for foundations comprises two resilience workstreams. These are for land stability and proactive hardening of towers in braided rivers. The other expenditure consists of marine foundation strengthening, new foundations, slope stability, and river piling to mitigate at-risk sites. The marine foundation-strengthening activities were to be completed in RCP3 but now expected to continue into RCP4 at some sites. In RCP4, RCP5 and RCP6, river piling at pole replacement sites have been accounted for in the transmission line pole portfolio.

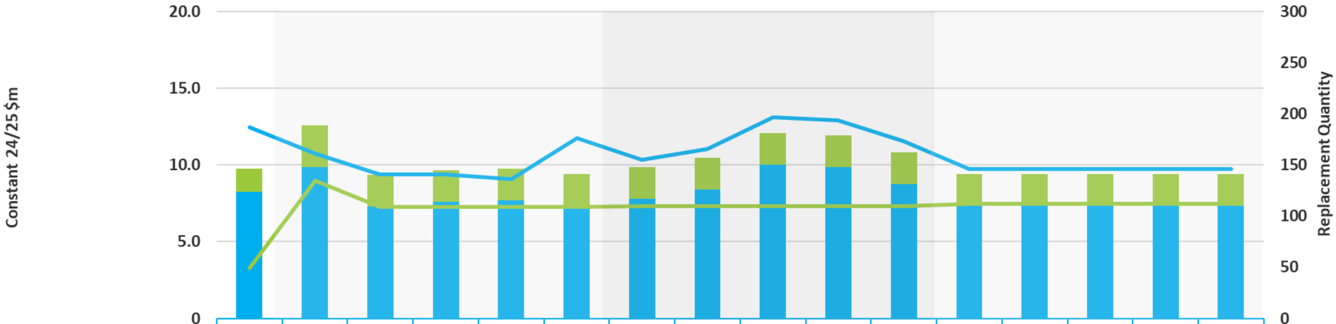
Figure 103 shows the grillage foundation forecast. This consists of CoG refurbishments and CP installations. Overall, the grillage refurbishment profile remains stable, with a similar mix of CP and CoG each year, which is expected to maintain the asset health and risk profile for these assets.

Figure 103: Grillage forecast capex and quantities



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Resilience	1.1	1.0	10.5	8.5	8.5	7.4	3.2	3.2	3.2	3.2	3.2	3.3	3.3	3.3	3.3	3.3
Marine foundation strengthening	9.6	13.1	5.1	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
New foundations	0.3	0.1	0.1	0.0	0.0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Slope Stability and River Piling	9.2	2.2	1.8	1.4	1.4	1.4	1.6	1.6	1.6	1.6	1.6	1.4	1.4	1.4	1.4	1.4
New foundations qty	4	1	1	2	0	0	2	2	2	2	2	2	2	2	2	2
Slope Stability and River Piling qty	11	8	11	10	10	10	10	10	10	10	10	8	8	8	8	8
Marine foundation strengthen qty	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure 102: Foundation forecast capex and quantities



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Cathodic protection	1.5	2.7	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
Concrete over grillage	8.2	9.9	7.3	7.6	7.7	7.3	7.8	8.4	10.0	9.9	8.8	7.3	7.3	7.3	7.3	7.3
Concrete over grillage qty	187	161	141	141	136	176	155	166	197	194	173	146	146	146	146	146
Cathodic protection qty	49	135	109	109	109	109	110	110	110	110	110	112	112	112	112	112

Accessways

Accessways provide routes to our transmission lines and structures from readily accessible areas such as local roads to more remote locations via private or public land. They are critical in enabling us to quickly and safely respond to faults or events on our transmission lines.

They consist of sealed and unsealed roads, spur tracks, walking tracks and unformed accessways (pasture). Accessways are typically owned by landowners and not Transpower. They often include watercrossing structures such as bridges, culverts, and fords, many of which were designed and built by private landowners.

Asset class snapshot

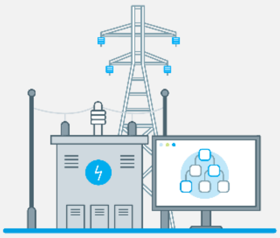
Population

15,668km Access tracks

631 Bridges

4,798 Culverts

610 Fords



Capex

RCP4 (forecast)

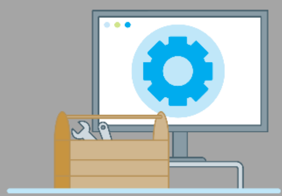
$12.5m

Condition

Pre-work inspections of accessways are undertaken to identify any immediate safety concerns and suitability for use.

Work programme (RCP4)

Management of access tracks, bridges, culverts, and fords.



Asset class strategy

Objective

Meet the safety and accessibility targets and to maintain and operate the grid at least lifecycle cost.

Asset strategy

Manage existing accessway assets at least lifecycle cost and develop better knowledge of our assets to enable cost-effective management. This includes management of access tracks, bridges, culverts, and fords.

Investment need is primarily based on bridges and large culverts where the water-crossing has been identified as requiring safety enhancements or upgrades to meet requirement use. Prudent investment is necessary to ensure that safe access is available to all of our transmission structures for maintenance and emergency work. Options considered for accessways are either repair, refurbishment, or replacement. Options are evaluated based on expert engineering advice, economic assessment, any alternative access that might be available, future works, pre-existing agreements with landowners, and the transmission structures to which the water-crossing provides access.

Table 27 shows our accessways population.

Table 27: Accessway Population

Asset type	Population
Access track length (km)	15,668
Total number of bridges	631
Total number of culverts	4,798
Total number of fords	610

Lifecycle – deliver, operate, maintain, decommission and disposal

Delivery time for accessway projects is typically 2 years, with the first year being used for scoping, optioneering, design, archaeological assessment and consenting. The second year is for the construction. This 2-year approach reduces delivery risk, increases cost certainty at time of construction and ensures sufficient time is allowed for design and consenting.

In addition to the regular transmission line patrols, inspections, and CAs, we undertake special earthquake or flood inspections of our accessways immediately following a significant earthquake or flood. Typical maintenance activities triggered from regular or special inspections include clearance of slips, water table maintenance, and grading of tracks.

As the majority of accessways are not owned by Transpower, it is rare for an accessway asset to be decommissioned. In most cases where the accessway is no longer required, with the landowner's agreement it will be left for their use and for them to maintain in the future.

Asset risk – health and performance

We do not have an asset health model for accessways. Asset health and remaining life for our water-crossings are based on inspections from chartered professional engineers with bridge experience.

Accessways deteriorate through use, the climatic conditions, and the varying environmental factors in which they are situated, and because of natural hazard events.

Pre-work inspections of accessways are undertaken to identify any immediate safety concerns and suitability for use. Our service provider contacts the landowner to confirm the most appropriate access on the day and will inspect the accessway that the landowner has suggested to confirm suitability or advise any remediation that is required.

The predominant causes of failure relate to access track wear over time, extreme weather, environmental factors, and natural disaster. The three key preventive controls that are critical to reducing the likelihood of a failure event are conducting routine patrols and inspections, pre-works walkovers, and planning.

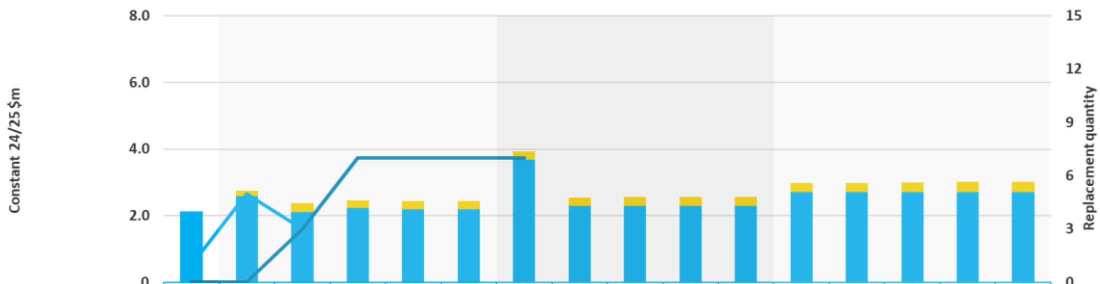
Forecast work and capex

Opex: The total opex forecast is an increase from the current expenditure levels as current expenditure levels are not meeting the general maintenance requirements and we are seeing an increase in accessway defects. An increased frequency and intensity of weather events is also resulting in the need for more accessway maintenance.

Capex: We are planning an increase in expenditure when compared with historical volumes of work. This change is based on inspections, in particular the recommendations from the 3-yearly water-crossing inspections undertaken by chartered engineers. The forecasted expenditure for RCP4, RCP5, and RCP6 is shown in Figure 104.

The actual costs for bridge refurbishment or replacement are highly variable and depends on the span, the soil type, the height above the waterway, how remote the water-crossing is, etc. Typically, if the watercrossing or accessway upgrade is required for a major project, then the replacement or refurbishment will be undertaken as part of the project.

Figure 104: Accessways forecast capex and quantities by year



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Resilience	0.0	0.2	0.3	0.2	0.2	0.3	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Accessways	2.1	2.6	2.1	2.2	2.2	2.2	3.7	2.3	2.3	2.3	2.3	2.7	2.7	2.7	2.7	2.7
Bridge replacements	1	5	3	7	7	7	7									
New Track	0	0	3	7	7	7	7									

HVDC

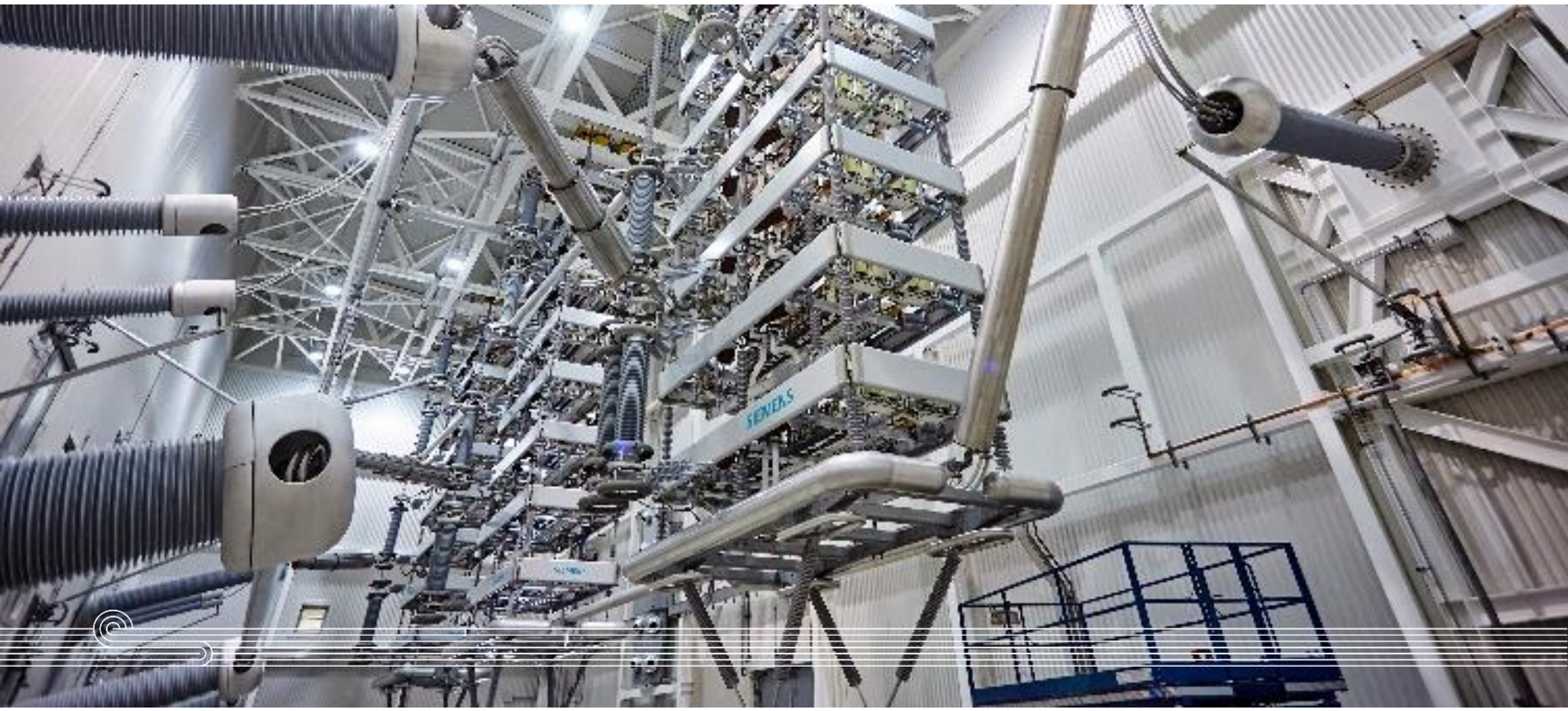
The HVDC system provides a high-capacity connection between the North Island and South Island electricity systems, providing energy security through the ability to access South Island renewable generation as well as enabling the operation of an efficient national electricity market. It also provides dynamic energy transfer response and frequency-keeping services that benefit the electricity market through considerably reduced frequency keeping and reserve costs. The HVDC system is expected to play a key role in compensating for intermittent renewable generation and load patterns going forward. As such the role and service criticality it plays in connecting New Zealanders will evolve along with electrification.

The HVDC system comprises of Pole 2 commissioned in 1992 and Pole 3 commissioned in 2013 with both based on thyristor valve technology. There are converter stations at Haywards and Benmore, cable stations at Fighting Bay and Oteranga Bay, electrode stations at Te Hikowhenua and Bog Roy, three submarine cables that cross the Cook Strait (38km per cable), and an overhead transmission line that connects Hayward to Oteranga Bay and Fighting Bay to Benmore. HVDC converters are used for converting alternating current (AC) to direct current (DC) which is then transmitted through HVDC overhead lines and cables into the other station, where the current is converted back to AC from DC.

Electrode stations are used to inject or extract DC current between two poles to remote earth/sea electrodes. They facilitate the operation of Pole 2 and Pole 3 with unbalanced currents, or with one pole out of service. Earth return removes the need for another set of conductors between Haywards and Benmore, thus reducing the initial capital cost of the system, maintenance costs, as well as system losses by providing a low resistance current path.

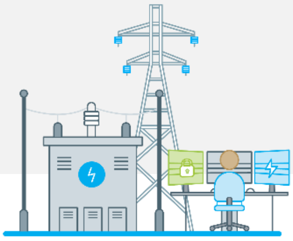
Each converter station consists of many AC and DC assets with some that are unique to the HVDC systems. There are circuit breakers, voltage and current transformers, power transformers including HVDC converter transformers, thyristor valves, valve cooling systems, redundant control systems, fire protection systems, mechanical ventilation systems, LVAC and DC distribution systems, HVDC harmonic filter banks and other reactive plant, and many other substation assets.

The TransGO telecommunications network supports the HVDC protection and SCADA communications service. The planned TransGO upgrade will consider the requirements of these services and will incorporate their modernisation as part of the network refresh. The local IP Network equipment used by HVDC and other Power Electronic systems will be lifecycle managed as part of the wider recurring lifecycle investment. The PI suite of systems is used for monitoring the condition of the HVDC rotating assets and for analysing trends and operational data which is a key input into our forward work planning and indicating asset health.



Asset class snapshot

Population
2 Converter stations
2 Electrode stations
2 Cable stations
3 Subsea cables



Asset health

Converter Transformer - 100% Good
Thyristor Valve Hall - 100% Good
Subsea Cable - 100% Good

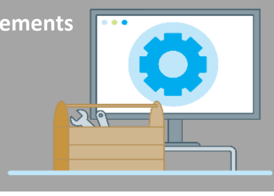
Capex
RCP4 (Forecast)
$79.3m

Work programme (RCP4 and RCP5)

Complete Pole 2 era mid-life refurbishment

HVDC cables & cable station replacements

Control system replacement



Asset Class Strategy

Objective
Our HVDC system is operated safely and reliably, at least lifecycle cost.

Measure:
Annual bi-pole availability greater than 98% for RCP4¸ excluding allowances and exclusions agreed by the Commerce Commission.

Asset Strategy

- Minimise risks to the environment from the operation of HVDC assets.
- Annual bi-pole capacity availability greater than the Transpower-individual price-quality-path-determination AP1 target, with target being 98% for RCP4¸excluding allowances and exclusions agreed by the Commerce Commission.
- Support the transition to more renewables and increased resilience requirements

The HVDC system forms a critical part of the Aotearoa New Zealand transmission system. The asset components that collectively make up the HVDC system are diverse, experience different environmental operating conditions and redundancy levels, and have different expected lives. Compared with their AC counterparts, the majority of our HVDC assets have been specifically customised and designed for our operating conditions and environment. The specialist nature of the HVDC requires specialist international expertise, specifically designed assets to meet local requirements, type testing, and early supplier engagement.

Our current proposed HVDC Link Upgrade Programme consultation scenarios demonstrates a continuing need for HVDC capacity [18]between the North and South Islands, with increasing use of South Island hydro to firm North Island intermittent generation.

Our expectation is that with higher demands on HVDC capacity, the availability of outage windows for lifecycle and life extension work on the HVDC system will be materially reduced. Similarly, HVDC reliability expectations will continue to increase. Our asset management accounts for these effects, including the phasing and packaging of the proposed work.

Our investment planning is based on achieving a 50-year operational life from each HVDC pole by undertaking necessary interventions at the correct times. Our life extension programmes will reduce the whole of-life costs by deferring expensive pole replacement by 20 years or more. Compared with reactive interventions, the life extension work reduces the risks associated with ageing assets in poorer condition and ensures the continued service levels expected by our customers. A Pole 2 and associated AC and HVDC assets (commissioned in 1992) life-extension programme is now under way, with a significant portion that has been delivered in RCP3 and now across RCP4. Our regular maintenance and other interventions supplement the life-extension plans.

Lifecycle – deliver, operate, maintain, decommission and disposal

Interventions for HVDC assets are individually scoped and priced based on asset health and other factors such as safety risks and obsolescence. They are scheduled according to need and resource

[18] https://www.transpower.co.nz/hvdc-upgrade

Table 28: HVDC condition monitoring and tests

Asset type	Measured condition parameters
Majority of HVDC assets	Visual inspections
	Unscheduled UV/Corona camera inspections
	Thermographic checks
Transformers including converter transformers	Dissolved Gas Analysis (DGA) – continuous online monitors and laboratory tests
	Tap changer operations count readings
	Electrical testing such as insulation resistance, power factor, polarisation index and capacitance test
	Unscheduled furans testing
Pole 2 & 3 Buildings	Pole 3 hasseismic event and deflection monitoring at Haywards. Both Pole buildings are checked after significant seismic events
Converter stations	Thyristor diagnostic inspections in line with manufacturers requirements + continuous monitoring by the control system
	Monitoring of water conductivity, electrode inspections, flow rates and pressure in valve cooling systems
	Secondary and auxiliary equipment monitoring such as self-check systems
Thyristor stack	Visual inspection of thyristor stacks
Filter bank circuit breakers	Circuit breaker operations count readings
	SF_6 gas pressure and quality – readings, quality checks, and low-pressure alarms
	Electrical testing such as insulation resistance and contact resistance tests
	Velocity plot – includes measuring timing of main contacts, closing/opening speeds and closing/opening damping tests
Cable stations	Bushing gas analysis
	Hydrophobicity testing of bushings
	Internal bushing gas pressure readings
Submarine cables	Line Resonance Analysis (LIRA)
	Dive spot checks and surveys
	Remotely operated vehicle surveys and checks
Cable Terminations	Oil Sampling to assess nitrogen contamination
Shore electrodes (THW)	Current sharing tests and resistance measurements
	Lift and clean electrodes of salt deposits
Land electrodes (BGR)	Current sharing tests and resistance measurements
	Resistance measurements
HVDC overhead lines	The maintenance of the HVDC and Earth electrode overhead lines are managed by the Transmission Lines portfolios

availability, while accounting for other work across all six sites. Many HVDC assets and systems have long lead times and can only be replaced during annual HVDC outages. The work requiring HVDC outages are planned to be delivered during the annual HVDC outage to ensure that the annual HVDC availability requirements can be met. Delivery times for larger HVDC projects account for detailed design, procurement, availability of specialised resources, outage planning, electricity market impacts, and coordination with other major works across the HVDC link. This is typically two to three years in duration. Some projects require highly skilled specialised engineering and service provider resources which are obtained through consultants, manufacturers, and service providers from other regions. Engineering support is normally provided internally by HVDC engineers. Due to the unique nature of our HVDC assets, active participation of HVDC engineers during delivery is necessary along with good documentation and training as part of close outs. It is important to ensure that our staff are

Major system component HVDC	Year commissioned	Life expectancy	Planned refurbishment & Cable Replacement	Expected end of life
HVDC Pole 2 converter stations	1992	50	~ RCP 3 & 4(underway)	2042
HVDC Pole 3 converter stations	2013	50	~ RCP 5 & 6	2063
Subsea Cable 4	1992	40	HVDC Link Upgrade Programme	2032
Subsea Cable 5	1992	40	HVDC Link Upgrade Programme	2032
Subsea Cable 6	1992	40	HVDC Link Upgrade Programme	2032
HVDC Control System	2013	20	HVDC Link Upgrade Programme	2033

Table 29: HVDC major component life expectancy

well trained to operate and maintain the new assets delivered through the project.

We generally plan HVDC outages in summer when the HVDC demand is lowest. Good planning and preparation is required and is undertaken with the industry to ensure HVDC work can be completed without major system impacts.

Regular condition assessments of our HVDC assets are undertaken in accordance with technical specifications. There are online-monitoring systems which enable us to monitor the condition of HVDC assets in near real time. There are several interval-based visual inspections. Table 28 outlines the condition assessments we undertake for HVDC equipment.

Most HVDC assets require special maintenance tasks prescribed by original equipment manufacturers. We also seek feedback from the international HVDC operator community. This information is reflected in our standard maintenance procedures. The majority of the HVDC maintenance work is carried out during the annual maintenance outage.

The maintenance of the HVDC line is covered under Transmission Lines portfolios. In general, HVDC assets require less opex, other than routine maintenance and some predictive maintenance works. The system criticality of the HVDC system demands a highly reliable HVDC system. Replacements, refurbishments and more frequent routine maintenance generally address these requirements.

Our maintenance activities for the HVDC system include activities such as:

- corrosion and defect repairs on primary equipment (i.e. maintenance of converter transformer tap changers, cooling fans, motors, etc.)
- land and shore electrode maintenance
- building maintenance activities such as roof, air conditioning and guttering repairs
- replacement or refurbishment of consumables and high-wear components and parts
- cleaning and water blasting of insulating material.

Where possible and useful, we donate retired equipment to education institutions. We recycle as much of the equipment as possible.

Asset risk – health and performance

HVDC assets that fit within our wider asset classes such as the HVDC line, circuit breakers, instrument transformers, power transformers and filter banks are included within those existing asset health models. For example, health modelling for HVDC circuit breakers is included within the health model for AC outdoor circuit breakers.

Table 29 (below)provides a view of remaining life by major system component below.

At 12 years into their operational life, most Pole 3 assets are still in relatively good condition and can be reliably maintained with preventive and corrective maintenance.

We have developed an asset health model for HVDC cables that we update regularly when new data is available, which incorporates ageing calculations, annual inspection results and test results to estimate the remaining life of the submarine cables. The current output of the asset health model is in alignment with the 40 year expected operational life of the cables. Figure 105 shows our asset health modelling indicates that the cables are currently in good condition. However, according to our inspections and asset health data, these cables will reach the end of their operational life around 2032. (this aligns with their design life). Extending their life beyond this date significantly raises the risk of failure, which could disrupt HVDC operations and compromise electricity supply, particularly during dry years when South Island hydro generation supports North Island demand.

There are also significant synergies in replacing/upgrading the cables as a single campaign due to manufacturing, transport, and installation costs., this is the approach with our current proposed HVDC Link Upgrade Programme.

Electrode stations and related assets are in good condition. Due to their dynamic operating environment, asset health modelling is not practical for HVDC electrodes. Factors such as electrode line current, direction of the HVDC flow, resistivity of the surrounding area, and weather events affect the degradation of electrodes.

Figure 106: HVDC Risk Bowtie

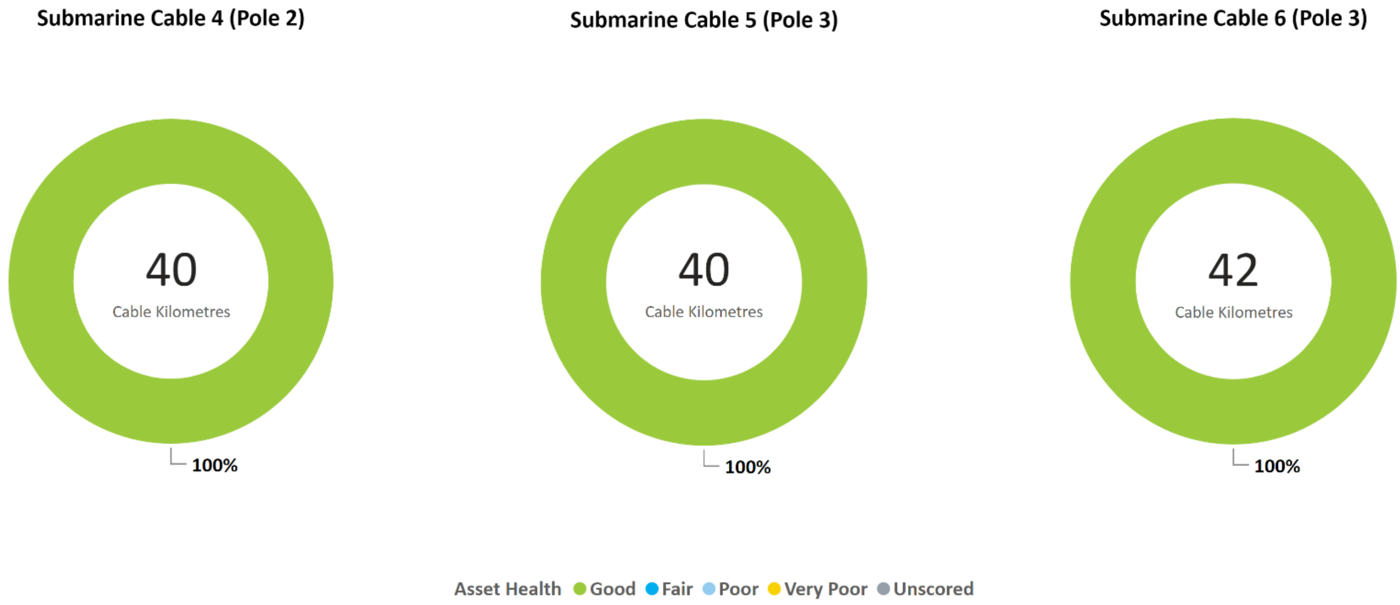


Figure 105: HVDC cable current asset health

Our HVDC Converter Station consolidated simplified bow-tie as shown in Figure 2 informs us of the most likely causes of failure, along with the most likely resulting consequences of the failure.

