Transgrid

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Telecommunications Systems Renewal and Maintenance Strategy

AMS Asset Class Strategy

2021/2022

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Table 1 – Change from previous version

Revision no	Approved by	Amendment
7	A. McAlpine – A/Head of Asset Management	New document template Review and update to deliver the 2021/22 Network Asset Strategy.
6	L. Wee – Head of Asset Management	Update document structure Review and update to deliver the 2020/21 Network Asset Strategy.
5	L. Wee – Head of Asset Management	Review and update to deliver the 2019/20 AM Strategy and Objectives.
4	L. Wee – Head of Asset Management	New document structure Review and update to deliver the 2018/19 AM Strategy and Objectives.
3	M. Jones – A/Manager/Asset Management	Review and update to deliver the 2017/18 Business Plan and further enhance the strategy.
2	L. Wee – Group Manager/Asset Strategy	Review and update to deliver the 2016/17 Business Plan and further enhance the strategy.
1	L. Wee – Manager/Asset Strategy	Separated into standalone document, review and update to deliver the 2015/16 Corporate Plan and further enhance the strategy.

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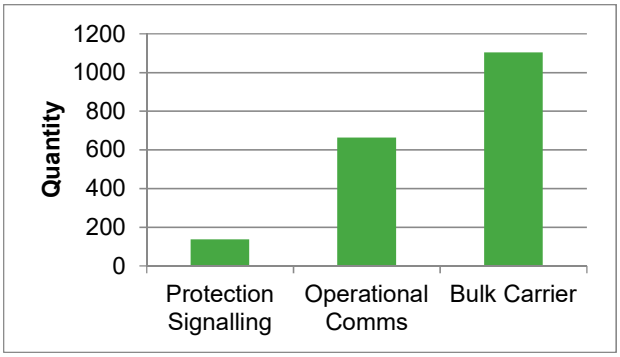
Executive Summary

Transgrid's network is made up of over 1800 assets providing telecommunication services. Managing the risks associated with an ageing population and adapting to new technologies are challenges requiring a consistent and aligned approach to maximise value. Asset condition information is being collected to better model asset health and ensure corrective and replacement activities are performed at an optimal time and cost.

Asset Review



Transgrid's telecommunications systems can be defined as assets providing communication medium for critical services throughout our network for remote monitoring and control.

The telecommunications systems portfolio predominantly consists of a variety of assets including terminal equipment, DC power systems, radio towers supporting Microwave and VHF services, and a large fleet of fibre optic cable. Transgrid's telecommunications asset base that is critical to ensuring the reliable operation of the HV electricity network

During 2020/21 telecommunication assets underwent the following developments:

- Continued improvements in asset data and its collection
- Improved route diversity
- Improved bandwidth capacity across the network

Achievements

In 2020/21 Telecommunications Systems achieved significant goals including:

- Realisation of cost savings from staged reductions in radio sites inspection frequencies.
- Continuation of Transgrid's prescribed MPLS-TP network rollout.
- Development of an optimised set of telecommunications asset data rules.
- Standard design guideline development for mast type radio tower guy wire visual identifiers and anchor point protective barriers.
- Integration of radio tower inspections into the Asset Inspection Manager (AIM) system.

Challenges

- Obsolescence of certain telecommunications assets, components and technologies.
- Asset decision making based on legacy data sets housed in disparate systems.
- Monitoring and improvement of systems to ensure consistent and accurate data capture by regulated and non-regulated businesses.

Initiatives

- Continual improvements in asset data to increase the efficiency and accuracy of works
- Reconciliation of data systems to minimise inconsistencies in asset information.
- Renewal of obsolete and ageing telecommunications assets with modern systems capable of self-checking.

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1. Foreword

1.1. Foreword

This document defines the renewal and maintenance strategies for Transgrid's prescribed Telecommunications Systems fleet. In doing this it applies the overarching asset management strategy and objectives, and relevant Lifecycle Strategies.

The document identifies the emerging issues with Transgrid's prescribed Telecommunications Systems assets, and details the renewal and maintenance initiatives to be implemented in response to these issues. The output of the strategy is the asset management program of works, which is derived via distinct paths as follows:

- The renewal and disposal initiatives are considered through the Prescribed Capital Investment Process and managed through the Portfolio Management group, which then leads to the resource-optimised capital works program.
- The maintenance initiatives directly drive the maintenance regimes which are detailed within the relevant Maintenance Plan. The maintenance plans are then resource-optimised through Transgrid's Enterprise Resource Planning (ERP) system, Ellipse and supporting applications such as TRAC.

The strategies contained in this document cover the prescribed assets for a five year period from July 2022.

1.2. Overview

We have reviewed the historical technical performance and capital and operating expenditure for Telecommunications assets within the network and we have determined that our current initiatives to date are successfully delivering our stated targets from last year.

The key initiative surrounding modernisation of the infrastructure surrounding our Telecommunications systems has led to greater confidence in the performance of our assets with increases in issue detection due to alarms. This indicates that we are no longer relying as heavily on preventative maintenance to identify failed components of the network.