The predominant causes for HVDC system failures are functional failures such as control system issues or auxiliary system failures, overheating, corrosion and material degradation, electrical failures such as insulation failures, mechanical failures, third-party activity close to assets, pests and vermin damage, and natural causes. The key preventative controls implemented to reduce the likelihood of failure event includes redundancy, lifecycle planning, monitoring, inspections and testing, quality assurance during the original installation, procurement specifications, maintenance activities, and staff and contractor competency management. Media and stakeholder engagement and regular patrolling of the cable protection zone are critical controls for managing the risk to Cook Strait submarine cables.

Our readiness plans for HVDC ensures we have an adequate level of emergency preparedness. This includes holding of emergency spares, tool and equipment, support agreements, and maintaining specialist contracts for short notice emergency work.

Cable stations require ongoing refurbishment work to ensure their reliable operation with the associated cable seal ends housed within these stations, until they are replaced with the proposed HVDC Link Upgrade Programme.

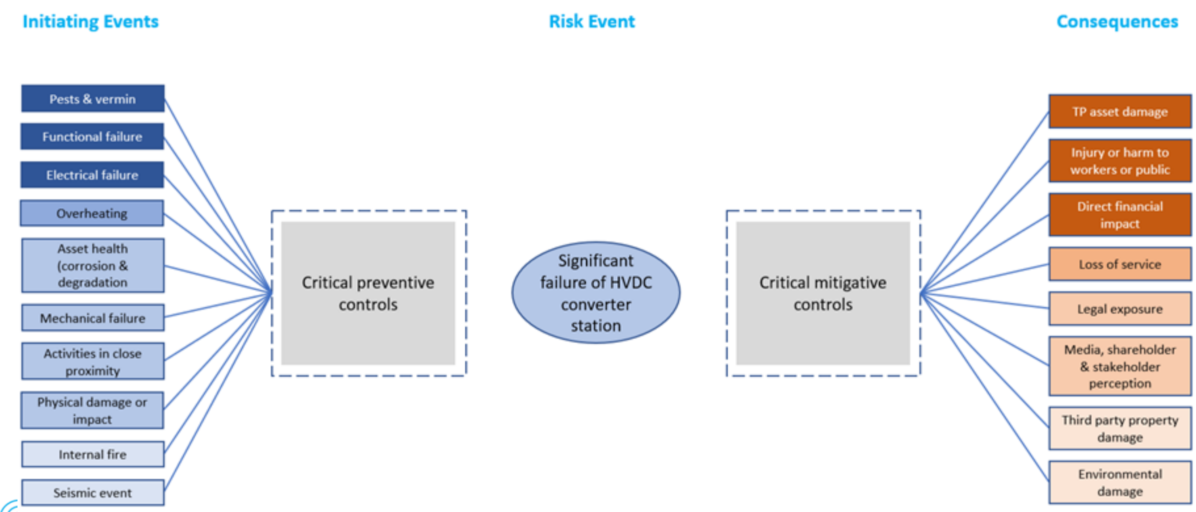
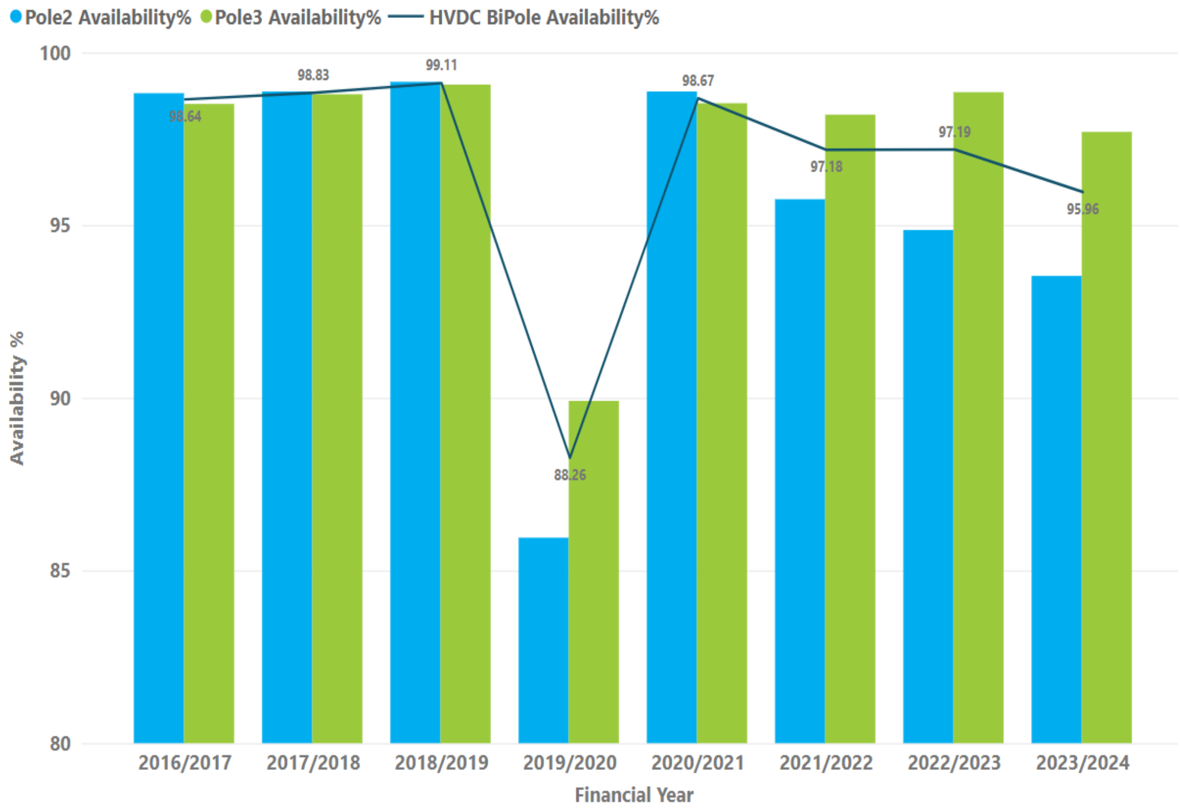


Figure 107: HVDC performance



Maintenance requirements associated with AC assets also apply to inspections and testing, quality assurance during the original installation, procurement specifications, maintenance activities and staff and contractor competency management. Media and stakeholder engagement and regular patrolling of the cable protection zone are critical controls for managing the risk to Cook Strait submarine cables. The availability of the HVDC link varies from year to year, due to the number and length of planned and forced outages. Overall, the HVDC link has achieved world-class levels of availability since it was commissioned. shows the annual availability of the HVDC link since 2015. The reduced availability across a)2019/20 is due to HVDC line reconductoring during February 2020 and b) 2021/24 is due to Pole 2 life extension work, extended outages.

Pole 2 life extension work aims to maintain the high availability target of 98% going forward into RCP4 and beyond. Without this life extension work, the probability of forced outages per annum exceeding the 0.25% target would increase significantly with the ageing of Pole 2 era assets. This life extension work will also defer the more costly replacement of Pole 2.

Forecast work and capex expenditure

Opex: The majority of the opex forecast covers HVDC cable surveillance and operational support. General testing and maintenance requirements associated with AC assets also apply to many HVDC assets. Refurbishments and major interventions on most HVDC assets are not feasible or cost effective. A failure of the HVDC system will affect the entire network rather than a small region or a site. Similarly, there is only one annual outage which is used for maintenance and capex work. Therefore, replacements are often necessary to maintain the required level of availability and reliability.

Opex projects such as investigation projects, condition assessments, refurbishment of tap changers and reactors are planned for condition improvement of assets. The opex expenditure is covered in detail in the Maintenance Asset Class Plan.

Capex: RCP4 expenditure covers the continuation of Pole 2 mid-life refurbishment programme after the refurbishment of the more significant assets in RCP3. We anticipate that the increased cost of procuring specialist HVDC plant due to increased worldwide demand, will lead to additional expenditure beyond what we have estimated in RCP4. To manage overall expenditure, we will prioritise our RCP4 workplan following detailed condition assessment and defer less urgent interventions into RCP5.

A significant portion of the Pole 2 life extension programme has been delivered in RCP3. The replacement of the remainder of Pole 2 era primary AC assets such as interventions to reactive support plant, addressing obsolescence issues, refurbishment of remaining auxiliary systems, interventions to some Pole 3 era assets and systems such as the communication and fire systems are planned for RCP4.

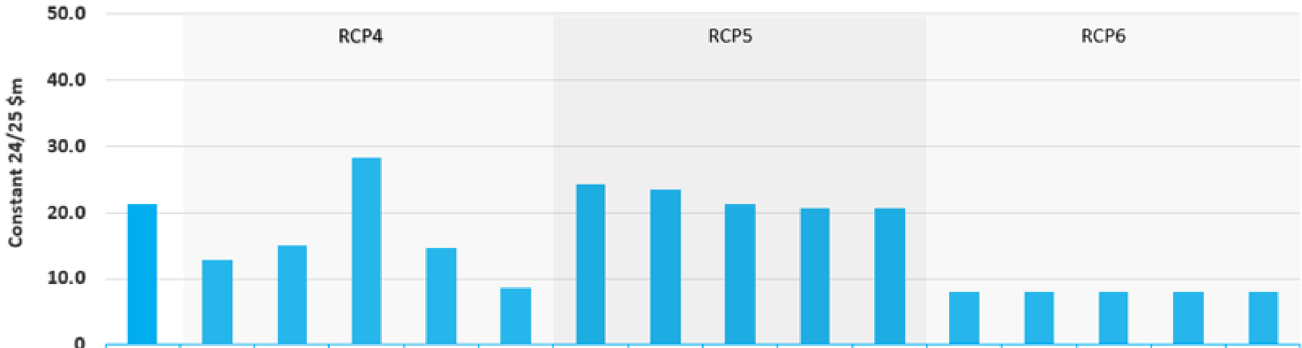
As Pole 2 interventions revert to routine minor work following the life extension programme, major interventions to Pole 3 era assets and secondary systems will commence in RCP5 and will continue across RCP6.

In RCP5, the following work is planned as part of the proposed HVDC Link Upgrade Programme:

- Undersea cable supply and install (1400MW)
- Cable Termination station upgrades
- HVDC control system replacement
- Benmore filter bank upgrade
- Pole 2 overload scheme
- Cable storage facility
- Recovery of decommissioned cables

Figure 4 shows the HVDC capex forecast until RCP6.

Figure 108: HVDC forecast capex, excluding any HVDC link upgrade programme expenditure



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
HVDC	21.2	12.8	14.9	28.2	14.7	8.6	24.3	23.5	21.3	20.7	20.7	8.1	8.1	8.1	8.1	8.1

Reactive assets

Our reactive assets incorporate:

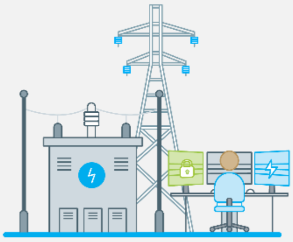
- Synchronous condensers
- SVCs and STATCOMs
- Capacitor banks and reactors

We use switched capacitor banks and reactors to provide most of the reactive power support required for the network. To ensure stability under transient or abnormal conditions, the system also requires fast-acting sources of dynamic reactive power. This is provided by the synchronous condensers, SVCs, and STATCOMs.

Asset class snapshot

Population

395 Reactors
65 Capacitor banks
8 Synchronous condensers
9 STATCOMs
3 SVCs



Capex

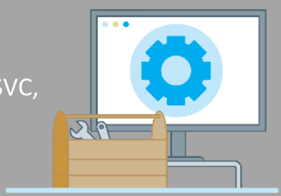
RCP4 (Forecast)
$91.3m

Reactor asset health 2025

- 84.8% Good
- 11.7% Fair
- 1.4% Poor
- 1.6% Very Poor

Work programme (RCP4)

Capacitor bank replacements, SVC, STATCOMs and synchronous condensers 'refurbishments.



Asset class strategy

Objective
Safe and reliable operation, at least whole-of-life cost.

Measures

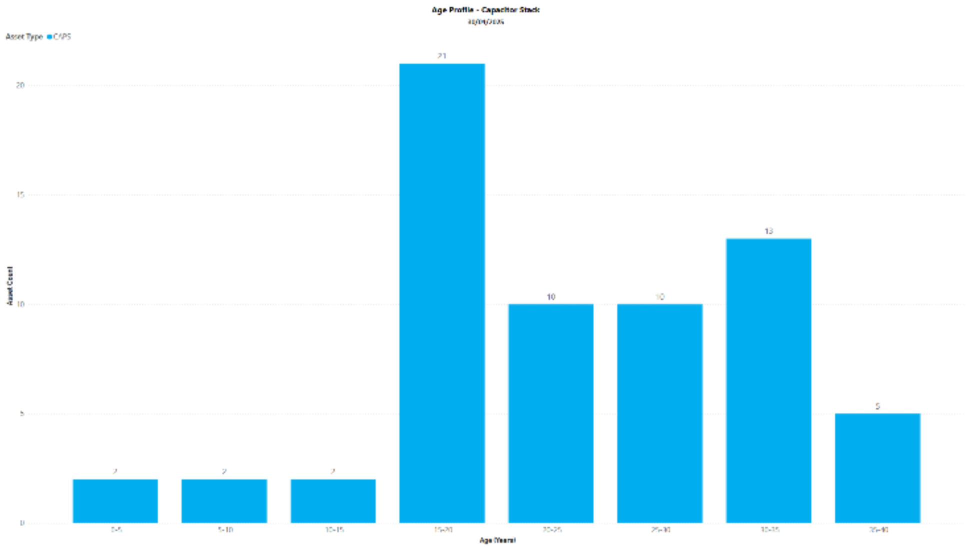
- Fewer than 10 unplanned outages per year caused by capacitor banks and their components at lowest lifecycle cost.
- 98 percent or better availability of SVCs and STATCOMs and fewer than three forced and fault outages each year from each SVC or STATCOM.
- Five-year average annual availability greater than 91.0 per cent for each Haywards synchronous condenser, including planned unavailability of 5.7 per cent or less and unplanned unavailability of 3.5 per cent or less.

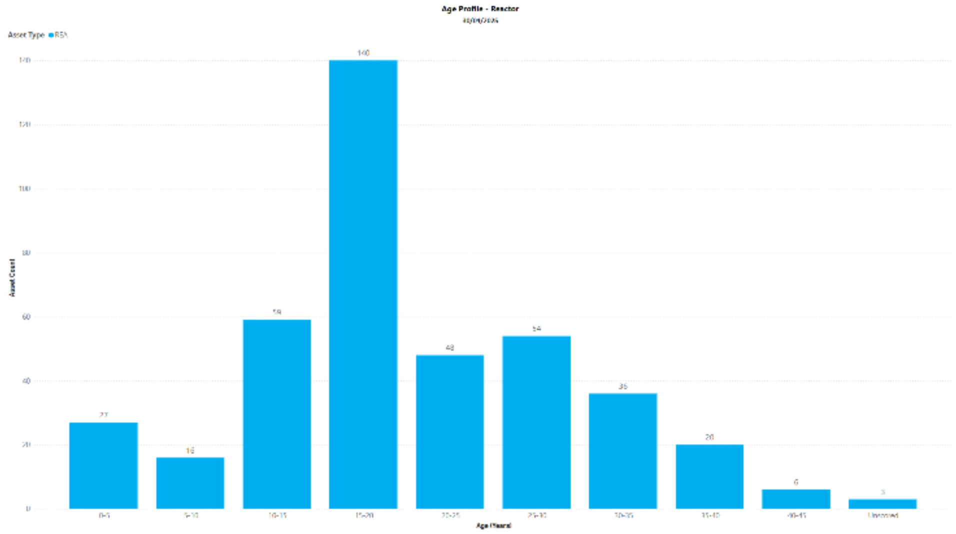
Asset strategy

- Replace capacitor banks and reactors when they satisfy replacement criteria and refurbish capacitor banks and reactors to extend their lives where they are not replaced.
- Undertake half-life refurbishments on SVCs and STATCOMs (typically 20 years) to ensure that the main plant can achieve reliable operation until the end of its engineering life.
- Undertake major overhauls to extend the life of the synchronous condenser main units, typically at 15- to 20-year intervals, or based on condition.

The population and age profiles of our reactive assets are shown in **Figure 109**.

Figure 109: Reactive assets population and age profiles


Age Profile - Capacitor Stack
Asset Type CAPS
Asset Count
Age (Years)


Age Profile - Reactor
Asset Count
Age (Years)

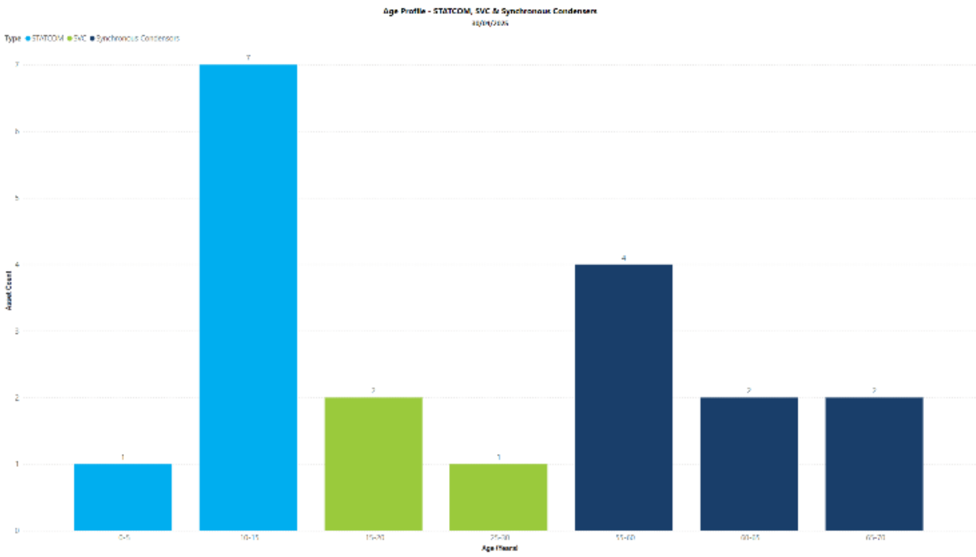
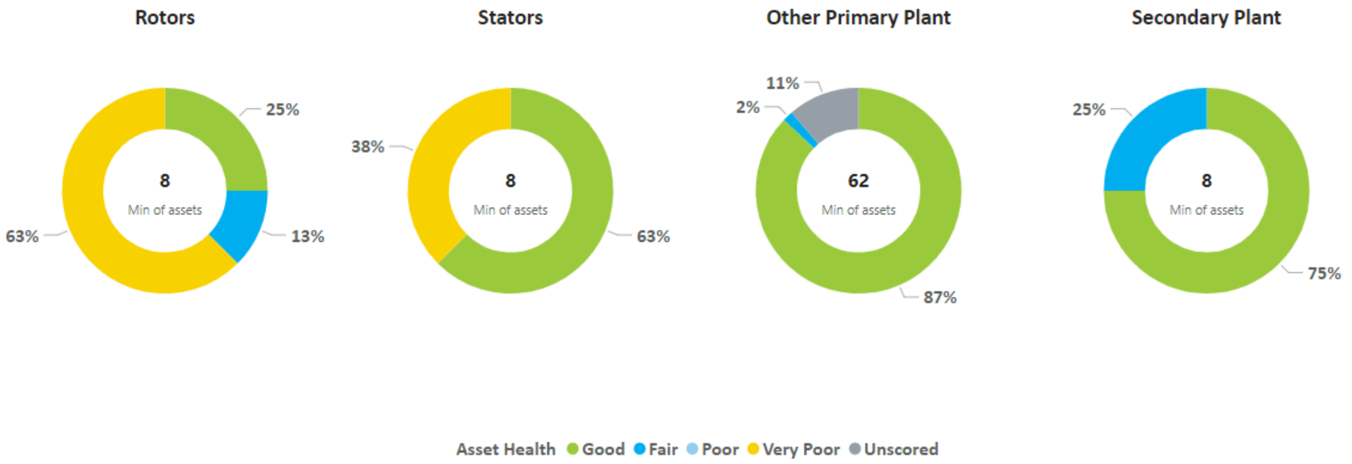

Age Profile - STATCOM, SVC & Synchronous Condensers
Type STATCOM SVC Synchronous Condensers
Asset Count
Age (Years)

Figure 110: Synchronous condenser current asset health



Investment need is primarily based on addressing capacitor can failures on ageing and deteriorating capacitor banks, addressing obsolescence and high risk of failure due to ageing of control systems, and improving synchronous condenser availability as well as minimising the risk of failures, addressing control and auxiliary system assets reaching end of life, and undertaking life-extension work on reactors.

The portfolio is arranged round the provision of reactive support to the network rather than a single asset type. As well as the portfolio-specific assets (e.g. synchronous condenser machines), there are many other components within the reactive device that are the same as those in other portfolios. For these items, we follow the strategies and maintenance methods of the main portfolio.

We consider the replacement of whole reactive devices when planning major works on individual assets to ensure that we balance the overall continuing need for the plant. This includes costs for partial replacement and the increased maintenance costs towards end of life with the capital cost for a complete replacement of the whole plant.

The forecast greater reliance on grid infrastructure with electrification increases the need for reliable reactive equipment. To support voltage stability, reactive power controllers are needed to manage these assets, power quality monitoring and maintaining voltage within the Electricity Industry Participation Code requirements. SCADA ensures this equipment can be monitored and data retrieved, controlled, and managed by the System Operator.

The PI suite of systems is used for monitoring the assets, including the health of the capacitor banks and our telecommunications equipment such as switches and terminal servers for the SVCs and STATCOM assets.

Lifecycle – deliver, operate, maintain, decommission, and disposal

Delivery times for reactive power assets include allowance for detailed design, procurement, outage planning, and coordination with other major works at the site. It typically takes 1-2 years to complete this work and can be much longer (>5 years) for larger programmes.

We plan and manage outages in a way that creates a safe environment for employees while minimising the disruption for customers.

Dynamic reactive power assets require specialised maintenance to be carried out during the warranty period. These requirements along with operation experience during the warranty period form the basis of standard maintenance practices following the warranty period.

We have online monitoring systems that monitor the condition of key assets in real time. We also undertake visual inspections and thermo-vision inspections for early detection of potential issues.

Synchronous condenser can include visual and thermal inspections as well as electrical, mechanical, bearing oil, and gas tests, at 3-monthly, yearly, 2-yearly and 4-yearly equipment service intervals. We have installed several smart monitoring systems to continuously monitor the condition of the synchronous condensers. We carry out internal inspections of the synchronous condensers 4-yearly to ensure reliable operation by identifying issues in advance.

Capacitors and reactors have 4-yearly (HVDC assets) or 5-yearly (HVAC assets) electrical testing and inspections to monitor signs of corrosion, paint peeling, leaks, loose terminations, or physical deformation. These issues are addressed as part of our maintenance activities.

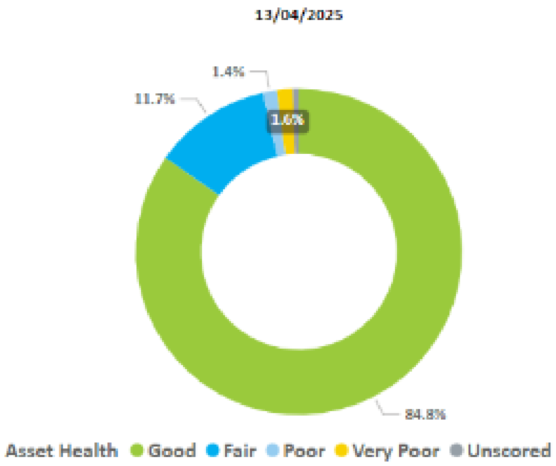
For most of our STATCOM installations, CA is still carried out as part of the warranty reporting process. Detailed service specifications and standard maintenance procedures have been developed for for SVCs and STATCOMs, and more are planned to reflect what we have learned about these relatively new assets during the inspections completed to date.

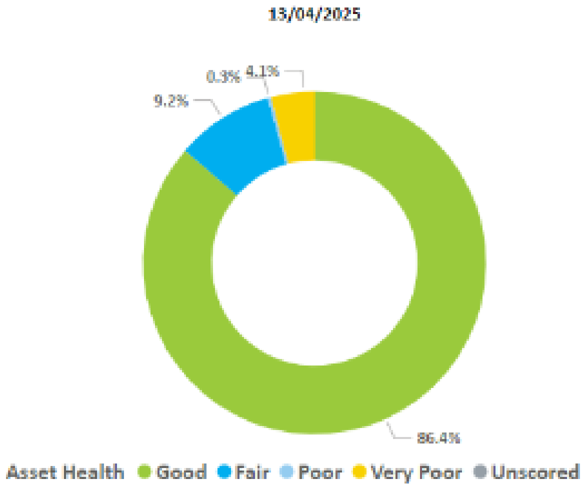
Disposal of used capacitor cans and other oil-filled assets follow our standard protocols.

Asset risk – health and performance

Figure 110 and Figure 111 show the current health of our synchronous condensers and reactive capacitors.

Figure 111: Reactor and capacitor current asset health





The predominant causes for reactive and synchronous condenser asset failure are:

- Corrosion and degradation of electrical insulation, protective paintwork, hydrogen pipe work, hydraulic systems, auxiliary system components, seals, and connections leading to a loss of service Mechanical failures of components such as rotors, motors, cooling systems, racks, reactors, switches, etc., causing loss of service
- Electrical failures such as insulation degradation due to ageing or overloading, failure of electrical components, or electrical faults leading to loss of service
- Functional failure such as software failure, malfunctioning, configuration issues of control system software and/or auxiliary systems that could lead to major failures depending on the failure mode.

The combined likelihood of electrical, mechanical, and functional failure increases relative to the age and condition of the asset.

The key preventive controls critical to reducing the likelihood of a failure event are:

- routine inspection, maintenance, testing, and treatment
- operating environment and temperature control
- alarms and monitoring.

Forecast work and capex

Figure 112 shows the capex forecast.

Several of the oldest capacitor banks are at end of life and will be replaced in RCP4.

To support the current 1200MW HVDC capacity requires all eight existing synchronous condensers and the STATCOM at Haywards in service. A reduction in the available synchronous condensers can have an impact on the HVDC transfer and the operation of the electricity market. Our recent Net Zero Grid Pathway scenarios demonstrates a continuing and growing need for HVDC capacity between the North and South Islands. This requires the associated availability of the synchronous condensers to support higher HVDC transfer levels to firm North Island intermittent generation. As part of the Net Zero Grid Pathway 1.1 programme, a new second STATCOM is to be installed at Haywards, to increase the availability of reactive equipment, that support the current maximum HVDC transfer level of 1200MW.

We are planning to perform major refurbishments on the synchronous condensers and their auxiliary systems between 2025 and 2030. At this time, it will then be ~20 years since the last major refurbishment occurred. This work is supported by the associated health model and is to ensure they have a high availability and that these units remain operational until at least 2042 when Pole 2 is forecast for replacement at which point, we will review the need to retain them.

The scope of these interventions is difficult to fully assess while the synchronous condensers remain in operation. To manage this risk, we have performed an invasive scoping investigation to better understand the scope and costs of the refurbishment work.

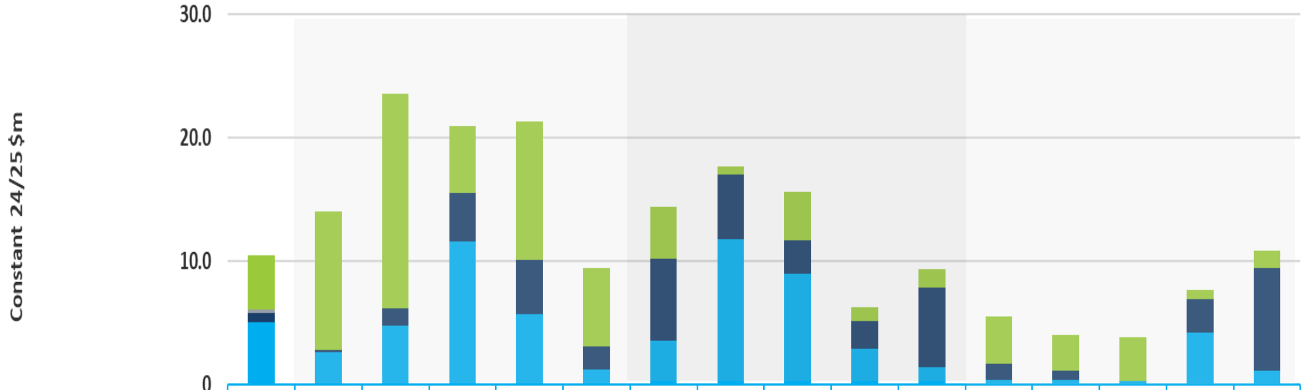
We are investigating what is needed to bring the Synchronous Condenser hydrogen systems up to modern standards, for process safety requirements where flammable gasses are present.

We have performed a mid-life refurbishments of one SVC assets during RCP3 and are at the final scoping stage for the second SVC starting early in RCP4 and we are expecting to refurbish the third SVC during RCP5.

We have an ongoing expenditure of replacement of auxiliary systems such as batteries and chargers when they meet the replacement criteria in the associated asset strategies.

There are only a small number of qualified suppliers of dynamic reactive equipment. We are seeing that, as the worldwide demand for reactive equipment increases with renewable investment, the price for such equipment is currently increasing ahead of inflation. This is lifting the cost of asset investments, replacements, and components, as well as increasing the procurement lead times.

Figure 112: Reactive assets forecast capex and quantities



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
HVDC Synch Condensers	4.4	11.3	17.4	5.4	11.2	6.4	4.2	0.7	3.9	1.1	1.5	3.8	2.9	3.5	0.7	1.4
ACS Reactive Power	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ACS Capacitors & Reactors	0.8	0.2	1.4	4.0	4.4	1.9	6.7	5.2	2.7	2.2	6.5	1.3	0.8	0.1	2.7	8.3
ACS Dynamic Reactive Power	5.0	2.6	4.8	11.5	5.7	1.2	3.5	11.8	9.0	2.9	1.3	0.4	0.4	0.2	4.2	1.1

Secondary Assets

Our secondary assets support the overall operation of the grid and provide essential services for the monitoring and control of equipment. The Secondary Assets Portfolio is covered by four asset classes:

- Substation management systems
- Protection schemes
- Revenue meters
- Station DC supplies.

Substation Management Systems (SMS)

SMS refers to the systems that enable real-time monitoring and remote control of the equipment at our substations. These telemetry and control systems are based on specialised electronics that have been specifically designed to operate in harsh substation environments. They communicate directly with Transpower's SCADA/energy management system (EMS) and therefore SMS reliability is essential to maintaining visibility and control of the power system.

Our main programme of work focuses on phasing out legacy serial-based RTU and input/output modules and replacing these with new ethernet-capable substation management platform systems. This new technology also includes remote engineering access (which allows us to interrogate and manage secondary systems without needing to be on site) and human-machine interface (HIM) capabilities (which provide local situational awareness and direct control over the site's assets). This body of work will be completed by the end of 2026.

We use a full SMS solution, as this approach leads to reduced lifecycle costs and provided the business benefits associated with remote engineering access services (quicker site restorations) through the ability to remotely work on devices reducing the need to travel to site. SMS implementation at all sites will be completed by 2026.

Protection

Protection schemes are used throughout the grid to rapidly detect and initiate isolation of electrical faults, protect primary equipment, and ensure the safety of employees, service providers and the public. As network loading increases, there will be more use of complex protection schemes to enable the management of the power system within stability limits, including management of over voltages, fast-acting load management, and reactive power control. These schemes are in turn dependent on additional protection-grade communications. Accordingly, the grid and Information Services and Technology (IST) teams have been working together to plan this need from RCP4 as the TransGO wide area network (WAN) is a critical enabler of technology solutions as covered above.

The useful life of protection schemes depends on the type of protection relays, i.e. typically 20-25 years for numerical or microprocessor-type relays and 35 years for electromechanical or static type relays. Included as part of protection schemes and re-used when protection is replaced, are ODJBs that marshal secondary cabling between the primary equipment in the outdoor switchyard and the protection equipment in the control and relay room.

The forecast is based on the replacement of all protection schemes at the end of their expected useful lives or aligned with replacement of primary plant, and installation of new protection schemes.

Revenue, local service and power quality meters

A metering system or scheme is a group of secondary system assets used for monitoring and recording system conditions on power systems.

Revenue meters supply electricity volume information and are used for wholesale market reconciliation and billing. Revenue meters are typically replaced at 12 years and this will be aligned to the 3-yearly maintenance cycle. Local service supply meters are installed to record the local service load that Transpower uses within a substation. Power quality meters are used to provide a baseline harmonic fingerprint prior to new non-linear generation connections proceeding.

The forecast is based on the replacement of all meters at the end of their expected useful lives.

Station DC systems

Station DC systems are required to provide power to protection schemes during normal operation and island-wide blackout scenarios, circuit breaker trip and close coils, control, and metering. Station DC batteries have a typical life that ranges from 8 to 12 years and the life of station DC chargers ranges from 20 to 30 years. Both 125V DC grid station batteries and ICT 48V DC communications, control, and indication batteries are needed to provide greater capacity and resilience for the System Operator black-start procedures to work. Therefore, both the grid and the IST teams have been working together to ensure planning and delivery targets of these batteries are aligned to ensure we have the necessary capability.

The number of station DC batteries, chargers and equipment coming due for replacement in RCP4 compared with RCP3 has decreased.

Consolidated simplified bow-tie

We have developed a simplified bow-tie describing a significant secondary asset failure event, as shown in Figure 31.

Figure 113: Significant secondary asset failure event simplified bow-tie

Our risk modelling has identified which preventive and mitigative controls are to be used to reduce the likelihood of a significant initiating risk event occurring on our secondary assets and to reduce the consequential impact of that event. We have used the bow-tie analysis to inform our procurement strategies and grid planning, including predictive modelling and strategic interventions to ensure we replace assets in a timely manner.

Our secondary ACPs advise the predominant likely causes of each asset class failure and the key controls that we have implemented to reduce the likelihood and resulting impact of a failure.

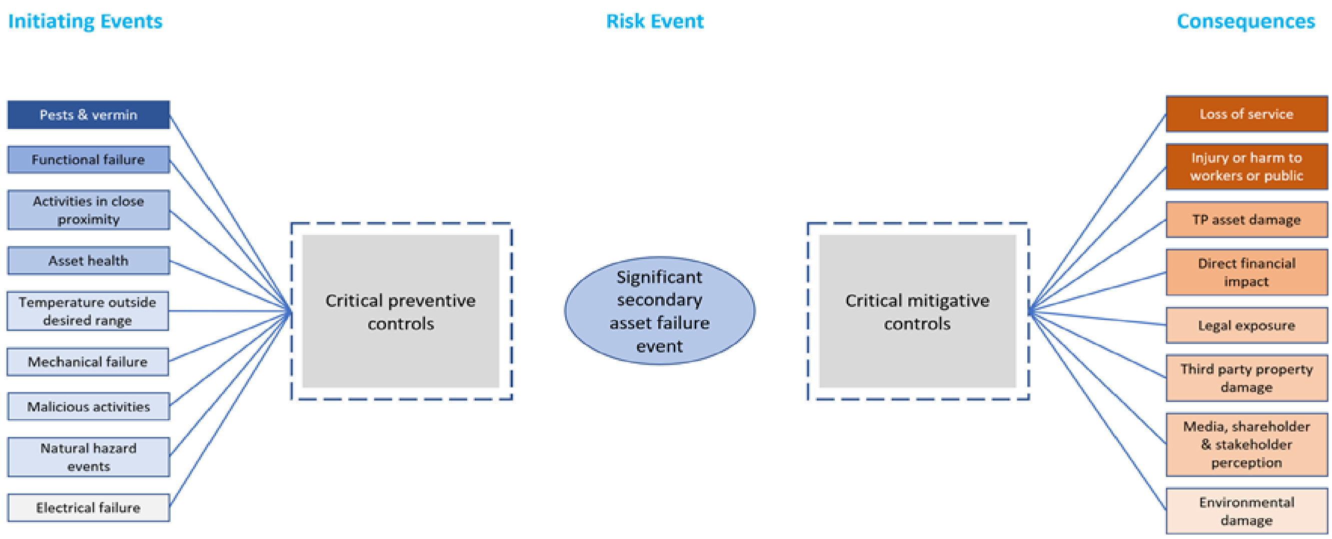
Technology dependencies between grid and IST assets

The grid asset technology has evolved over time to the point where the boundaries are intertwined with IST assets, requiring ongoing compatibility as assets are replaced and interface boundaries change. For example our RCP3 48V DC refresh programme in the Telecommunications, Network and Cybersecurity portfolio was to support the 125V DC grid black start carryover times required across the country. This refresh ensured that the network and secondary systems equipment connected to the 48v DC power supplies would still be provided with power during a localised power cut.

In RCP4, we are investigating the modernisation of our TransGO WAN assets in line with the TransGO Refresh sub-strategy. Our underlying fibre network will be retained while the telecommunications equipment supporting all of our services including our critical SCADA and HV line protection systems, will be modernised.

The TransGO network will have the capability of supporting the delivery of precision time services (based on PTPV2 IEE 1588) to help support our increased reliance on an accurate time source as we digitise our substations.

We will continue to invest in our corporate PI systems to support increased asset information and data from across our secondary assets for improved awareness of asset health and network risks, without impacting on our operational SCADA data sets.



Risks and uncertainties

The increasing use of complex protection schemes helps provide an interim solution to manage the time required before the investment in and commissioning of additional grid assets.

Complex protection schemes require greater protection grade communications. Therefore, both the grid and the ICT teams are working together to ensure planning and delivery targets of these systems are aligned to ensure we have the necessary capability.

There is an increasing use of ICT services in our substations, resulting in a growing level of sophistication, complexity, and potential operational threats that together the grid and IST teams have initiatives on. Our cybersecurity investment into operational technology (OT) protects our internet enabled devices (IEDs) from security breaches, which enables secure local then remote configuration of devices, password authentication, monitoring who has accessed devices, and active threat monitoring of devices on the substation local area network (LAN). The benefit of remote configuring is that it reduces the operational costs to maintain these assets, reduces our carbon footprint by avoiding travel to site, and provides a safer environment for our service providers.

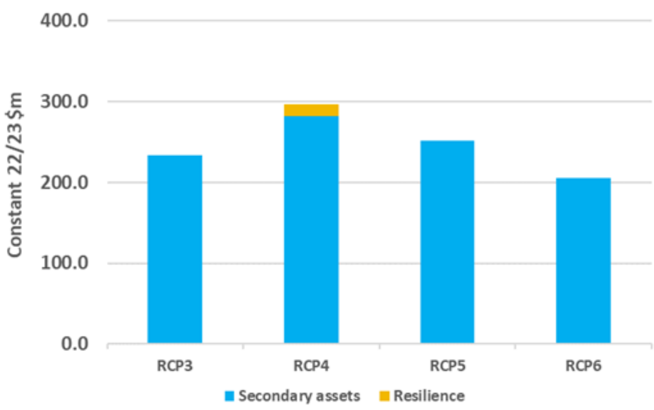
Other key uncertainties associated with this portfolio relate to 'brownfields' sites, which constitute the majority of the planned and unplanned work. Existing site legacy constraints and defects often require rectification before the deployment of deliverables can commence. The cost of such rectification is unique to each site and can impact significantly on the overall project cost, the scale of which is difficult to estimate in advance.

With the forecast electricity demand to meet Aotearoa New Zealand's de-carbonisation goals, the need for new substations continues to grow. To meet this need and provide benefits to our customer-funded investments, we now have a digital substation protection, automation, and control solution for greenfield substations. The next stages are to progress a solution for our existing brownfield sites, where we expect the solution to be cost neutral, avoid legacy issues as well as reducing inadvertent protection trips associated with testing and calibration. We currently have a wave of protection lifecycle replacements in the pipeline, so it is timely to make this change.

Expenditure forecast

Figure 114 shows the secondary assets capex in each RCP.

Figure 114: Secondary systems forecast capex



Asset class plans

The following sections describe in more detail our asset management approach for each of the asset classes. These ACPs describe the strategy, asset characteristics, management approach and expenditure profile for each asset class. The expenditure covers the capital requirements, along with any specific maintenance projects to be undertaken.

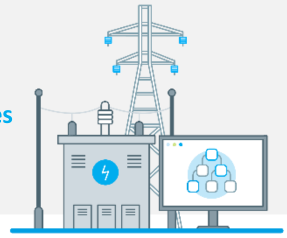
Protection

Protection schemes are used throughout the grid to rapidly detect and initiate isolation of electrical faults, protect primary equipment and ensure the safety of employees, service providers, and the public. As load increases, to fully utilise the grid there will be the addition of more complex protection schemes to increase capacity, an example of this is using special protection schemes (SPS) to enable greater power flow in the existing primary equipment. Their use can delay the need for more expensive solutions like installing new primary assets or replacing existing primary assets. Included as part of protection assets are ODJBs, which marshal secondary cabling between the primary equipment in the outdoor switchyard and the protection equipment in the control and relay room.

Asset class snapshot

Population

2,620 Protection schemes
1,583 Outdoor Junction Boxes



Capex protection and ODJB

RCP4 (forecast)

$265.7m

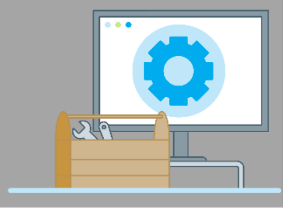
ODJB asset health

- 50.9% Good
- 16.8% Fair
- 10.5% Poor
- 16.6% Very Poor

Work programme (RCP4)

619 Protection schemes

284 ODJBs



Asset class strategy

Objective
Safe and reliable operation, at least lifecycle cost.

Measure
Number of protection technician human error incidents resulting in unplanned outage to be less than 10 per annum on a five-year rolling average.

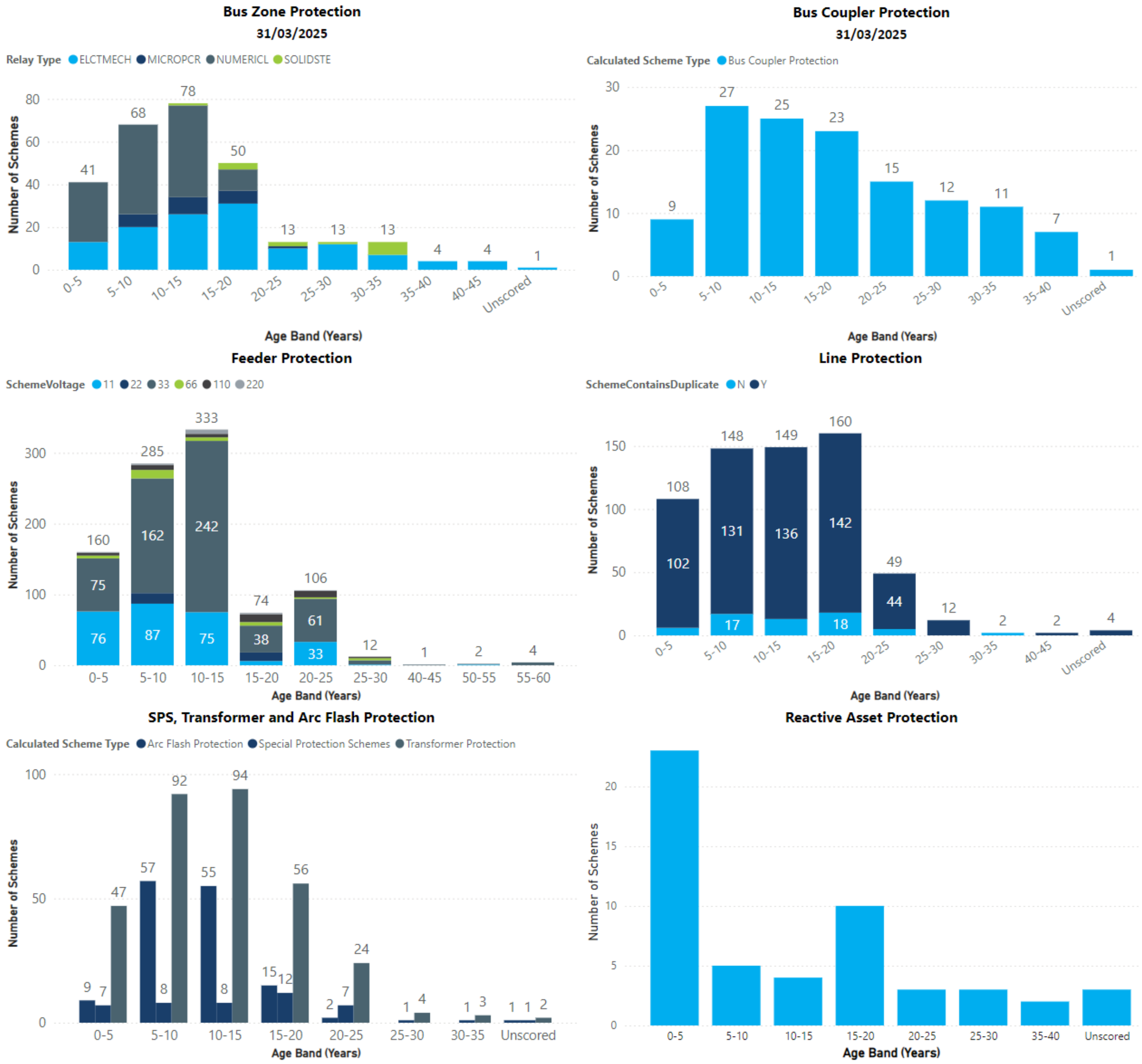
Asset strategy

- Replace relays on obsolescence or endemic failure, subject to a maximum life expectancy of 20–25 years for numerical and microprocessor relay schemes and 35-40 years for electromechanical and static relay schemes.
- Replace ODJBs when maintaining them is no longer practical or cost effective.

Investment need is primarily age driven, except for ODJBs which are replaced based on their age and condition. Life expectancies for protection schemes and relay types range from 20 to 25 years for microprocessor and numerical relay schemes and from 35 to 40 years for electromechanical and static relay schemes.

The only option is to replace the asset, as refurbishment is not cost effective. The exception to this is if the CA of the ODJB determines it can be refurbished cost-effectively verses replacement. The population and age profile of our protection schemes are shown in Figure 115.

Figure 115: Protection population and age profile



The need for SPS will likely increase as we enable electrification of the economy and assist with meeting Aotearoa New Zealand's decarbonisation targets. Investment need is also age-based replacement. The SPS schemes older than 20 years have static or electromechanical relays and will be replaced later in RCP4. The majority of arc flash protection schemes are relatively new. Some of these schemes will be coming to their end of life in RCP4.

The age profile for ODJBs ranges from 1 to 73 years of age.

Lifecycle – deliver, operate, maintain, decommission, and disposal

Delivery times for new protection schemes is typically 3 years. This includes allowance for scoping (1 year) followed by detailed design, procurement, outage planning, and coordination with other major works at the site over the next 2 years.

We plan and manage outages in a way that creates a safe environment for employees while minimising the disruption for customers.

All protection assets are visually inspected annually. The functionality of protection schemes is regularly tested at 4 years for schemes with electromechanical, static and microprocessor relays, and 10 years for schemes with numerical relays. CAs are generally binary pass/fail assessments – some of which are self-monitored, with failure resulting in replacement.

Due to the modular nature of the assets, there are no corrective or predictive maintenance activities undertaken. The exception is that we undertake predictive maintenance on ODJB assets, based on visual inspections and CA. Preventive maintenance activities are limited to the inspection regimen.

Decommissioned protection schemes are disposed of in an approved manner. Some are retained as strategic spares, especially for the relays that are no longer manufactured.

Asset risk – health and performance

Figure 116 shows the current asset health of our protection assets and the forecast health at the end of RCP4 with investment and without investment. Our protection assets are housed within control and relay buildings; thus, corrosion is of minimal concern. The two major factors contributing to deteriorating health for protection assets are age and any design, manufacturing, or batch-type issues.

The predominant failure causes for our protection scheme assets are functional failure caused by software, firmware, configuration issues; mechanical failure caused by cable failure, test switches, or relay contacts fail to close/open; and electrical failure caused by loss of hardware component or power supply failure. The combined likelihood of functional, mechanical, and electrical failures increases exponentially with the age of the asset.

The three key preventive controls that are critical to reducing the likelihood of a service failure event are:

- Replacing all assets in a timely manner
- Increasing system redundancy where appropriate to minimise the impact of unavoidable failures
- Monitoring real-world failure rates and adjusting replacement timeframes accordingly.

The performance of protection schemes is categorised as either human error incidents or performance of protection schemes during unplanned outages incidents.

Figure 116: Protection asset health

Figure 117 shows the asset health of our ODJB population.

Figure 117: ODJB current asset health

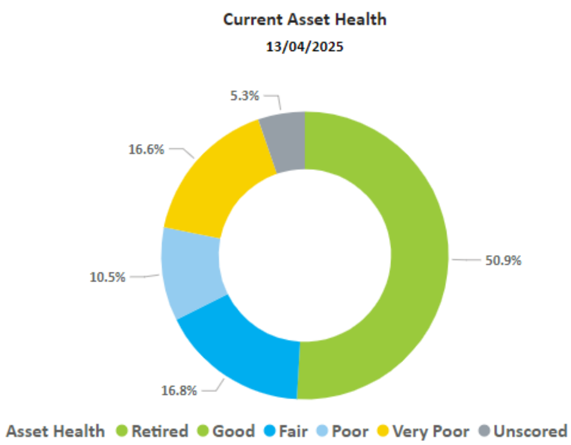


Figure 118: Protection performance

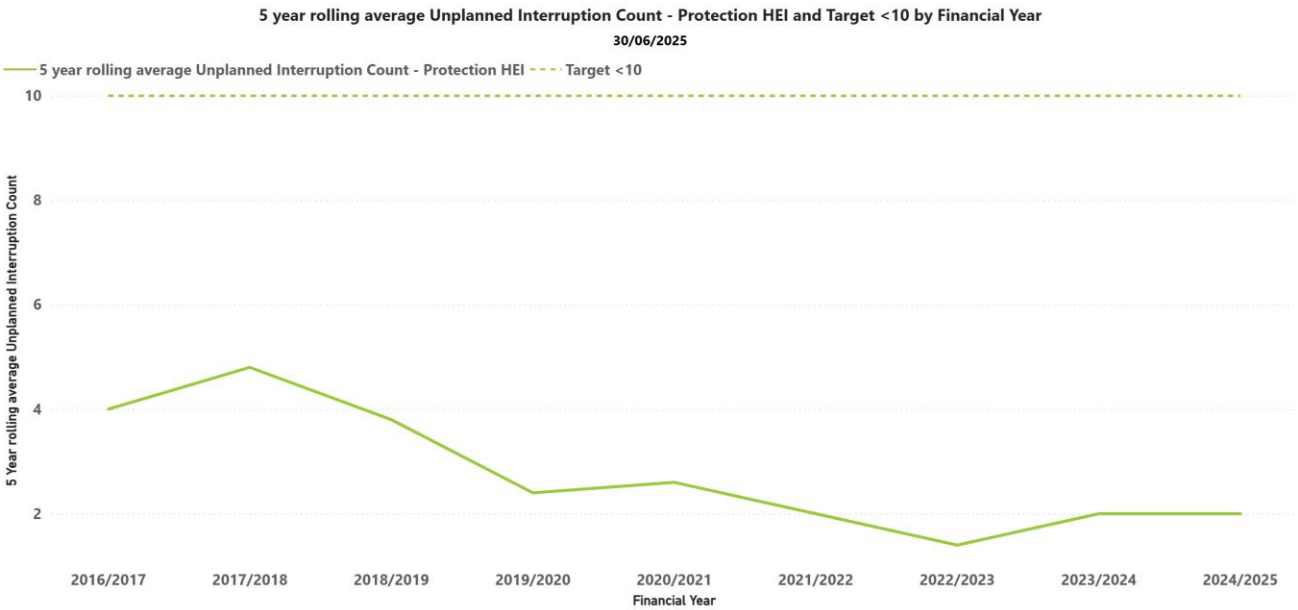


Figure 118 shows the 5-year rolling average of the number of protection technician human error incidents resulting in unplanned outages.

A significant proportion of human error incidents arise from human error during on-site work, or from incorrect settings being applied in the protection relay.

Our protection human error incidents are trending downwards. Factors attributed to this include our nationwide service provider training, improved visibility through modern SMS equipment, and improved standard designs.

The overall performance of our protection schemes is generally good.

Forecast work and capex

Figure 119 shows the expenditure and deliverables forecast for protection schemes and

Figure 120 shows the expenditure and deliverables forecast for ODJBs,

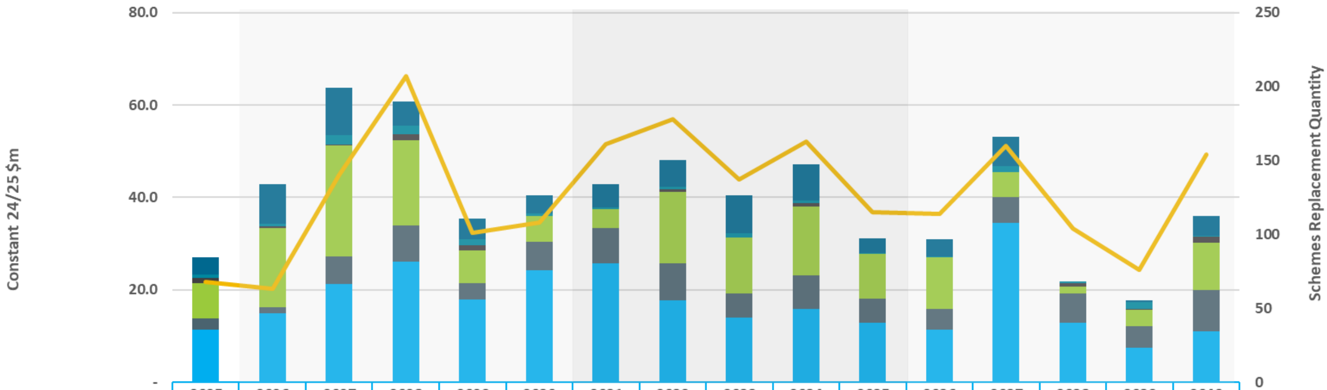
The forecast is based on the replacement of all protection schemes at the end of their expected useful lives or aligned with replacement of primary plant for efficiency.

The total forecast expenditure in RCP4 increases compared with RCP4 Submission costs due to:

- Increase in costs due to a global increase in demand for materials, equipment and skilled labour
- A number of rollovers, with significant expenditure, from RCP3 into RCP4 due to resource constraints, complex design’s requiring extended design timelines and site specific delivery challenges.
- Unplanned expenditure due to natural disasters e.g. Redclyffe substation rebuild due to Cyclone Gabrielle

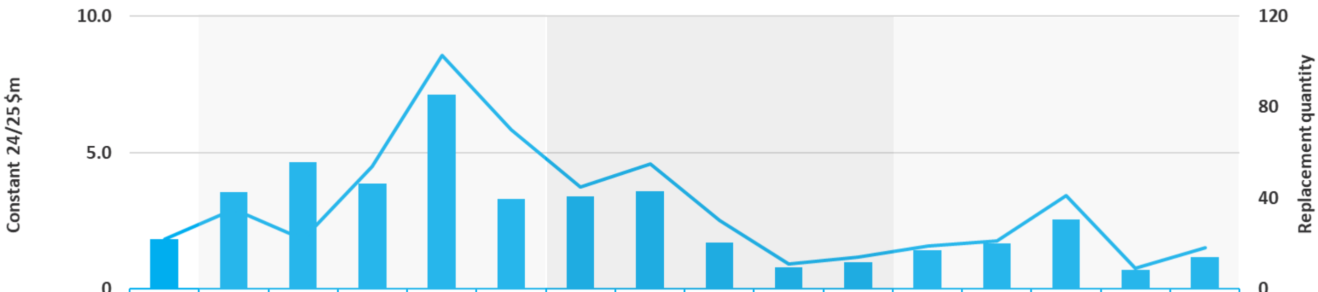
The protection portfolios now provides replacement forecasts based on asset health for all assets.

The ODJB portfolio maturity is still developing when compared with other protection assets as intervention is driven by life expectancy and then refined based on condition, closer to the time of replacement.



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Transformer Protection	3.8	8.5	10.4	5.2	4.5	3.9	5.0	5.9	8.2	7.8	3.1	3.7	6.3	0.0	0.5	4.4
Special protection	0.8	0.6	1.9	1.9	1.4	0.4	0.4	0.6	1.1	0.7	0.3	0.2	1.3	0.4	1.4	0.2
Reactive protection	1.1	0.4	0.3	1.3	1.0	0.1	0.1	0.5	0.0	0.6	0.0	0.0	0.0	0.6	0.3	1.2
Line Protection	7.6	17.0	24.0	18.4	7.1	5.5	4.1	15.4	12.1	14.9	9.6	11.1	5.3	1.5	3.5	10.4
Feeder Protection	2.3	1.5	5.9	8.0	3.6	6.1	7.5	8.1	5.2	7.2	5.2	4.5	5.6	6.3	4.7	8.8
Bus zone protection	11.5	14.8	21.2	26.0	17.9	24.3	25.8	17.7	13.9	15.9	12.9	11.3	34.5	13.0	7.4	11.1
Protection schemes qty	68	63	140	207	101	108	161	178	137	163	115	114	160	104	76	154

Figure 119: Protection forecast capex and quantities by year



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
ODJBs	1.8	3.6	4.6	3.9	7.1	3.3	3.4	3.6	1.7	0.8	1.0	1.4	1.7	2.5	0.7	1.2
ODJBs qty	22	35	22	54	103	70	45	55	30	11	14	19	21	41	9	18

Figure 120: ODJB forecast capex and quantities by year

SMS

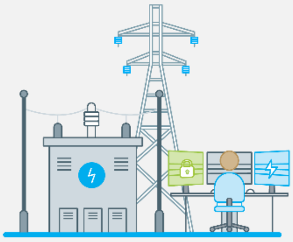
SMS enables the remote control and monitoring of our substations. SMS contains the telemetry systems based on computers and LANs that have been specifically designed to operate in electricity utility environments. SMS reliability is essential to maintaining visibility and control of the transmission network at both the national level (via the SCADA/EMS system) and the local level (via the substation HMI). The asset types covered by this ACP are:

- Substation management platforms (SMPs)
- HMIs
- GPS clocks
- SCADA junction boxes
- MIMIC Panels
- Neutral current transducers (NCTDs)

Asset class snapshot

Population

181 SMP sites
198 GPS clocks
196 HMI
88 NCTDs



Capex

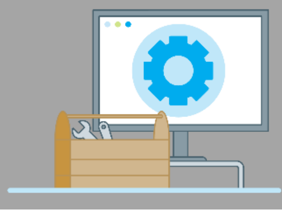
RCP4 (forecast)
$27.5m

SMS Gateway asset health

- 99% Good

Notable work programmes (RCP4)

Lifecycle replacements and telemetry data standard improvements.



Asset class strategy

Objective
Safe and reliable operation at least lifecycle cost.

Measure:

- Average of six or fewer SMS failures per year
- 5-year rolling average of 30 or fewer I/O module failures
- 100% of sites converted to SMS.

Asset strategy

- Replace all legacy RTUs with SMPs.
- Implement remote engineering access while deploying substation management platforms.
- Age-based replacement for all SMS assets.

Investment need is primarily based on asset age and obsolescence. Life expectancy for each asset type is based on manufacturer's recommendations and adjusted for factors such as measured mean time between failure statistics and real-world failure rates (both our own and other comparable customers).

Lifecycle – deliver, operate, maintain, decommission, and disposal

Delivery times for SMS assets is typically 2 years, except for GPS clocks and HMI work, which is typically 1 year. Delivery times include allowance for detailed design, procurement, outage planning, and coordination with other major works at the site.

We plan to maximise site work during outages in a way that creates a safe environment for employees and service providers while minimising the disruption for customers.

As SMS assets are electronic systems there are no planned maintenance activities (these devices have no serviceable components).

Once the HMIs and substation LAN equipment is installed, this is then managed by IST who monitor, maintain, and replace the assets at the end of their life.

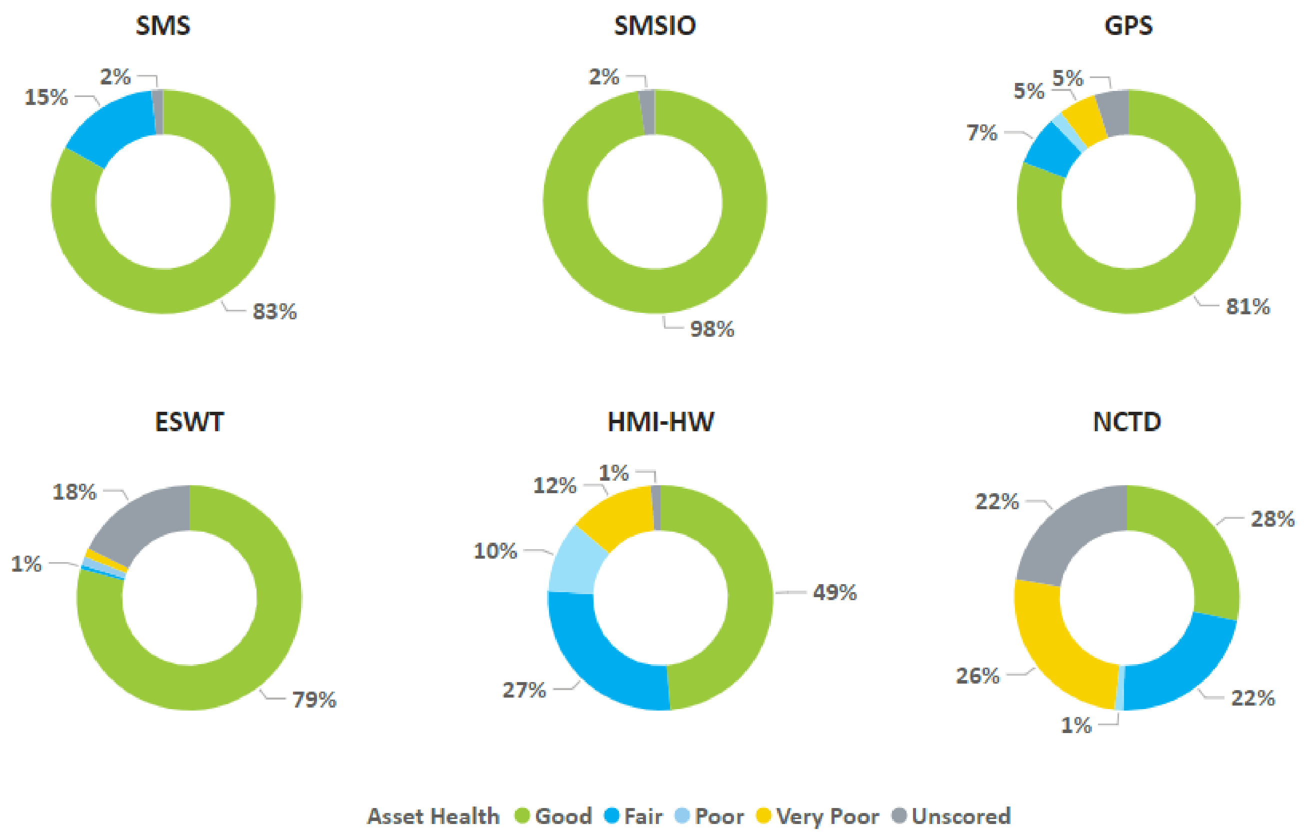
All decommissioned assets are retained as spares if required or disposed of as e-waste. Due to the specialised nature of the equipment, there is limited potential for re-use outside of Transpower.

Asset risk – health and performance

Asset age is used in the asset health model. The assets consist of modular electronic components, therefore there is presently no way of determining the condition of the units. To determine the intervention point we rely on manufacturer recommendations, measured mean time between failure statistics, and real-world failure rates (both our own and other comparable customers) to set the expected useful life of our assets.

Figure 121 shows the asset health of our SMS, SMS I/O, GPS, and ethernet switches assets respectively.

Figure 121: SMS systems asset health



The predominant failure causes for SMS are:

- Electrical failure caused by loss of hardware component or power supply failure.
- Mechanical failure due to loss of cooling, fibre failure, etc.
- Functional failure caused by software, firmware, configuration issues, and cybersecurity breach.

The combined likelihood of functional, mechanical and electrical failures increases exponentially relative to the age of the asset class. The key preventive controls critical to reducing the likelihood of a service failure are lifecycle planning, predictive modelling, data quality improvements, and strategic interventions to target at-risk assets.

Observed failure rates for SMPs are low but are increasing as the first-generation devices approach replacement age. All new and replaced units will be deployed as redundant pairs to eliminate the SMP as a single source of failure.

Observed failure rates for GPS clocks and HMIs have improved with the replacement of almost all the older cohort of devices as part of RTU replacement works. We expect failure rates to gradually increase as the average fleet age increases in the coming years.

Many of the SMS services contain, or are dependent on, ICT components or services. Understanding and managing the technological, operational, and funding boundaries between grid and IST requires careful consideration and is an integral part of the overall planning process. We therefore work closely with the IST team to ensure our strategies and long terms plans remain well aligned.

Forecast work and capex

Opex: This ACP has limited opex as most work is based on capital projects. Opex allowances are made for mimic panel decomissioning and the deployment of updated data models.

Capex: The forecast is based on the replacement of all assets at the end of their expected useful lives and any required supporting initiatives. RCP4 is focussed on delivering asset health-determined replacements of SMS assets.

Please note: The quantity counts are predominately based on the device replacements as we now have an accurate device count following the completion of the RTU replacement work. This work will be bundled into logical projects prior to delivery.

Figure 122: SMS systems forecast capex and quantities

	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
SMS other	1.5	0.6	0.2	0.7	0.8	0.1	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SMS Data	0.0	0.0	0.0	1.8	4.1	1.2	1.2	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SMS	7.5	3.1	3.7	3.5	6.2	1.6	5.3	3.4	6.8	4.0	5.7	3.5	11.3	3.0	4.7	1.9
SMS Qty Incl SMS, Coopers, Clocks, etc.	28	55	127	103	122	133	98	154	182	184	133	161	195	208	112	92

Station DC systems

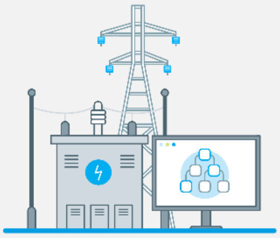
Station DC systems provide power to protection schemes, circuit breaker trip and close coils, control, and metering. These assets are required to operate not only during normal operation but also when the local AC service supply has failed, i.e. in a blackout, until power has been restored.

Asset class snapshot

Population

325 Battery banks

325 Battery chargers



Capex

RCP4 (forecast)

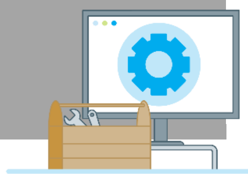
$14.4m

Asset performance

There have been no interruptions to customers due to minor or condition-based failures.

Work programme

	RCP4
Battery bank replacements	114
Battery charger replacements	60



Asset class strategy

Objective
To operate safely and reliably, at least lifecycle cost.

Measure
Zero instances of DC supply failures leading to interruption of supply.

Asset strategy

- Replace station batteries based on condition subject to an expected life of 8 years for existing and 12 years for new assets. A tolerance of up to 2 years either side of the nominal replacement date may be allowed, to enable efficiency in delivery through project bundling, or to allow for staggering of battery bank ages.
- Ensure new DC supply equipment meets future requirements, including sizing batteries for new carryover requirements.

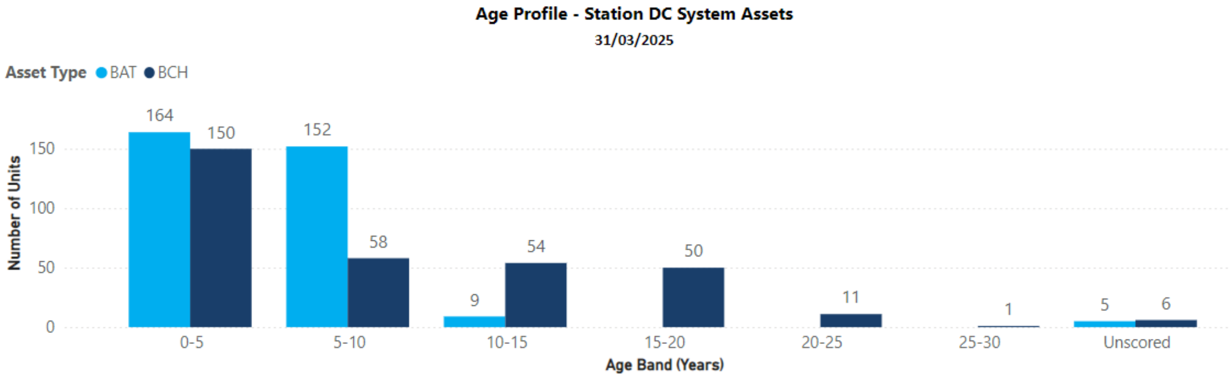
Figure 123 (over page) shows our battery and charger population and age profile.

Lifecycle – deliver, operate, maintain, decommission, and disposal

The delivery timeframes for 125V DC comprise detailed design, procurement, and coordination with other major works at the site. The delivery timeframe for this work is typically 1 year. This lifecycle management excludes the ICT 48V DC communications, control, and indication batteries.

Station DC systems are visually inspected annually. The station DC chargers cannot be maintained but key parameters are monitored during the battery bank inspections to ensure correct operation. For the battery bank, we carry out a variety of routine inspections and diagnostic tests on our batteries to inform condition at commissioning and 6 years for batteries that are replaced in their eighth year, and at commissioning and 8, and 10 years for batteries that are replaced in their 12th year.

Figure 123: Battery and charger population and age profile



Asset risk – health and performance

Major failures for DC systems are defined as the inability of the DC system to provide DC supply to secondary assets and/or operate circuit breaker trip coils, leading to either interruption of supply or unplanned outages. There have been several minor battery and charger failures in recent years. Battery cell failures are usually encountered during routine inspections and diagnostic testing. In most instances, battery cells failed during internal resistance or discharge tests and were replaced immediately upon discovery. There have been no interruptions to customers because of minor or condition-based failures.

Figure 124 and Figure 125 show the battery and battery charger asset health, respectively.

Figure 124: Battery Asset Health

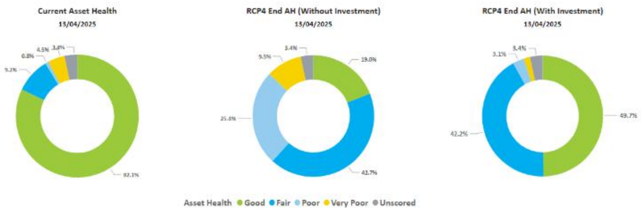
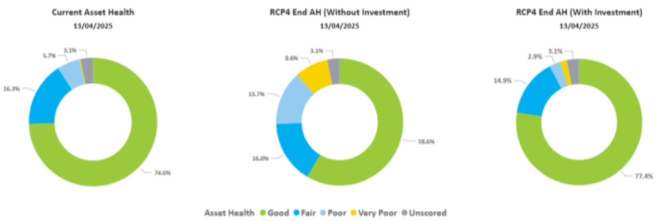


Figure 125: Battery Charger Asset Health

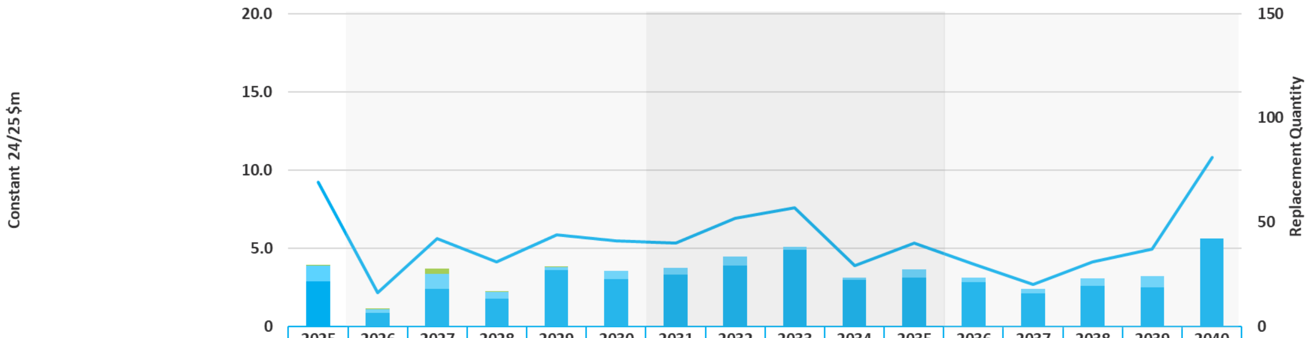


Forecast work and capex

The number or amount of station DC batteries, chargers and equipment coming due for replacement in RCP4 compared with RCP3 has decreased. The RCP4 forecast comprises the routine replacement of batteries and chargers as they come due for replacement.

Figure 126 (overpage) shows the expenditure and deliverables forecast.

Figure 126: Station DC systems forecast capex and quantities



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Other (incl. DC panels & lights)	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Charger replacements	1.0	0.2	1.0	0.4	0.2	0.5	0.4	0.6	0.2	0.2	0.5	0.3	0.3	0.4	0.8	0.0
Battery Bank replacements	2.9	0.8	2.4	1.8	3.6	3.0	3.3	3.9	4.9	3.0	3.1	2.8	2.1	2.6	2.5	5.6
Battery & Charger replacement Qty	69	16	42	31	44	41	40	52	57	29	40	30	20	31	37	81

Revenue, local service, and power quality meters

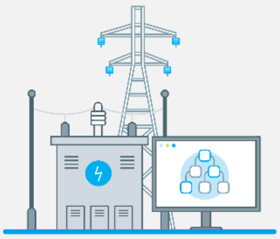
A metering system or scheme is a group of secondary system assets used for monitoring and recording system conditions on power systems. Most of our meters are used for revenue purposes by recording energy delivered through the network to our lines, direct connect, and distribution customers. The data they produce enables the allocation of transmission costs, electricity market reconciliation, and final pricing.

Our other meters are used for local service supply and power quality. Local service supply meters are installed to record the local service load that Transpower uses within a substation. Power quality meters are used to provide a baseline harmonic fingerprint prior to new non-linear generation connections proceeding. This is so that we can demonstrate with confidence and enforce compliance if required, should harmonic injection levels exceed the statutory requirements.

Asset class snapshot

Population

394 Revenue
174 Power quality
19 Local service



Capex

RCP4 (forecast)

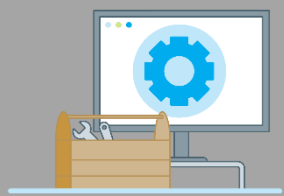
$0.7m

Asset health revenue meters

- 92.6% Good
- 0.5% Fair
- 4.9% Poor

Work programme (RCP4)

New Power Quality meters and replacement of PMUs as required



Asset class strategy

Objective
Operate accurately and reliably, at least lifecycle cost.

Measure
Maintain highly accurate and reliable monitoring across the network.

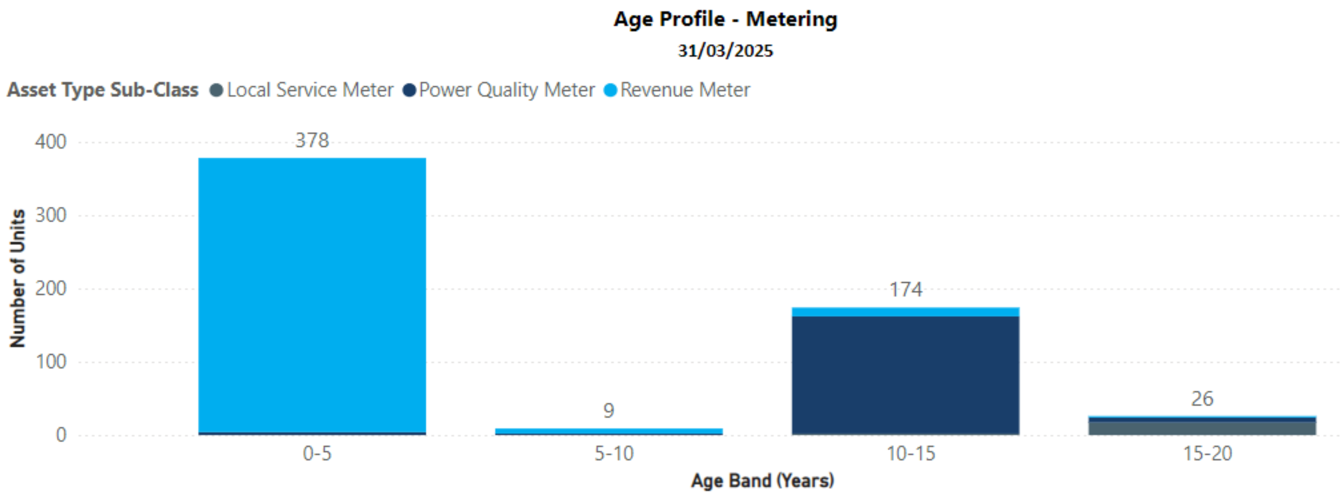
Asset strategy
Plan for investment in new metering equipment as required for planned new-generation and load connections.

The investment driver is to:

- Replace meters at the end of their expected useful life (12 years for revenue meters and 24 years for local service and power quality meters)
- Install meters where there are new connections to ensure that new inverter-based connections have a grid injection point (GIP) harmonic distortion baseline, prior to connecting and are monitored once commissioned.

Investigations have shown that the cost of each meter replacement becomes considerably cheaper when carried out in large quantities rather than piecemeal as they fail.

Figure 127: Meter age profile



The average age of our revenue meters is approximately 3 years. The majority of our revenue meters will be replaced with the remaining ones to be replaced by the end of RCP3, and the next scheduled replacements will occur in RCP5 & 6. The average age of our local service supply meters is approximately 17 years. Based on their 24-year lifecycle, most local service supply meters will be replaced in RCP5.

We plan to replace our meters used for power quality measurements at 24 years and will closely monitor their performance. The average age of our power quality meters is approximately 13.4 years.

Future metering panel renewals are driven by obsolescence, physical size of the new technology, and/or condition of auxiliary components.

Figure 129 shows the population and age profile of our meters

Lifecycle – deliver, operate, maintain, decommission, and disposal

Delivery times for revenue meters and local service meters include an allowance for detailed design, procurement, outage planning and coordination with other major works at the site. It typically takes 3 years to complete this work.

Maintenance, calibration, and data logger maintenance are carried out every three years for revenue meters and every 9-years for local service meters. Current and voltage transformer calibrations are completed every 8 years. We carry out calibrations by swapping the in-service revenue meters with recently calibrated meters. Calibration is undertaken off-site by service providers that are certified for calibration by the Electricity Authority. The maximum permitted error of a metering installation is 0.75%. We aim for as close as possible to zero error by applying corrections in the meters. The replacement of revenue and local service meters are in alignment with the expiry dates of the metering calibration certification, avoiding the need for calibration in the 12th year.

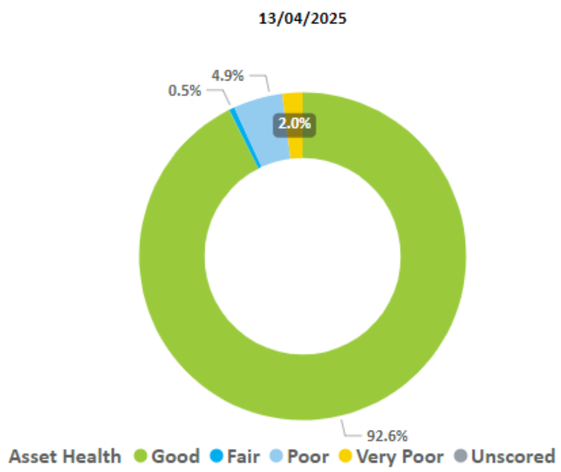
The majority of decommissioned meters are disposed of as part of the project in an approved manner. Some revenue meters are retained to re-use as power quality meters and as spares.

Delivery times for power quality meters include an allowance for detailed design, procurement, and outage planning. It typically takes a few weeks to complete this work as each meter is installed as the need arises. Power quality meters are not maintained.

Asset risk – health and performance

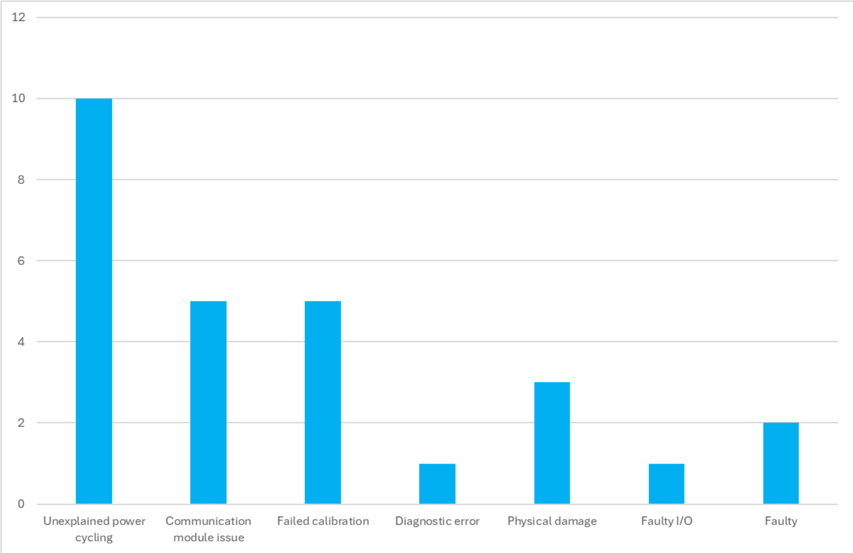
Figure 128 shows our meter asset health.

Figure 128: Revenue meter asset health



Obsolescence is a key risk to our metering assets, so we have spares on hand to manage this risk.

Figure 129: Meter performance



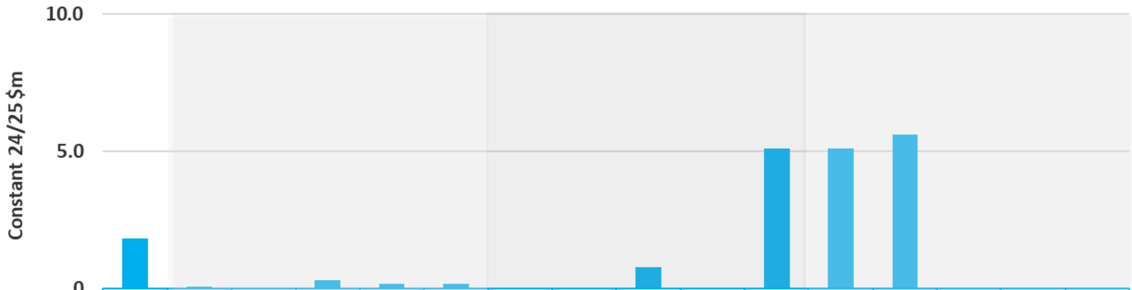
Since 2019 we have tracked diagnostic errors reported by the meters. In total, 27 meters have had issues – 10 with unexplained power cycling, five with communication module faults, five with failed calibration, one was a digital diagnostic error, three with physical damage, one with an I/O fault, and three that were faulty. Figure 129 shows the diagnostic events and issues with our metering fleet that have resulted in a service provider being called to investigate. Tracking started in 2019.

Forecast work and capex

Figure 130 shows our forecast capex. The majority of meters have been replaced in RCP3. The next scheduled replacements will occur in late RCP5 and early RCP6, depending on asset health.

The forecast is based on the replacement of all meters at the end of their expected useful lives. Metering expenditure during RCP4 is to cover the costs of power system modelling tools, standalone phasor measurement units and power quality meters. The total expenditure in RCP4 is significantly reduced in comparison with RCP3 since none of the revenue meters would be due for replacement within RCP4. it is expected that local service meters and some power quality meters will be replaced by the end of RCP5 and early RCP6.

Figure 130: Meter forecast capex and quantities by year



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Metering	1.8	0.1	0.0	0.3	0.2	0.2	0.0	0.0	0.8	0.0	5.1	5.1	5.6	0.0	0.0	0.0

ICT asset class plans

ICT asset class plans

This section describes our asset management approach, risks, plans and expenditure forecasts for the ICT portfolios. Each portfolio plan covers the strategic direction, lifecycle needs, and the forecast investment required for RCP4. For ease of readability, we have retained the five portfolio plans previously documented in this chapter, which consolidates the 12 Investment Cases that were the basis of our RCP4 proposal.

Portfolio plan overview

The Asset Management and Transmission Systems portfolio plans describe the business requirements for managing and operating the grid. Corporate Systems, ICT Shared Services and IT Telecommunication Network and Security Services portfolio plans describe the underlying business capability to support our operations across the company. Our forecast expenditure for RCP4 is aligned to our allocation.

Expenditure summary

Table 30: ICT capex and SaaS Opex in constant FY24/25 dollars in millions, by portfolio

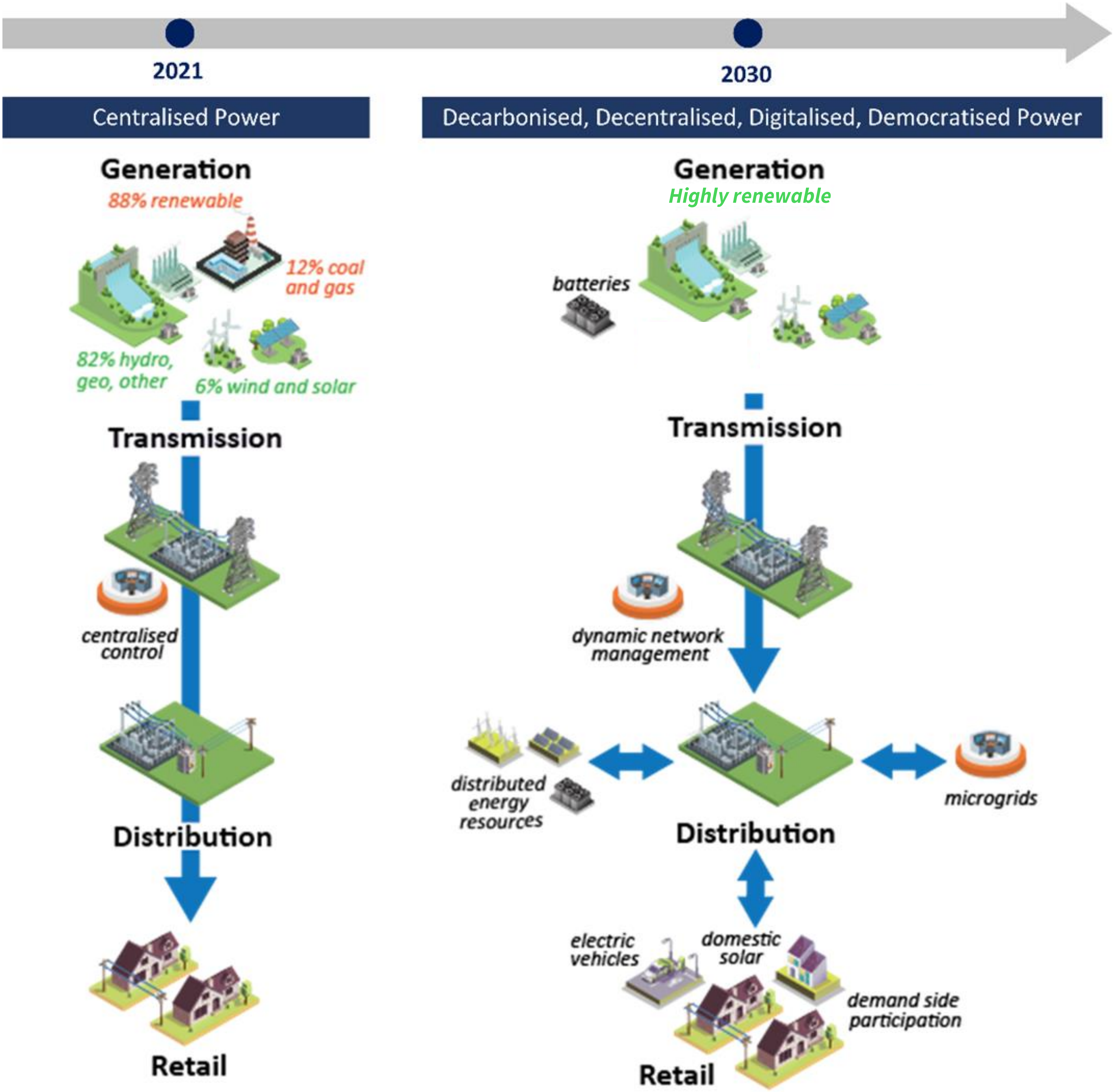
	RCP4					RCP 5					RCP 6				
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Asset Management Systems	6.7	4.0	3.5	4.5	4.8	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
Corporate Systems	12.6	12.0	11.1	11.5	6.0	9.5	9.5	9.5	9.5	9.5	9.3	9.3	9.3	9.3	9.3
ICT Shared Services	4.0	3.4	2.1	0.9	0.5	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
ICT Telecoms, Network & Security Services	39.4	49.2	39.3	13.1	9.3	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
Transmission Systems	11.6	10.9	7.7	10.8	5.7	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2
Total Capex and SaaS	74.2	79.6	63.8	40.8	26.2	40.0	40.0	40.0	40.0	40.0	39.8	39.8	39.8	39.8	39.8

Key Assumptions

In the foreseeable future, the acceleration of ICT technology development is poised to impact our anticipated expenditure. Consequently, while our current expenditure forecast is grounded in the robust information at present, expenditures beyond a five-year horizon are inherently uncertain and expected to change as new technologies emerge.

As outlined in *Whakamana i Te Mauri Hiko*, climate change and technology disruption are creating conditions that drive structural changes in utility systems. A more dynamic and bi-directional power system is emerging, characterized by increased grid connections and evolving customer needs. This evolution is primarily driven by the 4D forces: Decarbonisation, Decentralisation, Digitalisation, and Democratisation. These forces demand more dynamic network, system, and market operations, requiring us to leverage data and analytics for optimal asset decisions and adopt a better end-to-end approach to grid management.

Figure 131: Anticipated structural changes for the NZ electricity market



The following sections describe trends that are likely to impact on our ICT investments during RCP4.

Trends and Shifts

As we move towards a zero-carbon future principally driven by electrification as described in our *Whakamana i Te Mauri Hiko* scenarios, we are seeing technology changes across the industry that we are actively considering. For example, the integration of smart grid technologies, advancements in artificial intelligence, machine learning and data management, and the increasing capabilities of operational technologies and systems are informing the way we manage and operate our assets. These developments, along with others mentioned below, have the potential to enhance the efficiency and reliability of electricity transmission, and the ability to expand the system to meet demand.

As we navigate these changes, we have adopted a forward-thinking approach that embraces innovation and leverages emerging technologies. This section delves into the key trends and technological shifts that are influencing the electricity transmission sector, providing insights into how these changes result in improvements in asset management practices and overall system performance.

We continue to monitor the impact of these changes on our ICT systems and plan accordingly through the development and refinement of our ICT sub-strategies. We are exploring and incorporating the use of emerging technologies in several areas:

ML for grid optimisation

Machine learning (ML) is a transformative trend, leveraging advanced algorithms to analyse vast amounts of data and predict outcomes. This technology enhances efficiency, decision-making, and operational effectiveness.

For example, in vegetation management, machine learning integrates data from sources like Light Detection and Ranging (LiDAR) and orthophotography to predict growth patterns and potential risks, ensuring safety and reliability. It also optimises maintenance strategies, such as economic models for optimal asset maintenance, reducing costs and extending asset lifespans. Additionally, predictive analytics powered by machine learning helps forecast weather patterns and their impacts, crucial for grid planning and resilience.

IIoT for grid management

Industrial Internet of Things (IIoT) is a significant trend in grid management, involving the use of interconnected sensors and devices to monitor and manage physical assets digitally. This technology enhances grid resilience by providing real-time data and insights, enabling operators to detect issues early and respond swiftly.

IIoT facilitates predictive maintenance, reducing downtime and preventing outages by addressing problems before they escalate. Additionally, it optimises energy distribution and consumption, improving overall efficiency and reliability. By integrating IIoT, we can achieve greater connectivity and control, ensuring a more resilient and responsive grid.

Digital twins

Digital twins create virtual replicas of our physical grid assets and systems, enabling accurate simulations and what-if analyses. By integrating real-time data, digital twins can model complex grid behaviours, test scenarios securely, and optimise operations. This allows utilities to evaluate the impacts of disruptions, maintenance activities, or integrating new technologies before implementation. Digital twins enhance decision support, training, and contingency planning while reducing risks and costs associated with physical testing or unplanned events.

Operational intelligence

Operational Intelligence (OI) involves the real-time collection and analysis of data from various operational systems to monitor system health and pre-emptively address issues. This technology enhances decision-making by providing actionable insights, enabling organisations to detect and resolve problems swiftly.

By integrating OI into our operations, utilities can optimise maintenance schedules, reduce downtime, and improve our overall operational effectiveness.

DER integration

Distributed Energy Resources (DERs) include small-scale units of local generation connected to the grid at distribution level. These resources, such as solar panels, wind turbines, and battery storage systems, are transforming the energy landscape by providing decentralised power generation.

Continued integration of DERs into the grid enhances energy resilience, reduces transmission losses, and supports the transition to renewable energy. Integration at scale requires advanced grid management techniques to balance supply and demand, ensure grid stability, and optimize energy distribution.

Renewable energy forecasting

Renewable Energy Forecasting leverages advanced algorithms, Artificial Intelligence (AI), and big data to predict energy production from renewable sources like wind and solar. This trend enhances grid stability, optimises energy storage, and improves integration of renewables.

Key benefits include better demand-supply matching, reduced reliance on fossil fuels, and cost savings for utilities and consumers. Accurate forecasting supports efficient grid management and helps in planning maintenance and operations.

XAI & Responsible AI

Explainable AI (XAI) refers to AI systems designed to provide clear, understandable explanations for their decisions and actions. This transparency helps users trust and effectively interact with AI, ensuring they understand how and why decisions are made.

Responsible AI encompasses the ethical development and deployment of AI technologies. It focuses on fairness, accountability, transparency, and ensuring AI systems do not cause harm. By ensuring that our AI systems are transparent and understandable, we build trust with our stakeholders and comply with regulatory requirements.

Agentic AI & Agentic workflows

Agentic AI and Agentic Workflows refer to AI systems that autonomously make decisions and execute tasks, adapting to dynamic environments. These workflows leverage core components of intelligent agents such as reasoning, planning, and tool use to execute complex tasks efficiently.

Agentic workflows are designed to streamline and optimize business processes, improving efficiency and productivity by automating routine and complex tasks, effectively acting as a virtual co-worker.

Real-time streaming analytics

Real-time streaming analytics is transforming industries by enabling instant processing and analysis of continuous data streams.

In power grids, it enhances operational efficiency, fault detection, and predictive maintenance by analysing sensor data, IoT inputs, and grid performance metrics in real time. By leveraging AI and cloud computing, utilities can make proactive decisions, prevent failures, and optimize energy distribution.

AI-driven development

AI-driven development is revolutionising software engineering by integrating artificial intelligence into coding, testing, and deployment. Tools like GitHub Copilot, ChatGPT, and Tabnine assist developers with code generation, bug detection, and optimisation, significantly enhancing efficiency.

AI-powered testing automates bug detection and ensures higher code quality, while AIOps streamlines DevOps by predicting failures and optimizing workflows. AI also enables low-code/no-code platforms, making software development more accessible.

Hybrid multi-cloud adoption

This trend refers to the practice of using multiple cloud service providers (AWS, Azure, Oracle Cloud, etc.) to store, process, and manage data. This approach enhances flexibility, avoids vendor lock-in, ensures compliance with our regulatory requirements, and optimises performance by leveraging the best features of each provider while considering greater cost efficiencies.

By integrating multiple cloud services with on-premises systems, we achieve greater flexibility, resilience and scalability.

Segment routing for multi-protocol label switching (SR-MPLS)

Segment routing for multi-protocol label switching (SR-MPLS) is a modern network technology that enhances data routing by combining segment routing with MPLS labels. In SR-MPLS, the source router sets the path using segments encoded as labels, improving efficiency and scalability without complex signalling.

Using SR-MPLS supports smart grid services such as tele-protection for fault isolation, enhanced SCADA systems for grid monitoring, and Substation Automation for better control. It also enables efficient Field Area Network (FAN) data backhaul from IIoT (Industrial Internet of Things) devices, aiding in distribution automation and real-time data transfer for a more reliable and intelligent power grid.

Zero trust security architecture

Zero trust security architecture is a cybersecurity model that assumes no entity, whether inside or outside the network, is trustworthy by default. It requires strict identity verification for every person and device attempting to access resources on a private network. This approach minimises the risk of data breaches by continuously monitoring and validating access requests.

Asset Management Systems

Transpower's ICT Asset Management Systems support our business processes to plan, build and maintain physical assets on the grid, which in turn deliver the transmission services we provide to customers.

The strategic ICT direction in this portfolio is set out in our *Asset Management, Network Risk and Planning systems, and Enterprise Information & Data ICT sub-strategies*, that are described in the sections that follow. These sub-strategies define investment needs categorised as non-recurrent modernise and benefits driven. Our approach to managing the lifecycle of the assets relevant to this portfolio, is set out in the Asset Lifecycle Management – Applications strategy, which describes how we manage recurrent maintain investments. This plan covers the RCP4 regulatory periods.

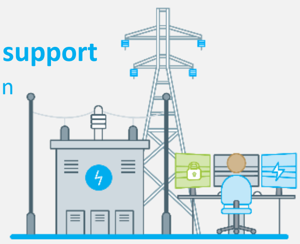
The figure below shows all the ICT sub-strategies and asset lifecycle management strategies categorised by investment type. In red we highlight the strategies covered by this portfolio.

Asset class snapshot

Asset Management Systems support

the management of over $5 billion in assets across approximately:

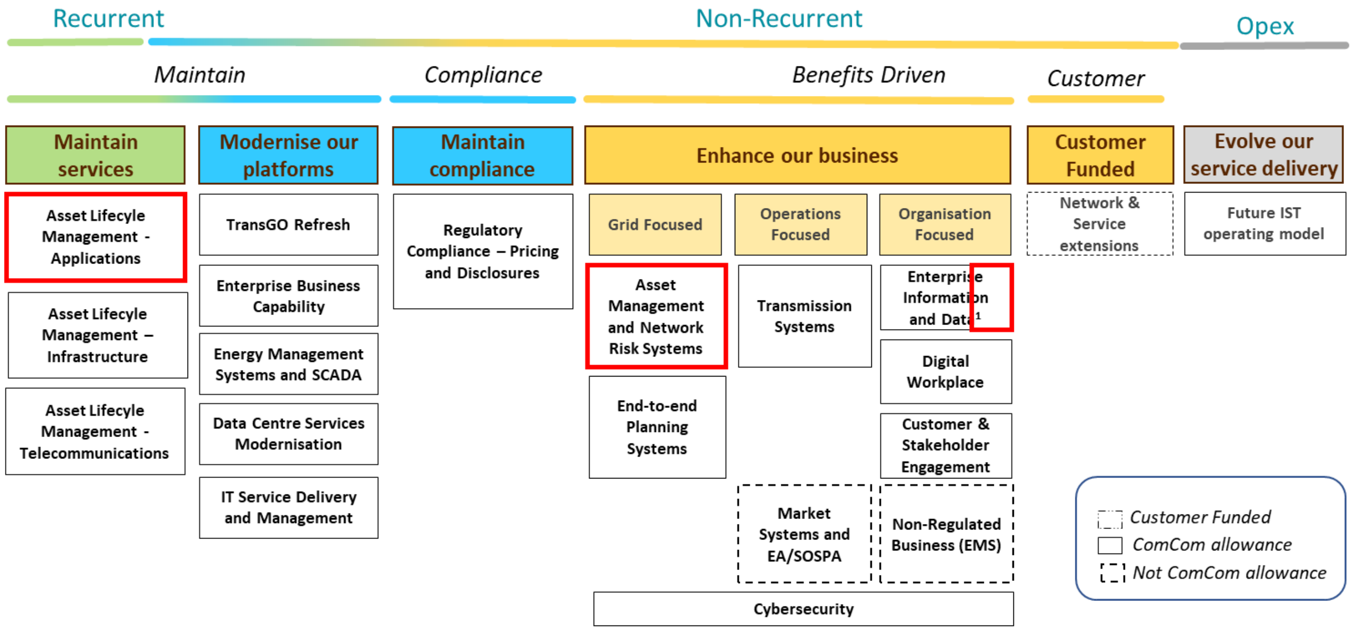
- 30,000 properties
- 180 substations
- 25,000 transmission towers
- 11,000 kilometres of lines



Capex & SaaS Opex

RCP4 Forecast

$23.6m



1 – BIM is included in Enterprise Information and Data sub-strategy

Asset class strategy

Strategic direction

Our strategic ICT direction and its alignment to Transpower business strategies is summarised below.

Providing quality data to inform asset health and network risk management

Transpower's key strategic focus is on maturing the assessment of asset health and the associated network risk and impact of failure, as outlined in our Asset Health and Network Risk Roadmap. Our ICT investments in industry-leading asset management information systems and tools, and a strong focus on improving the quality of our asset management data, are the key enablers for this maturity shift.

To continue progressing on our maturity journey we need to go beyond manual data collection and analysis and focus on adopting digital information capture, automated business processes and the use of advanced analytics. By progressively using high-quality information, e.g., conductor defects collected through our work with drones and machine learning, we can quantify current and future risk and select from a wider set of options for how and when to intervene to manage that risk. We will also increase the cadence of data capture where appropriate to provide advanced warning of emerging risks on the grid and mitigate them before an incident occurs. Using advanced analytics will reduce the amount of manual inspection work needed, freeing up engineering resources to focus on higher value activities.

Increasing breadth and sophistication of asset health and network risk models

We are focused on improving the breadth and sophistication of our asset health and network risk models and the associated tools and integration between them. These improvements are needed so that we continue to deliver our safety, service and sustainability commitments during a period of rapid change that the electricity transmission industry is going through. We are developing models via the new Python ecosystem and migrating away from the existing Conditional Based Risk Management (CBRM) system.

National vegetation management

We now have a national vegetation management approach that enable full visibility of the vegetation risks, hazards, and defects. This will provide us with a complete picture of all the approaching vegetation issues and risks for effective prioritisation and apportionment of necessary expenditure across the grid network. We now have the tools for managing/visualising vegetation using LiDAR data.

Empowering our field workforce, improving information exchange and mitigating risks around a changing workforce

Our field workforce mobility approach provides ready access to information from any location and presents information in ways that are intuitive and actionable, so that our workforce can act with confidence and reinforce consistency in accordance with our standards and objectives. Transpower needs to manage a safe transition for new entrants into our workforce who have higher information technology exposure and expectations whilst ensuring ongoing engagement from our experienced workers. The upgrade of Maximo to MAS9 (Maximo Application Suite 9.0) introduces new functionality that we will investigate to help drive the adoption of newer ways of working. We also need to further invest in interfaces with high usability and easy access to context specific information in the field.

Improving access to information and consistency of decision making through building information modelling

Digital Engineering simplifies organisational decision-making across the entire asset lifecycle (plan, design, construction, operation, maintenance, and decommission) by providing a single view of information about an asset that is standardised and easy to find. It supports digital simulation and what-if scenario analyses to improve the quality, speed, and consistency of decision-making across the asset lifecycle.

Continuous improvement in safety

Health and safety will continue to be a top priority as we strive for a zero-fatality workforce with reduced severe harm and injury frequency. This will enable Transpower to continue to meet our obligations under the Health and Safety at Work Act.

Driving a continuous quality improvement culture

We continue to invest in industry standards and best practices supported by tools that drive a continuous quality improvement culture. Several industry recognised quality improvement frameworks highlight the need to demonstrate conformity to standards and to systematically identify and eliminate non-conformances, such as to design standards, material quality, policies and agreed work practices across the asset management lifecycle. Transpower will continue to align to best practices by enhancing our digital processes and field mobility interfaces to enable the systematic capture, root cause analysis and routing of non-conformances across teams to improve quality across the asset delivery lifecycle and drive a continuous improvement culture.

Integrate enterprise planning with processes and tools that optimise our plans

Under Transpower's Enterprise Planning initiative, we are implementing business process changes to optimise and adopt an integrated approach to asset planning. Our goal is to digitise workflows, enhance alignment across the organisation, and identify opportunities to optimise our plans, thereby delivering greater efficiency and throughput in line with our strategic objectives. We are promoting collaboration to drive effective and efficient portfolio planning and delivery. From an ICT strategic perspective, we are enhancing integration between existing systems to provide the necessary cross-functional planning and optimisation capabilities through pour Enterprise Business Capability programme.

Enabling self-service data and analytics

We have empowered over 100+ citizen data scientists across the organisation through a standardised development and deployment ecosystem and self-service through Python and

Power BI. By doing so, we have provided them with trusted analytical modelling source data, thereby enhancing data re-usability and consistency and reducing overall effort in the process.

Our delivery in RCP3

Our most significant investments in RCP3 focused on improving our mobility services, enabling geospatial knowledge management and consolidation of our photos and multimedia systems.

Digital Engineering

During the latter part of RCP2 and throughout RCP3, Transpower has trialled Digital Engineering - centred ways of working across a targeted group of projects to understand how it can be applied in our industry, and we have seen sufficient benefits to initiate a strategic programme of work to implement it across all of our substation sites in the next 15 years.

Field workforce mobility

Significant progress has been made in providing ready access to collect asset management data from the field using a mobile application (Mātai) to replace manual paper-based processes. The application was co-designed with representatives from our field workforce to ensure high usability in the field and we are continuing to drive adoption with our field crews. Mātai provides a step change in our capabilities in line with our strategy to improve the speed and accuracy of information exchange across the organisation, empower our workforce and feed high quality data into our asset planning functions.

Maturity of Field workforce mobility tools continue to improve, and we will investigate opportunities to adopt more modern field workforce management systems.

Improved tracking and visualisation of our five potential energy futures

We have successfully delivered a new interactive geospatial application (Te Kāpehu Hiko) that allows us to visualise and track the five energy futures outlined in *Whakamana i Te Mauri Hiko – Empowering our Energy Future*. This tool supports our asset planning decisions and consultation with customers and industry as we navigate through a period of accelerated electrification (68 per cent increase in generation by 2050) and a move towards a carbon zero future.

Interface to transmission network information

TPR Envision Tools' complements the Transmission Planning Report. This is a public facing visualisation providing information to help our customers understand the opportunities and constraints on the transmission network.

Improving access to multimedia and providing a platform that will support future improvements in asset health assessment and network risk identification

Transpower uses photos and multimedia to identify risks and issues that could impact our assets, network services and public safety. We have consolidated our photos and multimedia systems to provide a single digital multimedia repository that can be easily linked to our core asset management systems and data. This initiative has simplified and extended access to multimedia across our teams and service providers, and we are exploring the use of drone and machine learning data to quantify current and future risk with intelligent conductors. This is an essential first step in our plans to incrementally lift the quality and cadence of data capture. The planned next step is to use analytics to convert large data volumes into insights and progressively automate inspections to provide a forward-looking view of high priority risks to inform our plans.

Lifecycle maintenance to provide fit-for-purpose tools

We have maintained our current systems to ensure that they remain fit-for-purpose, secure and supported through managed lifecycle investments and minor enhancements. A software refresh of our core asset information system (Maximo) has been implemented, and we are planning another refresh in the latter part of RCP4. We have completed a strategic investigation to confirm Maximo is suitable through to RCP5.

Our future investments

Our investments across RCP4 will focus on the following key areas:

Digital Engineering

Investment in Digital Engineering will provide a methodology, standards, tools, and training to supply owned, managed, and discoverable high-quality data about our assets to improve decision making. This will enable us to improve data access, share structured asset information and enable enhanced insights. We have procured a Model Management system that will provide a single source of truth to manage our asset model data across Transpower and our partners. Our Digital Engineering programme will unlock future capability such as automated detection of conflicting changes, enhanced construction sequencing, predictive maintenance and more accurate site set out works. This investment will enable material cost and time savings and other efficiencies across the grid project and asset lifecycle. Further information can be found in our *Enterprise Information and Data sub-strategy*.

Digital twin

Investment into a digital twin will extend Digital Engineering capabilities, accelerating Transpower's efficiency and asset management capabilities, empowering smarter decision-making and risk-informed strategies for a stronger future. Further information can be found in our Enterprise Information and Data sub-strategy.

Asset health and network risk management

Further expansion of our asset health and network risk models is planned to enable continuous improvement in asset management maturity and to manage expected changes on the grid. Significant improvements have already been made to our asset health models and focus has shifted towards improving our network risk models, taking a broader array of risks and organisational objectives into consideration. From an ICT perspective we need to ensure our tools and associated integration continue to support the breadth and sophistication of models needed. Our investments in Data and Analytics, as well as the Python Ecosystem will help to simplify the process of combining data and generating insights that feed into our models.

Further information can be found in *our Asset Management and Network Risk and Planning Systems sub-strategy*.

Field workforce mobility

As part of our *Asset Management and Network Risk Systems sub-strategy*, we will enhance Maximo and our geospatial systems with new data from the national vegetation management system. This will enable our service providers to visualise the risk across the network or specific spans and to manage vegetation encroachment work orders more efficiently.

The upcoming LiDAR program, scheduled for RCP4, will include additional requirements to better support Transpower's broader needs. These enhancements will range from improved analytics to extended imagery capture of substations, thereby reducing the need for extra flights.

Health and safety

Enhancements to our health and safety systems are needed to provide a much more dynamic and engaging exchange of information with our people, stakeholders and the public regarding health and safety. By increasing collaboration and awareness we can continue to reduce risks to our people and the public. Further information can be found in our *Asset Management and Network Risk and Planning Systems sub-strategy*.

Enterprise planning

Enterprise Planning is a framework that incorporates strategic, financial and operational planning to optimise decision making at Transpower. It incorporates business planning, forecasting, budgeting, reporting, optimisation, scenario analysis and performance analysis against strategic direction and goals. Enterprise Planning at Transpower covers specific planning activities across two distinct time horizons: Short Term Planning (up to 2 years) and Long Term Planning (2 – 10+ years). Enterprise Planning contributes to Transpower's strategy by unifying and aligning strategic priorities supporting Whakamana i Te Mauri Hiko across all divisions.

During RCP4, we plan to enhance data exchanges with our service providers, enabling integrated planning, improved visibility, and systematised enterprise planning by tracking cross-functional process performance indicators against objectives.

Estimation

Our Transpower Enterprise Estimation System (TEES) supplying quantity surveyor capabilities to support grid investment planning will be replaced during RCP4. We will also improve integration with our end-to-end planning process to ensure consistency, quality, and traceability of estimates across the planning phases. Further information can be found in our Asset Lifecycle Management – Applications strategy.

Lifecycle management

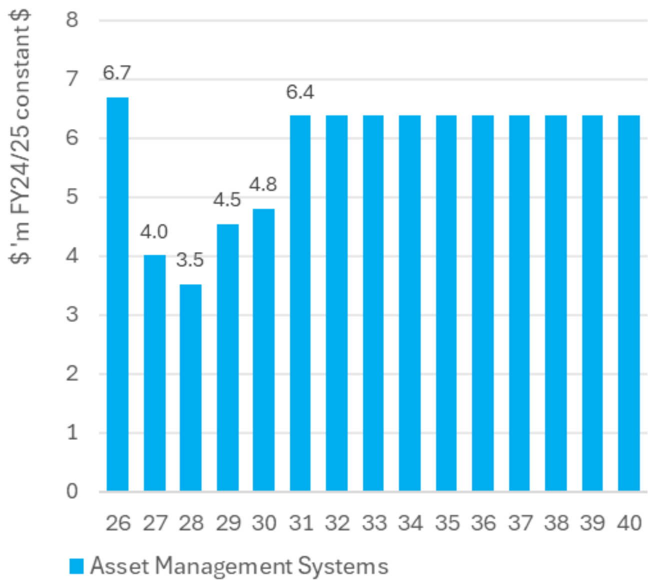
Our assets will continue being maintained in line with the Asset Lifecycle Management – Applications strategy. The major upgrades planned in the period are upgrades of our asset information management system (MAS9), our Asset Capability Information system (ACI), our Transpower Enterprise Estimation System (TEES) and our asset management planning system (AMPS). Our geospatial platforms will also require an upgrade during RCP4. Our photos, multimedia and drawings systems have been replaced in RCP3 with a Software as a Service (SaaS) arrangement which will require ongoing Opex to support but will not require any major upgrades.

Forecast expenditure

Capex and SaaS Opex: Since our AMP 2023 we have revised our roadmap to align with our updated ICT sub-strategies.

Figure 132 shows asset management and network Capex and SaaS forecast.

Figure 132: Asset Management Systems - AMP 2025 Capex and SaaS Opex forecast



Transmission Systems

Transpower's ICT Transmission Systems enable the real-time operation of the national grid, and the day-to-day operations and maintenance activities required to ensure Transmission asset safety, performance, and reliability.

The strategic ICT direction, in this portfolio, is set out in our Energy Management Systems and SCADA and Transmission Systems sub-strategies. These sub-strategies define investment needs categorised as non-recurrent modernise as well as benefits driven. Our approach to managing the lifecycle of the assets, relevant to this portfolio, is set out in the Applications Assets asset lifecycle management strategy, which describes how we manage recurrent maintain investments. This plan covers the RCP3 and RCP4 regulatory periods.

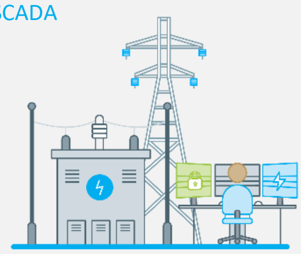
The figure below shows all the ICT sub-strategies and asset lifecycle management strategies categorised by investment type. In red we highlight the strategies covered by this portfolio.

Asset class snapshot

Transmission systems support:

Achieving situational awareness and control of our assets via approximately 234k data points on 5521 SCADA displays from RTNET, DTS, DSA, RAS etc.

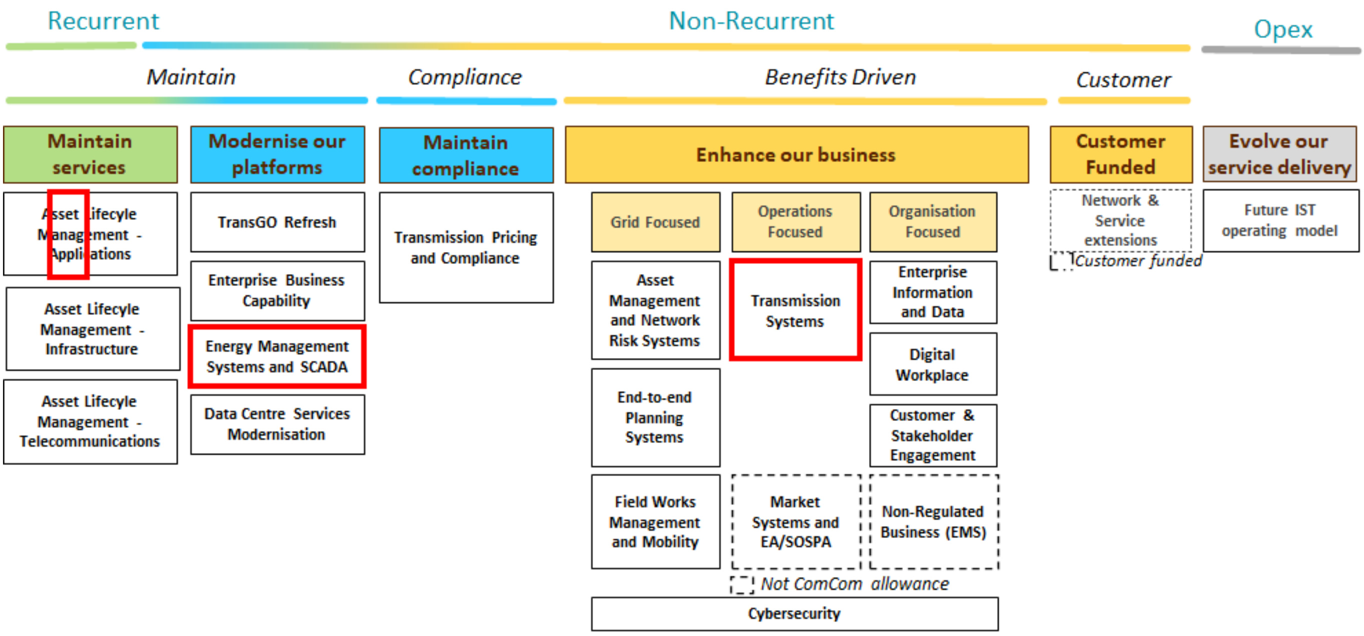
Connecting to over 8171 IED's (Secondary systems) across all substations.



Capex & SaaS Opex

RCP4 Forecast

$46.7m



Asset class strategy

Strategic direction

New demands on our operational functions as the power system evolves

There are new demands on our operational functions as the power system evolves to be more complex while the need for affordable, reliable and sustainable electricity becomes increasingly critical to Aotearoa New Zealand. Transpower needs to invest in our people, processes, and technology during this transitional period to ensure that we can continue to operate a safe, reliable, and secure grid, be ready for a complex future and adapt for an increased workload (complexity and volume). Transpower is in a unique position to play an active role in enabling Aotearoa New Zealand's energy future by extending our network analysis capabilities and improving collaboration with connected parties to manage a more dynamic, intermittent, and bi-directional power system.

Technology investments in our outage management systems, extending the use of situational information for decision making, usability of operational tools, and improvements in operational data quality will enable us to successfully manage the power system through a period of accelerated change, increased complexity, and higher volumes of work.

Our alignment to Transpower business strategies is summarised below.

Safe, efficient, and simplified grid operations

We will continue to evolve and adapt our existing systems, processes and capabilities and invest in new, innovative technologies to deliver scalable and industry purpose fit solutions that will realise benefits to Transpower and its customers. We will enable a self-service model for industry interactions with the grid, providing visibility of outages, asset status, and safety controls to make it easier for the industry to interact with the power system. We will leverage our operational expertise to work with others to enable and accelerate the integration of new technologies.

We will continue to improve outage planning and associated digital switching capability to ensure safety as increased electrification drives complexity into grid operations. Advanced capabilities are needed that can predict the behaviour of distributed and renewable energy resources and enable the management a larger volume of more complex outages. Business process efficiencies are needed so that planning is agile enough to keep pace and plans can be optimised to balance competing demands to reduce risk, minimise customer impacts, reduce operator and service provider workload and make the most efficient use of our assets.

Processes, systems integration, and data

Improving end-to-end data governance and the underlying process and systems integration is essential to:

- Providing high trust, high resolution data for operational and non-operational use cases,
- Simplifying non-critical data acquisition processes to remove barriers for capturing a broader array of information to support decision making, and
- Continuing to automate business processes to improve productivity, agility, and quality.

Our delivery in RCP3

Since the start of RCP3 we have invested significantly in our SCADA/EMS modular upgrade programme, Digital Switch Management, Telemetry Change Release Tool and maintaining our systems.

Supervisory control and data acquisition (SCADA) / Energy Management System (EMS) modular upgrade

Our revised modular upgrade approach to SCADA/EMS has enabled us to reduce delivery risks and enabled efficiencies through improvements to our ICT delivery. The efficiencies achieved meant that the SCADA programme delivered to a lower cost than what was delivered 5 years ago despite exchange rate and CPI impacts.

Digital switch management (DSM)

The DSM Enhanced Planning and Enhanced Checking projects have been successfully completed and digitised the Planning and Reviewing stages of the Switch Management process. All users have been trained in using the DSM tool and all switching Jobs are now planned in DSM.

Telemetry Change Release Tool (TCRT)

The Real-Time Systems (RTS) function ensures that accurate and reliable data from field devices is continuously available to the National SCADA and PI systems. This data is critical for enabling Transpower to effectively monitor, operate, maintain, and invest in the national grid and wider power system.

The TCRT introduced a purpose-built Jira workflow tool designed to standardise and streamline project delivery processes across Real-Time Systems.

Lifecycle maintenance to provide fit-for-purpose tools

We have also maintained our current systems to ensure that they remain fit for purpose, secure and supported through managed lifecycle investment and minor enhancements. Lifecycle upgrades to several key systems including Stationware, Lightning Detection and Corporate and Sanctum PI tools have been implemented.

Our future investments

Our investments across the remainder of RCP3 and RCP4 will focus on the following key areas:

DSM

Future investment into DSM capabilities will focus on reducing switching risk, improving the effectiveness of centralised operational switching and communication with the field workforce as grid complexity increases. Our DSM programme will further enable enhancement of our Remote Switching capabilities to improve the safety and efficiency of service provider switching on-site.

Operational situational intelligence

We aim to enhance our operational intelligence capabilities by aligning with the goals of the Control Room of the Future (CRoF) initiative that is now underway.

CRoF is a strategic effort to ensure our real-time operations remain resilient and effective in the face of an increasingly complex energy landscape. In collaboration with teams across the business, this initiative explores how our control rooms must evolve to meet future demands.

This involves identifying investments to uplift the operational intelligence capabilities for our Grid and System Operations teams. With these investments, we anticipate that our enhanced operational intelligence solution will enable us to discover correlations between events and outages, create predictive models for pre-failure alerts, conduct specific scenario analyses, and integrate environmental parameters to predict operational impacts.

Grid resilience and work distribution

Our objective is to develop advanced workload sharing to build on work distribution resilience and flexibility. We will drive optimisation and reduce risk by even work distribution across operators as well as across regional centres through business process standardisation, targeted training, and tools alignment.

Outage planning and management

The Outage Handling and Management System (OHMS) project has been launched to replace the existing Integrated Outage Notification System (IONS) application with a modern solution, followed by the implementation of feature enhancements. The delivery of this new solution is structured in two distinct phases. The first phase, referred to as the 'Modernisation' phase, is focused on replicating the existing functionality—along with selected improvements—within the new platform. The subsequent 'Enhancement' phase will build upon this foundation by introducing further capabilities aligned with key business objectives: improving productivity, enhancing planning effectiveness, reducing risk, and ensuring adaptability to support future needs.

Protection systems

We will continue to evaluate and modernise our Protection Systems Management capabilities by phasing out legacy tools and replacing them with future fit products. This will encompass deployment of power system modelling and protection fault diagnostics. There will also be further improvements into protection information sharing resources to support related business processes. This will reduce risk and ensure better utilisation of the grid enabled by highly trusted protection systems for more effective response to events.

SCADA / Energy management system

We will undertake upgrades to safeguard the security, reliability, and long-term supportability of the SCADA System and Market Solver—key platforms that support the operation of New Zealand's electricity market. This work involves upgrading essential components, including GE products such as Habitat, Platform, SCADA, and Archive, to their latest versions, in line with the SCADA Refresh Roadmap.

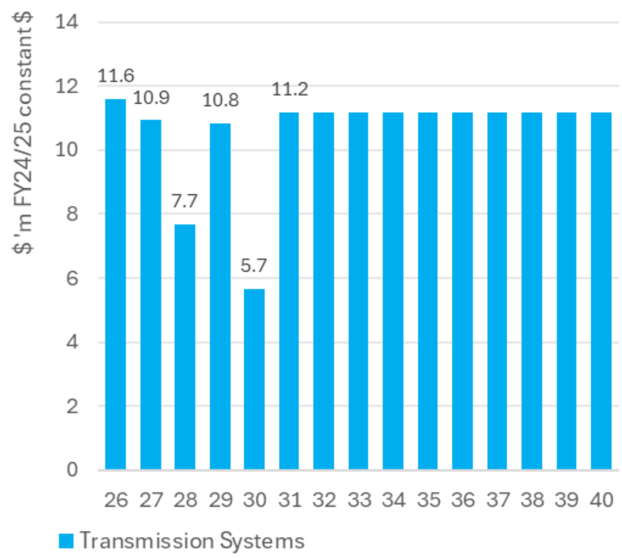
These upgrades are vital to ensure seamless compatibility with Grid Orchestration Software (GridOS)—a next-generation platform designed to manage and coordinate the growing complexity of the future energy grid.

Forecast expenditure

Capex and SaaS Opex: Since our AMP 2023 we have revised our roadmap to align with our updated ICT sub-strategies.

Figure 133 shows the Transmission Systems Capex and SaaS forecast.

Figure 133: Transmission Systems - AMP 2025 Capex and SaaS Opex forecast



Corporate Systems

Transpower's ICT Corporate Systems support Transpower's core day to day business operations, providing shared capabilities across all business teams.

The strategic ICT direction in this portfolio is set out in our *Enterprise Business Capability*, *Customer & Stakeholder Engagement*, *Regulatory Compliance – Pricing & Disclosures* and *Enterprise Information and Data* sub-strategies. These sub-strategies define investment needs categorised as non-recurrent modernise, benefits and compliance driven. These enable us to take a strategic approach to progressively digitise and transform our corporate processes, improve our collaboration and empowerment across internal and external stakeholders to achieve higher levels of business performance and accelerate our organisational effectiveness. Our approach to managing the lifecycle of the assets, relevant to this portfolio, is set out in the *Applications Assets asset lifecycle management strategy*, which describes how we manage recurrent maintain investments. This plan covers the RCP4 regulatory periods.

The figure below shows all the ICT sub-strategies and asset lifecycle management strategies categorised by investment type. In red we highlight the strategies covered by this portfolio.

Asset class snapshot

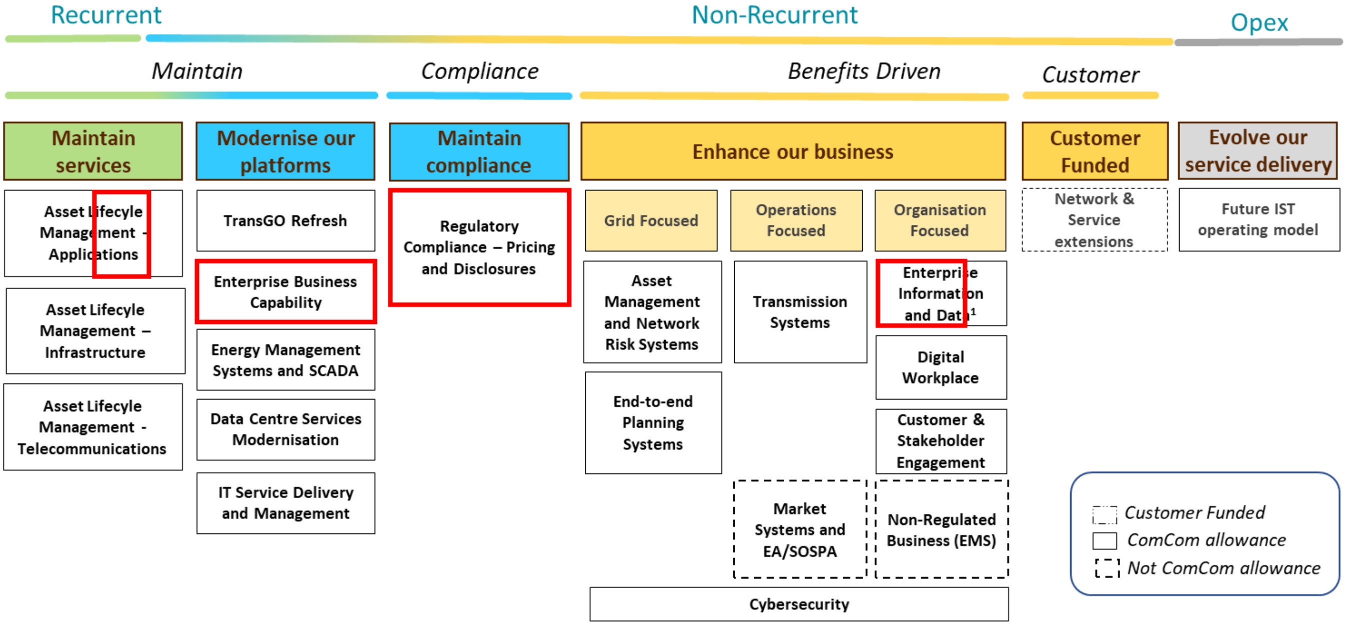
Corporate Systems support the management of approximately:

- $1,000m - Totex through financial systems p.a.
- $980m – processing revenue p.a.
- 29k Landowner interactions p.a.

Capex & SaaS Opex

RCP4 Forecast

$53.3m



1 – Data & Analytics is covered in Enterprise Information and Data sub-strategy

Asset class strategy

Strategic direction

The transmission utility industry is going through a period of rapid change with increased demand for new customer connections, increased reliance on electricity to reduce Aotearoa New Zealand's carbon footprint and the advent of new technologies that have the potential to impact on our corporate systems capability to meet customer and regulatory expectations.

Our alignment to Transpower business strategies is summarised below.

Enterprise business capability

Whakamana I Te Mauri Hiko describes a future that will demand a different set of skills and capabilities from those we have today. As part of this, we need to continue to focus on cost-effectiveness, enabling our continued transformation and accelerate our organisational effectiveness.

The Enterprise business capability (EBC) programme's intent is to streamline our business processes and information with new tools and industry standard data models and practices deployed on a modularised platform that will improve our system integration and to provide greater availability and consumption of data for enhanced decision making.

Customer and stakeholder engagement

Our stakeholder map is highly diverse and focused. It ranges from generators, distributors, direct customers to landowners, regulators, partnering government agencies and city councils. While the customer numbers are small, they are large, complex entities. We engage with the various stakeholders across various capacities. New connections, planning and design, commissioning, consenting, environment planning, permits, corporate communications, and a large part of operations. Customer operations involve detailed engagement around outage management and planning, maintenance, upgrades and providing insights on performance to enable power transmission.

Our current stakeholder engagement systems and their underlying maturity, integration capability, lifecycle and architecture are diverse. We are centralising systems and functions to manage interactions and engagements with customers and stakeholders across appropriate channels, to provide a single or "360" view of stakeholders across all touch points within Transpower using Salesforce as our Customer & Stakeholder Relationship Management. This will ensure our customers and stakeholders have a compelling engagement experience and that we understand the specific needs for the stakeholder engagement so that the experience can be tailored and integrated with other business systems and systems of our key stakeholder partners, and to provide Digital workflows that facilitate and enhance customer engagement and supporting processes.

By modernising our customer and stakeholder experience we will continue to support the increasing volume of interactions around new connections, renewable energy zones and reporting on our sustainability as we move to a net zero carbon future.

This will enhance how teams coordinate with each other to communicate with customers and stakeholders and identify future opportunities to improve planning and coordination and delivering compelling user experiences and providing the ability to interact through a multitude of digital channels.

Regulatory compliance – pricing and disclosures

The intent is for Transpower to maintain and improve our ability to meet regulatory compliance obligations, as set by the Electricity Authority (EA) and Commerce Commission through the Transmission Pricing Methodology (TPM), investment contracts, pricing and information disclosures. To achieve this, we will deliver initiatives as modular or incremental additions to the existing platform, effectively mitigating non-compliance risks. The Transmission Pricing System (TPS) system is bespoke, designed to accommodate its complexity and the pricing regime. Fulfilling our compliance obligations to regulators includes providing regular information and IPP disclosure requirements on various aspects of the business, such as grid performance, price impacts, financial reporting, and providing sufficient TPM pricing information to our customers. Our strategic direction involves moving away from manual reporting and analysis, streamlining information retrieval, and ensuring easily consumable pricing information to sustain our social license to operate in the Aotearoa New Zealand electricity market.

Enterprise information and data

In response to increasingly complex grid management demands and consequently decision making, we have implemented the data and analytics capability with the processes, tools and expertise to deliver rich insights and support Transpower's strategic decision making. The platform provides an enterprise-wide repository of corporate and operational data, using cloud-based technology to rapidly integrate advanced storage, analytics and machine learning services to scale as data volumes grow.

We continue to invest in an annual programme of data and intelligence products that will consolidate and prioritise informational and analytical needs across the organisation. Using advanced analytics with machine learning allows for more complex and automated decision making that will maximise the value of data and insights with improved returns on investment. By embedding Generative AI into our analytics ecosystem, we will enable more intuitive, automated, and context-aware decision support—enhancing the speed, depth, and accessibility of insights, and maximising the value of our data.

Improving warehouse efficiency, asset utilisation and delivery

There are opportunities to investigate the use of digital technologies, smart tags and sensors to enhance our asset inventory management and warehousing to improve utilisation of warehouse capacity and improve supply chain efficiency. Our inventory and warehousing initiatives will integrate with work planned in our corporate strategy to improve our purchasing, supply chain and contract management capabilities.

Our delivery in RCP3

Enterprise business capability

In RCP3 we have completed a detailed investigation looking at the transformation of our Enterprise Business Capability processes across HR, finance, programme & project management, purchasing & contract management and established that we will need to procure and migrate to a new modularised platform in RCP4.

Enterprise information and data

During RCP3 Transpower has implemented an enterprise-wide business process management capability as a strategic enabler, to drive operational excellence and continuous improvement throughout the organisation.

We have successfully implemented a modern data and analytics platform using Snowflake, Informatica, and dbt, which enables cloud-based data warehousing, integration, and transformation at scale. Our legacy data warehouse has been decommissioned, with all core data migrated to the new platform. Building on this foundation, we are expanding our Historised Data Set (HDS) and Operational Data Set (ODS) and developing high-value data and intelligence products. Additionally, we are significantly enhancing self-service capabilities, allowing business users to access trusted data and generate insights independently using tools such as Power BI, Python, and SQL. This supports faster, more informed decision-making across the organisation.

Regulatory compliance – pricing and disclosures

The new TPM has seen us invest significantly in changes to our TPS. In RCP3, we replaced our existing legacy pricing applications with modern, fit for purpose solutions. We also extended TPS to cater for the new TPM requirements, such as the calculation of the Residual Charge, Benefit Based Charge, and Transitional Cap charge.

Lifecycle maintenance to provide fit-for-purpose tools

We have maintained our current systems to ensure that they remain fit for purpose, secure and supported through managed lifecycle investment and minor enhancements. This has seen us upgrade our Financial and payroll systems to ensure they remain compliant with Aotearoa New Zealand regulations.

Customer and stakeholder systems

In RCP3, a programme was initiated to enhance Transpower's Customer & Stakeholder Relationship Management capabilities. By the end of 2025, it aims to deliver a modern CRM foundation that supports our current legacy CRM systems. This foundation will be an enabler to achieving strategic business outcomes to be delivered in RCP4.

Inventory management

In 2024, a programme was initiated to enhance Transpower's inventory management. By the end of 2025, it aims to provide more accurate inventory data, establish a robust spares management framework, and improve the functionality of our inventory management system. Expected benefits include optimised inventory holdings, reduced supply chain costs, minimised data and process risks, and improved decision-making through well-documented processes and policies. This programme will also support our efforts to enhance Enterprise Business Capability and warehouse efficiency.

Our future investments

Our investments across the RCP3 and RCP4 will focus on the following key areas.

Enterprise business capability

For RCP4 we plan to use a business-led capability approach to standardise and streamline our processes, enhance productivity, and foster innovation across all our business units. This strategic approach recognises the need to grow Transpower's maturity in business process modelling at an enterprise-wide level over time.

We will expand our functional capability footprint of our financial systems to adapt to changing business needs, increase productivity and efficiency using pre-integrated Out-of-the-Box (OOB) functionality, standardised processes and achieve a leading best practice solution for more informed decision making.

Customer and stakeholder systems

For our customer and stakeholder systems we are modernising our CRM system with Salesforce and will consolidate our systems into a fit for purpose platform to provide a holistic customer view. During RCP4 we have planned investments to enhance our landowner interactions and augment the customer portal.

Regulatory compliance – pricing and disclosures

We will maintain and incrementally improve the system to ensure longevity through the RCP5 period and remove transactional activities that are costly to maintain. A roadmap will be updated during RCP4 to address any substantial code amendments and/or changes in policy if required.

Inventory and warehousing

Our inventory and warehousing programme will continue to enhance procurement, inventory and warehousing systems, ensuring that they are integrated into our supply chain platform, contract management and end to end planning systems. The programme will tie into the work we are doing to improve our Enterprise Business Capability and will also look for systems improvement in our physical warehouses e.g. mobility access, digital tagging of assets, and use of smart warehouse technology. An end-to-end programme will mitigate increasing global supply chain risks. These investments have the potential to reduce costs through improved utilisation of assets and improved warehouse efficiency. Further information can be found in our *Asset Management and Network Risk and Planning Systems* sub-*strategy*.

Enterprise information and data

In RCP4, we will build on the strong foundations laid in RCP3 by accelerating adoption of our cloud data platform, expanding both our HDS and ODS environments, and growing our suite of data and intelligence products. A key focus will be increasing business adoption through enhanced self-service capabilities—leveraging tools like Power BI, Python, and SQL—while also integrating Generative AI to enable users in generating insights, automating analysis, and taking informed action with greater speed and confidence.

We will also develop and scale advanced analytics and AI-driven decision models to support predictive operations and asset risk management. Key initiatives will include expanding intelligence products such as Alarm Analytics, the Overhead Line and Tower Painting economic model, and the Work Plans and Asset Health & Risk portals. These will evolve from early-stage insight tools into integral components of intelligent workflows and decision automation, helping us respond faster, allocate resources more effectively, and deliver better outcomes for the grid and our customers.

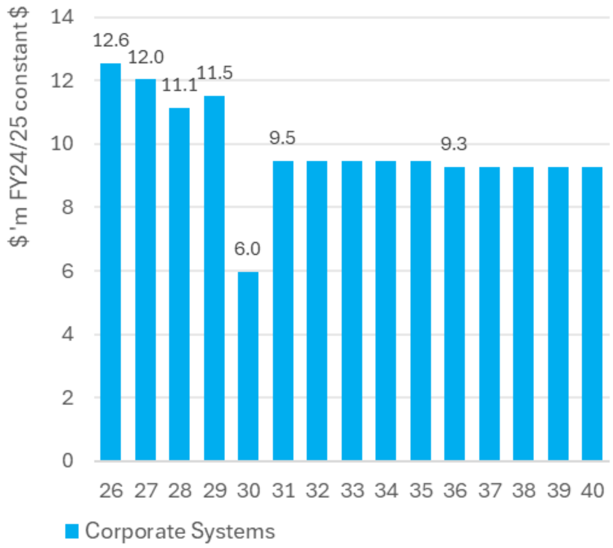
Lifecycle management

Our assets will continue being maintained in line with the *Asset Lifecycle Management – Applications strategy*. The major upgrades planned in the period are upgrades of our Peoplesoft Financial Management to maintain support until replacement in RCP4 and payroll systems.

Forecast expenditure

Figure 134 shows the Transmission Systems Capex and SaaS forecast.

Figure 134: Corporate Systems - AMP 2025 forecast (including capex reclassified as SaaS Opex)



Shared Services

Our ICT Shared Services portfolio supports the ICT infrastructure, systems and processes that are required for the delivery of ICT services. The focus of investments in this portfolio are predominantly risk-driven lifecycle changes whereby we continue to proactively maintain our ICT assets by upgrading them, so they remain supported and fit-for-purpose.

The strategic ICT direction, in this portfolio, is set out in our *Data Centre Services Modernisation* and *Digital Workplace* sub-strategies. These sub-strategies define investment needs categorised as non-recurrent modernise, benefits and compliance driven. Our approach to managing the lifecycles of the assets, relevant to this portfolio, is set out in the *Asset Lifecycle Management – Applications & Asset Lifecycle Management – Infrastructure strategies*, which describe how we manage recurrent maintain investments. This plan covers the RCP3 and RCP4.

The figure below shows all the ICT sub-strategies and asset lifecycle management strategies categorised by investment type. In red we highlight the strategies covered by this portfolio.

Asset class snapshot

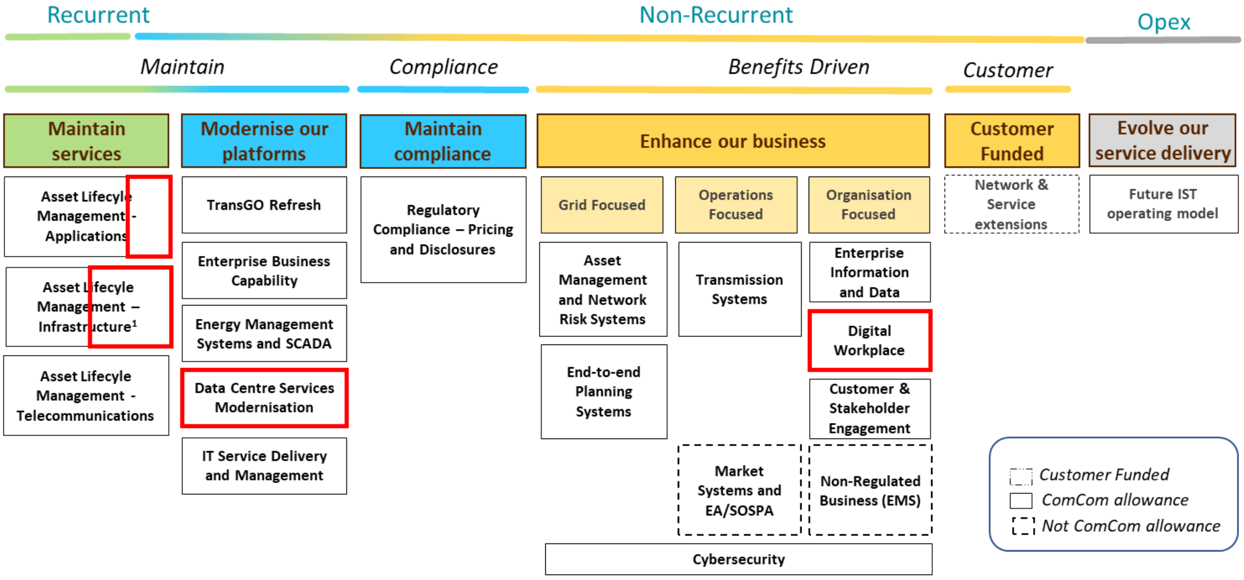
Shared Services manage approximately:

- 1500 Server Instances
- 270 Physical Servers
- 1500 TB Managed Storage
- 1100 Corporate Desktops

Capex & SaaS Opex

RCP4 Forecast

$10.9m



1 – IP Networking assets are covered in TNSS Portfolio

Asset class strategy

Strategic direction

The primary objective of this portfolio is to maintain the ICT infrastructure which supports our application hosting, workplace productivity and operations, delivery, and assurance services. As such, the *Asset Lifecycle Management – Applications & Asset Lifecycle Management – Infrastructure strategies* provide detail on how we lifecycle manage our existing assets, optimising our investment and managing our asset risk effectively.

Enhanced data centre services modernisation strategy

Instead of maintaining dedicated data centre facilities, we are considering shifting towards an "as a service" model, leveraging shared data centre services. This transition will be paced thoughtfully, with the goal of reaching the target state in the latter half of RCP4.

Key considerations include:

- Robust Hosting Environment: Ensuring our systems have a robust and reliable hosting environment.
- Hybrid Cloud Integration: We will ensure seamless integration of the cloud environment with our on-premises systems, supporting a hybrid cloud environment.
- Consumption of Data Centre Services: We will consume data centre services rather than owning and controlling dedicated facilities.
- Leveraging Cloud Market Offerings: Utilising SaaS, IaaS, and PaaS solutions to drive innovation and efficiency.

Digital Workplace

Transpower is adapting our ways of working, learning from the lessons provided through the COVID-19 global pandemic. The drivers for doing things differently include the continued "war for talent" and need to provide a compelling employee experience in line with the shift in expectations of employees. In addition, the need to codify our knowledge continues.

Our *Digital Workplace sub-strategy* seeks to embed a flexible workplace culture without losing the productivity and performance of teams. Building on a successful roll-out of mobile-first, O365 and more recently a new intranet, Transpower aims to build a blended workspace that enables seamless working between office and virtual environments.

Our operating environment spans a diverse range of settings—from corporate and regional offices to field-based locations such as inventory stores, warehouses, and substations. To support our workforce across these varied contexts, we will continue investing in the Digital Workplace. This includes leveraging Generative AI to enhance productivity, streamline access to information, and support decision-making in real time. As our workforce transitions from a knowledge-rich group that acquired digital skills in adulthood to a predominantly digital-native generation, we aim to foster a culture that embraces AI-powered tools and digital-first ways of working

ITSM modernisation

As part of our revised IT Service Delivery and Management we have developed a future state to converge on a unified toolset serving as the single source of truth. This integration will streamline processes and enhance data consistency across the organisation and enabled by "out of the box" and configuration, as opposed to customisation.

Our delivery in RCP3

Since the start of RCP3 we have invested in the following:

IT service provider reset

We engaged the market and transitioned our infrastructure service provider to a new supplier. This new engagement has now been fully transitioned and is expected to deliver increased service benefits and capabilities.

Lifecycle management

Our key lifecycle investments included:

- Our most significant investment was the replacement of our converged compute platform which constitutes approximately 70% of our compute and storage infrastructure supporting our critical and critical corporate services. Services were migrated to new Hyper Converged software defined infrastructure, implementing policies and guardrails removing the requirement for inefficient physical separation of services.
- We have replaced the virtualisation technology and hardware that hosts our Oracle workloads, which were nearing its end-of-life.
- Ongoing refresh of our non-converged hardware infrastructure to ensure the platforms remain in support.
- Continued maturing of our management and monitoring toolset.
- We have replaced our intranet site by improving usability, navigation, and search capabilities in line with our digital workplace sub-strategy.
- We have migrated our Exchange Mail server from on-premises to cloud.
- Established "Landing Zone" for our AWS cloud tenancy aligning with industry standards and best practices to more effectively manage our cloud assets including compliance enforcement and consumption.

Our future investment

Our investments across the remainder of RCP3 and RCP4 will be targeted at the following key areas:

Supporting business change

The way we provide corporate and critical applications is changing with the adoption of cloud services. This requires change in the way infrastructure and supporting platforms provided by this portfolio are delivered with new requirements for cloud hosted Infrastructure and Platform 'as a service' environments. Our approach to modernising our data centre services to support migration to, management of, and consumption of cloud is defined in our *Data Centre Services Modernisation* sub-strategy. We will remain in dedicated data centres as we wait for the domestic cloud market to mature, whilst continuing to invest in maturing our cloud hosting capabilities.

Additionally, we have increasing demand for on-premises systems connecting to cloud services. We anticipate this to drive a change in spending, away from traditional capex investments to consumption based Opex investments.

This demand is also driving a shift in the way we consider the security and management of our infrastructure services. We are implementing our *Cybersecurity by Design* ICT Objective and looking at ways we can build our infrastructure to be more inherently secure. We are looking at cloud management and monitoring tools to successfully operate, secure and manage cloud and hybrid cloud services.

Asset management - infrastructure

Our infrastructure assets will continue to be maintained in line with the *Asset Lifecycle Management – Infrastructure* strategy. Additionally, modernisation of tools will be required to meet business demands and maintain services.

This will include the following:

- Aligning our TransCloud converged compute platform refresh in our data centres to the revised Data Centre Modernisation strategy outcomes and migrating suitable applications to the new environment.
- Continuing to leverage our investments in new ITSM tools to consolidate and mature our environment monitoring and management capabilities, supporting a shift from reactive fault resolution to proactive maintenance and self-service.
- Improving how we build and manage our environments by adopting automation techniques.
- Providing enhanced end-to-end monitoring, management, and analytics of our systems and services.

Modernise our data centre services

As we begin to modernise our data centre services as defined in our Data Centre Services Modernisation sub-strategy, we will remain in dedicated data centres. We will invest in developing and maturing our cloud hosting capabilities. These cloud capabilities include but are not limited to the following:

- Deploy cloud native ITSM tooling to support a hybrid ICT Infrastructure model, establishing a common control plane across our cloud and on-premises assets.

We will continue to build on the establishment of well-architected "Cloud Landing Zones" in our public cloud tenancies. This may include refactoring our current cloud tenancies to align with industry best practices. Cloud landing zones enable us to securely and more effectively manage our cloud assets, including compliance enforcement and consumption.

- Enhance cloud connectivity - creating a secure, dynamic, and reliable connectivity to public cloud services. Stretching Transpower's on-premises data centres to public cloud service providers' data centres.

Digital workplace

In early RCP4 we plan to rollout Office Copilot, which is expected to enhance office productivity, improve collaboration, and streamline workflows. This will form part of our "common platform". Copilot offers a personalised digital experience based on roles, ensuring access to relevant tools, knowledge, and information. This will enhance productivity, as employees can focus on high-value activities while the AI undertakes administrative, routine, and/or repetitive tasks. During the latter part of RCP4 we will look to invest to further enhance the fostering of digital innovation and collaboration, introduce analytic functions that provide insights into adoption of digital ways of working and embrace blended workplaces that will enable seamless physical and virtual collaboration.

We will also continue modernising the way we deploy and manage our end user devices through cloud management tools.

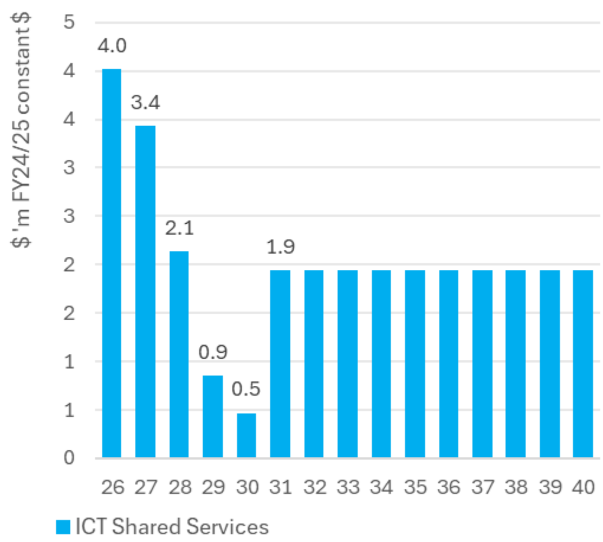
Student management

Our role as a Private Training Establishment for Grid Transmission qualifications requires capabilities that enables enrolment in courses, tracking of progress, and management of student assessments and records. We will look to improve our capabilities for managing training to our external partners, supporting the increase of the skilled workforce necessary to undertake the work identified in Transpower's RCP4 growth targets.

Forecast expenditure

Figure 135 shows the Shared Services Capex and SaaS forecast.

Figure 135: Shared Services - AMP 2025 forecast (including capex reclassified as SaaS Opex)



Telecommunications, Network and Security Services

Transpower's ICT Telecommunications, Network and Security Systems (TNSS) portfolio delivers services which provide a secure, high-capacity nationwide communications network which underpin our mission critical grid operational services and our business-critical corporate services. This portfolio addresses our Local Area Network (LAN), Wide Area Network (WAN) and Unified Communications network services as well as providing the end-to-end protection against cybersecurity threats to our people, systems and data.

The strategic ICT direction, for this portfolio, is set out in our *TransGO Refresh sub-strategy* for our non-recurrent modernise investments. Our approach to managing the lifecycle of the assets, relevant to this portfolio, is set out in the *Telecommunications* and *Infrastructure asset lifecycle management strategies*, which describe how we manage recurrent maintain investments. Our *Cybersecurity sub-strategy* is guiding all our Cybersecurity investments in this portfolio. This portfolio also supports and is influenced by the *Data Centre Migration* and *Digital Workplace strategies*.

The figure below shows all the ICT sub-strategies and asset lifecycle management strategies categorised by investment type. In red we highlight the strategies covered by this portfolio.

Asset class snapshot

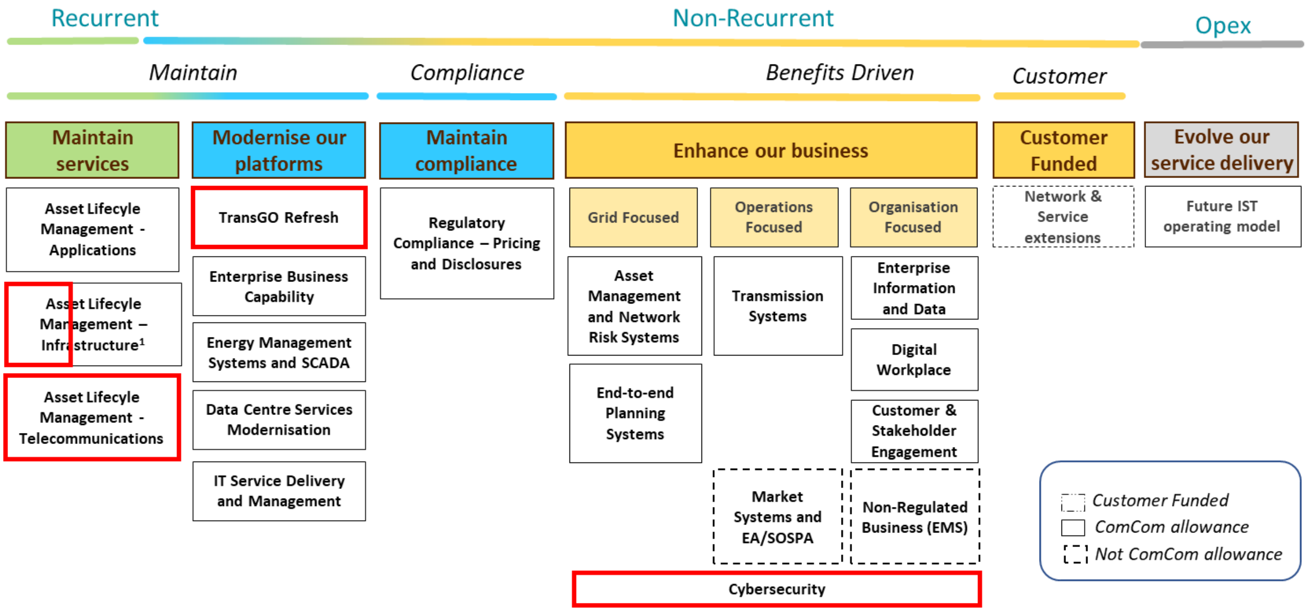
Telecommunications, Network and Security Systems manage approximately:

- 7500km Fibre
- 560 Multiplexors
- 38 MPLS Routers, modernising to 360
- 2700 Network Devices

Capex & SaaS Opex

RCP4 Forecast

$150.4m



1 – IP Networking assets are covered under Asset lifecycle management – Infrastructure sub-strategy and in TNSS Portfolio

Asset class strategy

Strategic direction

Our strategic ICT direction is summarised below.

TransGO Refresh - major reinvestment to modernise our telecommunications network to ensure the network continues to meet the needs of the business

Several key components of our nation-wide area network, TransGO, are reaching the end of their effective life. This is driving a major investment to modernise the network during the latter part of RCP3 and RCP4. This investment was first targeted for the start of RCP3, but the pre-purchase of spare equipment and careful lifecycle management enabled this to be deferred. As part of the RCP3 submission, we articulated the possibility that some investments for TransGO may need to be brought forward. As part of the development of the TransGO Refresh sub-strategy we revisited the services supported by the communications network and reconfirmed their current and future requirements. The development of some of these services is informed by other ICT and business strategies and include:

- Supporting the adoption of cloud services and the modernisation of our data centre services.
- Supporting our field mobility systems.
- Supporting the ongoing upgrade and modernisation of our line protection and telemetry systems.
- Supporting the development and deployment of our digital substation solution.
- Supporting our substation asset management capabilities.

We anticipate that this will drive the need for more services and greater network capacity into our substations while shifting network services away from our data centres and towards internet and cloud hosted services.

The remote nature of some of our sites, the specialised nature of our high voltage line protection and Supervisory Control and Data Acquisition (SCADA) telemetry services, and the design constraints they place on the communications network means that we cannot source telecommunications services from the open market for these. This, along with our existing long-term commercial commitment to our national fibre infrastructure drives us to continue to deliver these services using bespoke network infrastructure.

For our network services that are not industry specific, we have a choice to either leverage our dedicated network infrastructure or to source services from the telecommunications market.

Cybersecurity - protecting our people, systems and assets

We use cybersecurity controls to secure our people, systems and data. We ensure we understand and measure risk and respond with the appropriate level of information security controls.

The cybersecurity landscape continues to change, with:

- An increasing number of evolving cyber threats targeting organisations like ours.
- Increased use of data sharing, cloud-based services, artificial intelligence, and connected Operational Technologies.
- The evolution to a digitally enabled workforce and new ways of working.
- How we respond to business, technology, and threat change, including the TransGO Refresh and Data Centre Services Modernisation.

We are adopting and applying appropriate controls for data management, privacy, and security, to continue to provide our services in a safe and secure manner.

Our strategic direction is to drive cybersecurity by design, and to maintain and modernise our security controls to ensure Transpower continues to operate within our risk appetite.

The consequential cost of cybersecurity control failure remains significant and could include failure to operate the National Grid or Electricity Market.

Asset lifecycle management - effective lifecycle management of our existing assets

Our asset lifecycle investments are informed by our *Cybersecurity, Asset Lifecycle Management - Infrastructure* and *Asset Lifecycle Management - Telecommunications strategies*. These strategies set out how to lifecycle manage our existing assets; optimise our investment and manage our risk.

Our *Cybersecurity sub-strategy* addresses our future investment across all aspects of Cybersecurity. This includes the lifecycle of our existing physical security assets and supporting systems (e.g. Firewalls). We are adopting a low-risk approach to this investment ensuring our assets remain supported.

Our *Asset Lifecycle Management - Infrastructure* and *Asset Lifecycle Management - Telecommunications strategies* inform our investment for each class of assets. The approach for each asset class is defined considering a simple likelihood/impact model which takes into consideration the criticality of the services supported by the assets.

Data centre service modernisation – supporting our migration to the cloud

The *Data Centre Modernisation strategy* directs our approach for providing cloud and datacentre compute services. This portfolio will support this strategy by evolving the telecommunications, networking and security services to meet the needs of this modernisation.

Our delivery in RCP3

Our most significant investments to date in RCP3 focused on:

Telecommunications

Our recurrent maintain investments to date have been aligned with our lifecycle objectives to maintain capability and service levels, support process efficiency and meet the privacy and security standards.

To extend the life of our current TransGO assets and defer the major TransGO refresh investment to RCP4, we have implemented several network reconfigurations and localised capacity upgrades. Early in RCP3 we decided to change from a strategic network refresh to a tactical approach where changes were completed on an as-needed basis. We also sourced sufficient strategic spares for critical equipment to reliably maintain the continuity of operations. This reduced the level of investment required and redirected the investment towards life-extension of TransGO and black-start requirements.

TransGO Refresh completed the procurement selection phase and has progressed onto site preparations and network design which will continue into RCP4.

Network

IP Network Equipment Lifecycle has been an ongoing recurrent investment which maintains the capability and service levels for data networking equipment. This has been supported by modernising IP networking management tools, including rationalising and consolidating the current toolsets. It has delivered a consolidated and holistic end to end view of the network.

The corporate office and warehouse Wi-Fi service was refreshed, and the existing office access points were redeployed to the substations.

Operational Unified Communications endpoints and central call control equipment refresh has been initiated and will be completed early RCP4 while maintaining service levels and availability requirements.

Cybersecurity

We continue to use cybersecurity risk modelling to ensure we enhance our existing controls and implement new controls, where changes to our risk posture occur because of new technology, changes in the threat landscape, or the way we deliver services and requirements from our customers and industry.

We invested in initiatives that were prioritised based on risk reduction, defined budget and what can be achieved in each financial year of an RCP period. This process is repeated on an annual basis based on an updated cyber threat profile for Transpower and results of our ICT assurance programme. This investment modelling approach is repeatable, contextual, scalable and directly based on our risk-based approach to managing cybersecurity.

Key highlights to date include:

- Enhancement of our endpoint detection and response (EDR) capabilities.
- Selection of a new firewall solution and ongoing implementation as part of the lifecycle refresh programme
- Selection and implementation of a new web proxy solution that improves seamless protection across on-premises and off premises Internet access.
- Enhancement of our Operational Technology (OT) visibility and security within substation networks to address OT-specific threats.
- Enhancement of our Identity and Access Management (IDAM) capabilities.
- Modernisation of our SOAR/SIEM platform (cyber operational monitoring platform), cybersecurity threat hunting and incident management capabilities.
- Enhanced our secure software engineering practices, processes, and tools within our delivery practices. Enhanced service resilience against Distributed Denial of Service (DDoS) attacks.

Our future investments

Our investments across RCP4 will be targeted at these key areas:

TransGO

Our TransGO WAN assets are being modernised in line with the TransGO Refresh sub-strategy. Our underlying fibre network is retained while the telecommunications equipment supporting our high voltage line protection systems will be refreshed including critical and non-critical substation IP Services. It leverages the substation network investment to also modernise core network connectivity between our data centres, control centres and offices.

TransGO Refresh site preparations and network design continue in early RCP4. This is followed by Technical Acceptance Testing (TAT). This enables network build and service migration to be completed before the current network reaches the end of vendor support in 2028. Planning and preparation for this started in RCP3 with most of the capex investment occurring in the first 3 years of RCP4. To minimise the impact on our operational services we will need to operate parts of the old and new network infrastructure in parallel for several years and need to temporarily lease additional fibre across much of the network. During this time our operational costs will temporarily increase as we support and maintain both sets of infrastructure.

We will also modernise our current cloud connectivity to Hyperscaler providers, including Azure, AWS and other cloud providers. This aligns with our Data Centre Services Modernisation sub-strategy. We will also add an Internet connection at Waikoukou to enable Internet offload at our largest office, rather than carry the traffic over the TransG0 network

Cybersecurity

Our cybersecurity assets will continue to be maintained and modernised in line with the *Cybersecurity* sub-strategy to manage our cybersecurity risk to the agreed risk appetite.

We will continue to use the RCP3 approach to cybersecurity risk modelling and prioritisation for investment across the following initiative categories:

- Maintain and modernise existing capabilities. Key initiatives include:
  - Substation Network Firewalls
  - Identity & Access Management Capabilities
  - OT Vulnerability Management
  - Software Security
  - Security Logging & SOAR platform
- Sustain security control effectiveness.
  - The expenditure proposal relating to this category has been rejected for RCP4. Proposed initiatives will be refined and reevaluated for implementation by funding substitution through our productisation governance process.
- New capabilities in response to threat change. Key initiatives include:
  - Critical Applications Security Risk Improvements
  - Market System Security Investments
- New capabilities in response to business change
- New capabilities in response to technology change

Lifecycle management – Network

Our IP networking assets will continue being maintained in line with the Asset Management - Infrastructure asset lifecycle management strategy. We will continue to invest annually to maintain our fleet of IP network switches and routers to an appropriate level of support to meet the business need. This lifecycle investments will increase as our substation IP network assets introduced in the last ten years approach the age where they need to be refreshed. As we transition away from our current physical data centres we will reduce our ongoing investment in our datacentre IP networking infrastructure. We will also continue our regular investments to maintain our operational and corporate unified communications platforms to the appropriate service level meeting the business needs.

Lifecycle management - Telecommunications

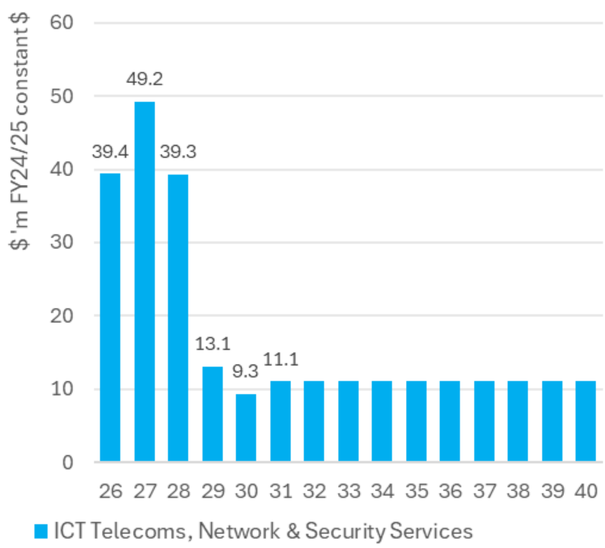
Our Telecommunications assets will continue being maintained in line with the Asset Lifecycle Management - Telecommunications strategy. We will continue annual maintenance of our supporting substation infrastructure e.g. batteries and power supplies and lifecycle upgrades of our device firmware and network management applications. We will perform the minimum required updates to the TransGO network up to its replacement.

Forecast expenditure

Capex and SaaS Opex: Since our AMP 2023 we have revised our roadmap to align with our updated ICT sub-strategies.

Figure 136 shows Telecommunications, Network and Security Systems Capex and SaaS forecast.

Figure 136: Telecommunications, Network and Security Systems - AMP 2025 forecast (including capex reclassified as SaaS Opex)



ICT Opex

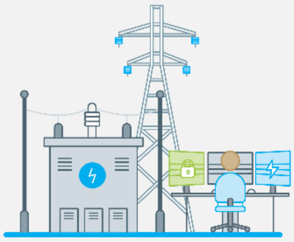
Our ICT Opex portfolio covers the external costs to run our ICT function and comprises leases, third party support and maintenance, outsourced services, licenses, communications and control, and investigations.

Expenditure related to people in our teams i.e. costs of staff, contractors, consultants and overheads associated with these resources is included within the scope of business support Opex and is explained in the separate section on business support Opex. We continuously try to optimise our workforce by deciding between insourcing and outsourcing arrangements to balance the trade-offs between quality, cost and in house capability.

The figure below shows all the ICT sub-strategies and asset lifecycle management strategies categorised by investment type. In red we highlight the area covered in this portfolio.

ICT Opex snapshot

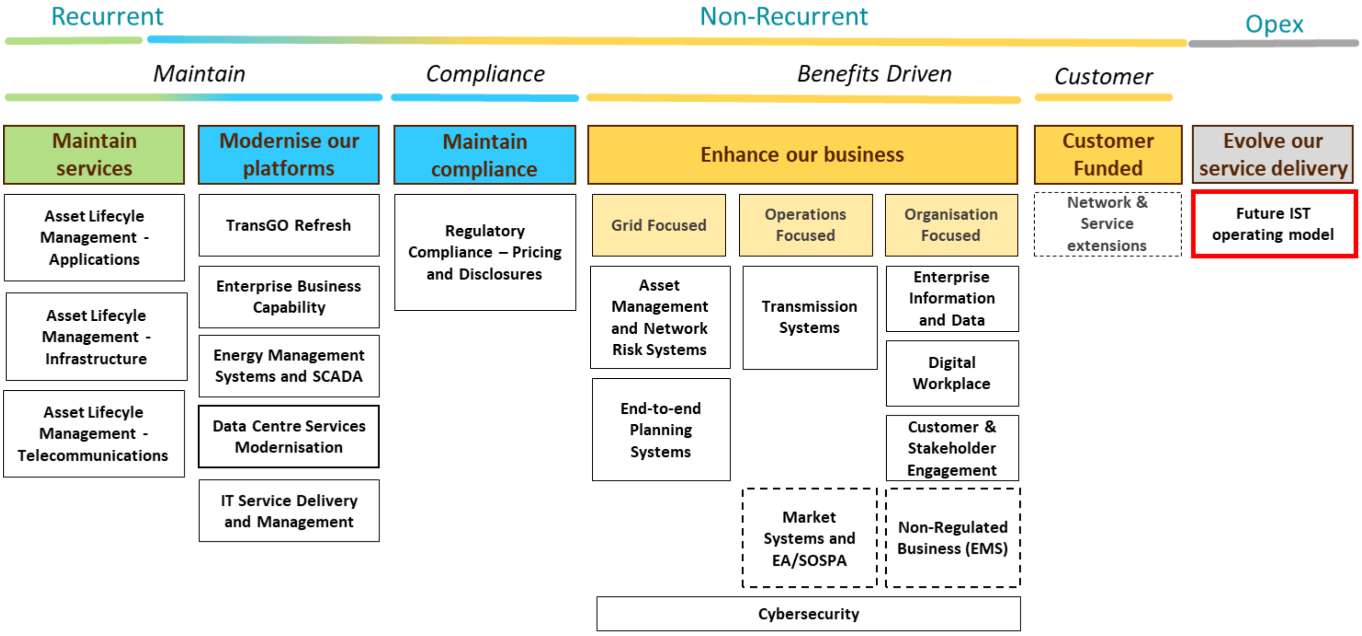
ICT Opex complements the delivery of investments across all five ICT portfolios



Opex

RCP4 Forecast

$251.3m



ICT Opex Strategy

Strategic direction

Our ICT Opex portfolio is defined by the work programme set by our sub-strategies and asset lifecycle management strategies as outlined in the five ICT portfolio plans.

We applied the base-step-trend approach to forecast our Opex. We used the FY22/23 actuals as a base from which adjustments are forecasted due to known initiatives and trends. This chapter expresses the expenditure numbers in FY24/25 real dollars.

The strategic investments with the most significant impact on the forecast Opex step changes across RCP4 are:

- **Our investments in data and analytics, Digital Engineering, and Generative AI** capabilities are contributing to an increase in licencing and SaaS subscription costs.
- **The modernisation of our data centre services** from on-premise infrastructure to cloud services will increase our infrastructure costs. However, this rise will be partially offset by lower hosting expenses and reduced capital investment in hardware.
- **Increases in license costs** are driven by new capabilities for applications identified in our sub-strategies and outlined in the five ICT portfolio plans.
- **Following the major upgrade to our TransGO network** the Opex cost of running our telecommunications network will increase, driven by replacement of our radios and new core network capacity.

Our RCP4 forecast will see a shift in cost classification from capex to Opex for any initiatives recognised as SaaS arrangements. Our portfolio plans present both capex and SaaS Opex together for comparative purposes.

Our investment

Leases

From 1 July 2019, under NZ IFRS 16 Leases, our long-term leases for fibre and data centres have been capitalised. Of the remaining leases, the most significant costs relate to telco leased circuits and other minor leases. These were not capitalised as they did not meet the capitalisation criteria of the standard.

We continue to manage our lease costs carefully. With the re-classification, improvements in lease costs will show in the depreciation line rather than under Leases.

Our total forecast for lease costs is $11.7m for RCP4.

Third-party support and maintenance

- Our total forecast for in this category is $38m for RCP4. The significant cost elements in this area are: general infrastructure support and maintenance
- support for critical systems (SCADA/EMS)
- Inter Control-Centre Communications Protocol (ICCP) support
- enterprise application support by various service providers
- telecommunications support and maintenance
- internet gateway, video, telephony and data network support
- outsourced IT supply
- bureau/data services

We expect to see annual third-party support and maintenance to increase progressively during RCP4 due to several initiatives.

IST outsourced services and cloud

Our total forecast for in this category is $73.5m for RCP4. The significant cost elements in this area are:

- infrastructure support (server management and desktops)
- operations management of the TransGO network by specialist providers supporting the Transpower Network Operations Centre
- data centre facilities management
- operations management of our on-premise Infrastructure and tenancies
- amortisations of telecommunications service fees
- service desk services
- cloud services

The remainder covers a range of other outsourced providers for system and operations support.

We expect to see increases in our IST Outsourced Services and Cloud across RCP4 driven by:

- An increased cost in RCP4 associated with the transition from our current “own and control” data centre approach towards adoption of the “as a service’ approach where we utilise leveraged data centre services and an ongoing increase in Infrastructure as a Service costs following the transition. This will be partially offset by reduced hosting costs and capital refresh costs.
- An ongoing increase in cloud services as more applications are delivered via cloud-based Software as a Service instead of on-premise. This will be partially offset by a reduction in hosting costs.
- Software licensing costs increase in line with the forecasted growth in Transpower FTEs, reflecting additional user requirements across our core platforms.
- Increased costs of outsourced core capacity and maintenance services in line with the TransGO upgrade.

IST licences

The base costs in this category for Microsoft, Oracle, and other licences was $11.3 million. All Transpower software licences are consolidated into the ICT Business area.

Our investment in Digital Engineering capabilities and generative AI is expected to drive an increase of approximately $1 million per year in licencing and SaaS subscriptions. Our investment in Cybersecurity and firewalls required for TransGO upgrade will drive a further increase of license costs by $3.3 million in RCP4.

Our total forecast for in this category is $60.4m for RCP4.

Communications and Control

The base costs in this category totalled $1.4 million. We have maintained our discipline in managing preventative maintenance visits to the grid sites in a conscious effort to drive costs down. The current level of spend is believed to be sustainable in the long-term based on current operational needs and will continue to be required also after we refresh our telecommunications network (TransGO Refresh).

Our total forecast for in this category is $8.5m for RCP4.

Investigations

Selected investigations are carried out on an as required basis. The level of expenditure is nominally capped to an assigned budget.

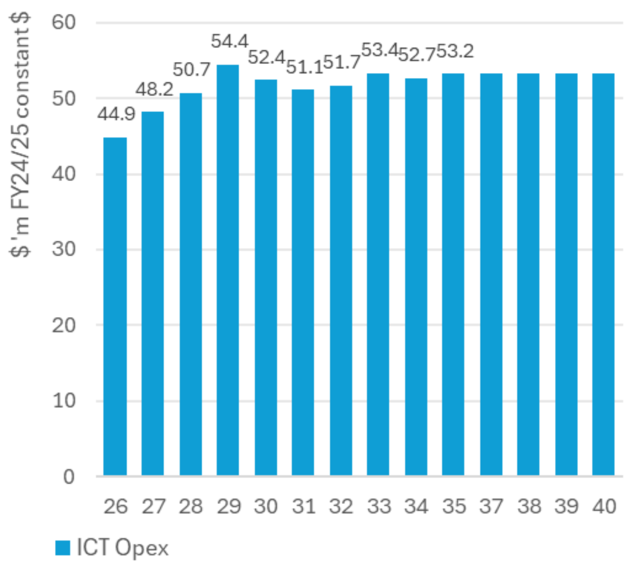
The investigation expenditure is related to the size of our delivery. Our forecast was built bottom up based on the Capex and SaaS Opex investments included in our forecast. With significant investments in Data Centre Services Modernisation, TransGO Refresh and Enterprise Business Capability in RCP4, we expect to see a spike when the investigations for relevant projects take place. Similarly, there is a drop off thereafter for the latter years of RCP4.

Our total forecast for in this category is $7.9m for RCP4.

Forecast expenditure

Opex: Figure 137 shows the ICT Opex forecast.

Figure 137: ICT Opex (excluding capex reclassified as SaaS Opex)



Business Support Asset Class Plan

Business Support Asset Class Plan

Our business support assets include assets not otherwise included in other asset classes and required for the successful operation of the business as a whole. They are diverse in nature and, as such, are managed individually, dependent on the type and nature of asset involved. This ACP covers:

- Office buildings
- Vehicles
- Minor fixed assets – office equipment
- Minor fixed assets – IT and other
- Residential houses
- Forecast RCP3 and RCP4 expenditures.

Table 31 below provides a summary of the assets included.

Table 31: Business support asset population

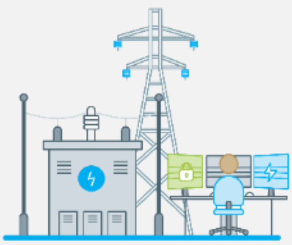
Asset category	Description
Office buildings	Two leased offices – Wellington and Palmerston North Three owned offices – Auckland, Hamilton, and Christchurch
Vehicles	123 vehicles (including passenger vehicles, utility vehicles, and minibuses)
Minor fixed assets - Office equipment	Office desks, chairs, and meeting room furniture for all our corporate offices, plus the warehouses, training centres, Hamilton Control Centre, and NGOCs
Minor fixed assets – Information Technology	Replacement of IT office equipment, e.g. laptops, mobile phones, and peripheral devices for corporate end users.
Residential houses	Two residential properties that are tenanted. We also have 15 houses that are used as emergency accommodation by our contractors and field staff

Asset class snapshot

Population

123 Vehicles

5 Corporate offices



Capex

RCP4 (forecast)

$41.1m

Asset class strategy and lifecycle approach

Each of the asset categories are described below.

Office buildings

We have corporate offices in Auckland, Wellington, Hamilton, Palmerston North and Christchurch. The Auckland, Hamilton and Christchurch offices are on sites owned by Transpower, so the maintenance of these sites is included as part of buildings and grounds asset management. The Wellington and Palmerston North offices are leased. All the offices are in good condition and regularly maintained.

Planning

Various works are planned at all the offices

Operations and maintenance

We have agreements with suppliers to maintain the office buildings. These are regularly reviewed.

Disposal and divestment

We are not proposing to dispose of any offices during RCP4.

Grid skills training facilities

We have grid Skills training facilities in Huntly, Blenheim and Bunnythorpe that offer training programs aimed at developing a qualified workforce for the transmission industry. All the sites are owned by Transpower and the maintenance is included as part of buildings and grounds asset management.

Planning:

Included within the forecast is $10.3m to expand the capacity of our Grid Skills training facilities. Grid skills training is increasing, as we increase the overall workforce to deliver the required work in RCP4 and beyond.

Operations and maintenance

We have agreements with suppliers to maintain the training facilities.

Disposal and divestment

We are not proposing to dispose of any training facilities during RCP4.

Vehicles

Our vehicles are predominantly located at the Auckland, Palmerston North, and Christchurch offices. They are either used as pool vehicles or allocated to staff who regularly visit our sites and landowners.

Planning

We replace vehicles when they meet our replacement criteria. We have committed to changing all our passenger vehicle fleet to hybrid or electric vehicles. We participate in the All of Government contract for the supply of motor vehicles, which is regarded as the best available price offered in the market. A similar approach is planned for RCP4.

Operations and maintenance

The vehicle fleet is managed by an external provider who takes a consistent and cost-effective approach to maintenance based on manufacturer's guidelines. GPS is fitted to vehicles to ensure they are operated efficiently and safely. We also participate in the Ministry of Defence syndicated fuel contract with BP to minimise our annual fuel bill.

Disposal and divestment

Generally, petrol vehicles are replaced after 4 years or 120,000 kms travelled and diesel and electric vehicles are replaced every 5 years or 150,000 kms travelled. We usually sell vehicles through established auction houses.

Minor fixed assets - Office equipment

Planning

Each year, we review the office equipment needs at all our offices and budget for replacements, or new vehicles, in the following year's business plan. Office furniture mainly consists of desks, chairs, and meeting room furniture. There are numerous projects in 2025/26 to replace office equipment.

Operations and maintenance

Office equipment is repaired or replaced as required. We purchase office equipment from established furniture suppliers.

Disposal and divestment

We sell redundant office equipment or donate it to charities.

Minor fixed assets – ICT

Our digital workplace consists of end-user computing devices for all corporate users, which are managed and maintained by our desktop team.

Planning

The forecast plan for the asset class comprises:

- Refresh of primary devices for staff laptop and desktop bundles (with keyboard, mouse, pen and cabling) that are 4 years old based on purchase date
- Refresh of high-performance graphics laptops used by specialist graphics, digital modelling, and mapping staff and are 4 years old based on purchase date
- Refresh of smartphones for employees that are 3 years old based on purchase date
- Peripheral equipment for the office – monitors, headsets, webcams, encrypted USBs, laptop bags and occupational safety and health-recommended items such as ergonomic keyboards
- Refresh of display screens and purchase of new miscellaneous collaboration equipment across Transpower.

Operations and maintenance

This category comprises numerous low-value IT items that are maintained or replaced. The budget provides equipment for both new staff as well as replacing existing equipment that has reached the end of its useful life.

Disposal and divestment

These assets are replaced in line with industry standard (on a 3 to 4-year cycle, depending on the asset type). These assets are supported by a regularly reviewed disposal policy, with a focus on sustainability.

Residential houses

The houses are predominantly ex-substation operator houses that have been retained to act as a buffer between adjoining private properties. Some houses have been purchased as part of projects and retained as strategic landholdings for future line routes or substations.

Planning
Each year, we review the residential house portfolio and identify any properties for disposal. We typically divest a house if the maintenance becomes too expensive, the land is surplus to requirements, or as part of a substation asset transfer. Any houses required as part of a project are identified during the project planning stage, and the purchase is budgeted for in the project. A similar approach is planned for RCP4.

Operations and maintenance
The tenanted houses are managed by external property management companies who collect the rent, arrange any maintenance that is not the responsibility of the tenant and ensures compliance with any relevant legislation. The emergency houses are managed by the relevant regional office, and any maintenance is completed by the substation grounds and buildings maintenance contractor.

Disposal and divestment
We sell the houses via a real estate agent or tender them for removal to ensure the highest price is obtained.

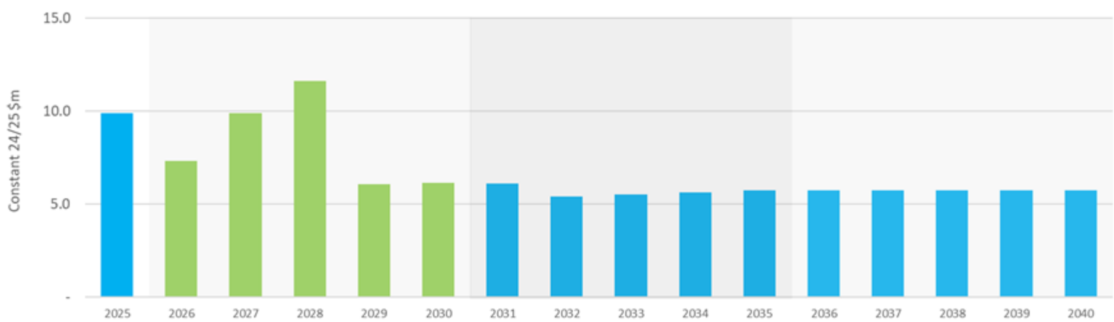
Expenditure Summary

Figure 138 shows the forecast capex. Included within the forecast is $10.3m to expand the capacity of our grid skills training centre. Grid skills training is increasing, as we increase the overall workforce to deliver the required work in RCP4 and beyond.

Operating lease costs

The Wellington and Palmerston North office leases are being capitalised in accordance with the new IFRS 16 Accounting Standard.

Figure 138: Business Support forecast capex



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