Overall performance between 2016/17 and 2020/21 has seen:

- An overall reduction in unitised capital expenditure
- Continuance of maintaining low unitised costs of operating expenditure
- A minimised maintenance portfolio meeting our performance requirements while exceeding scoping benchmarks at the Australian and International level.

A review of updated capital cost estimates, asset performance, health and condition has identified several initiatives that will be adjusted to maintain sustainable age profiles and risk levels across the AM portfolio. As it stands, the Digital Infrastructure suite of strategies have been revised with initiatives resulting in:

- A committed $11 million of capital expenditure over the next two years
- A further estimated $40 million over the following five years

In addition to the expenditure targets, initiatives are continuing to:

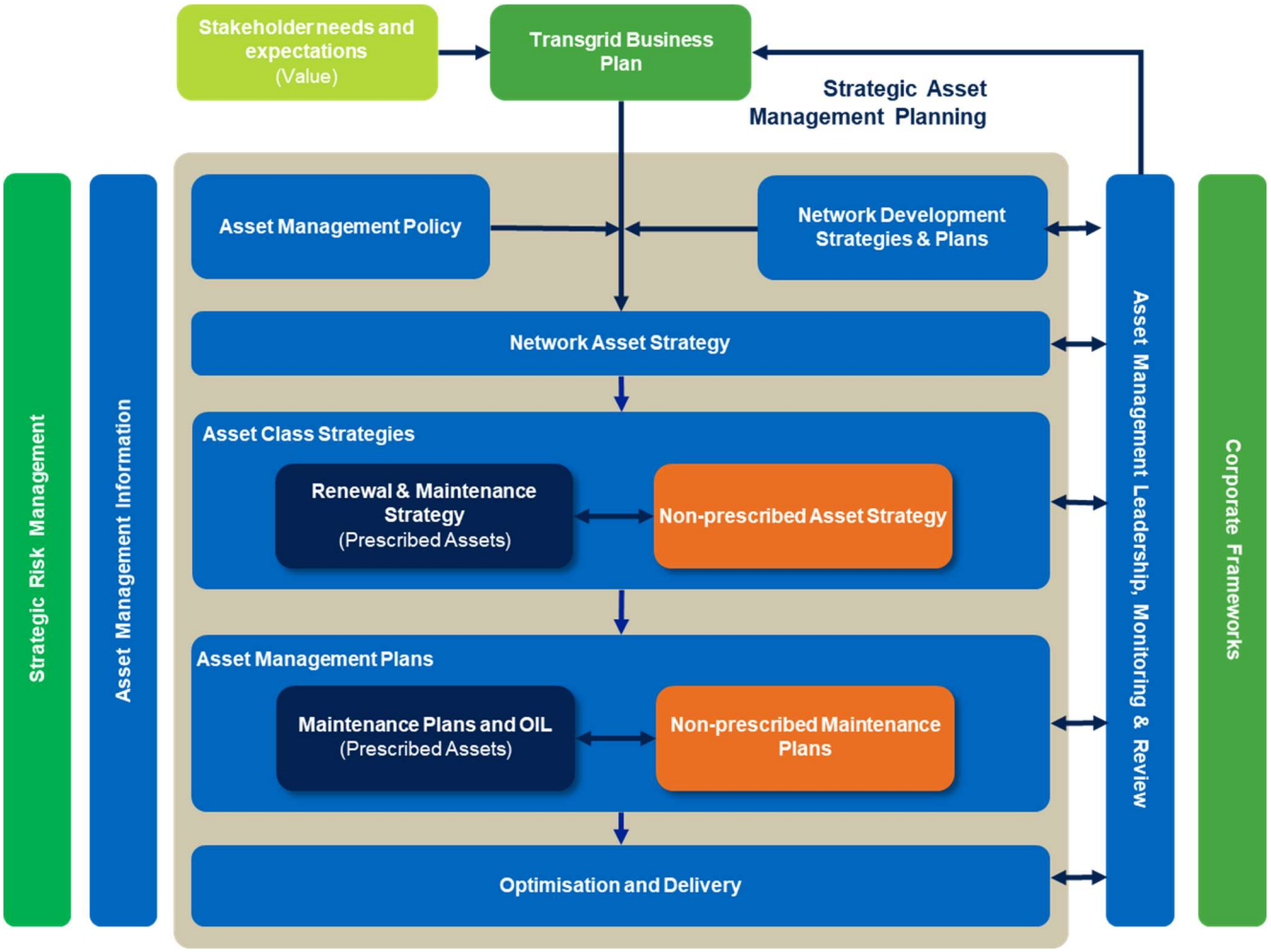
- Limit planned maintenance requirements for deployed assets – effectively reducing OPEX costs
- Limit components in any system – effectively reducing defect costs
- Continual improvements in asset data and analysis – which will increase efficiency and minimise the potential for compliance breaches

2. Context and Background

2.1. Relationship to Asset Management Systems

This Renewal and Maintenance Strategy document is one of several that comprise the Asset Management Strategies within Transgrid's Asset Management System. This document sits below the Asset Management Strategy and Objectives document as shown in Figure 1.

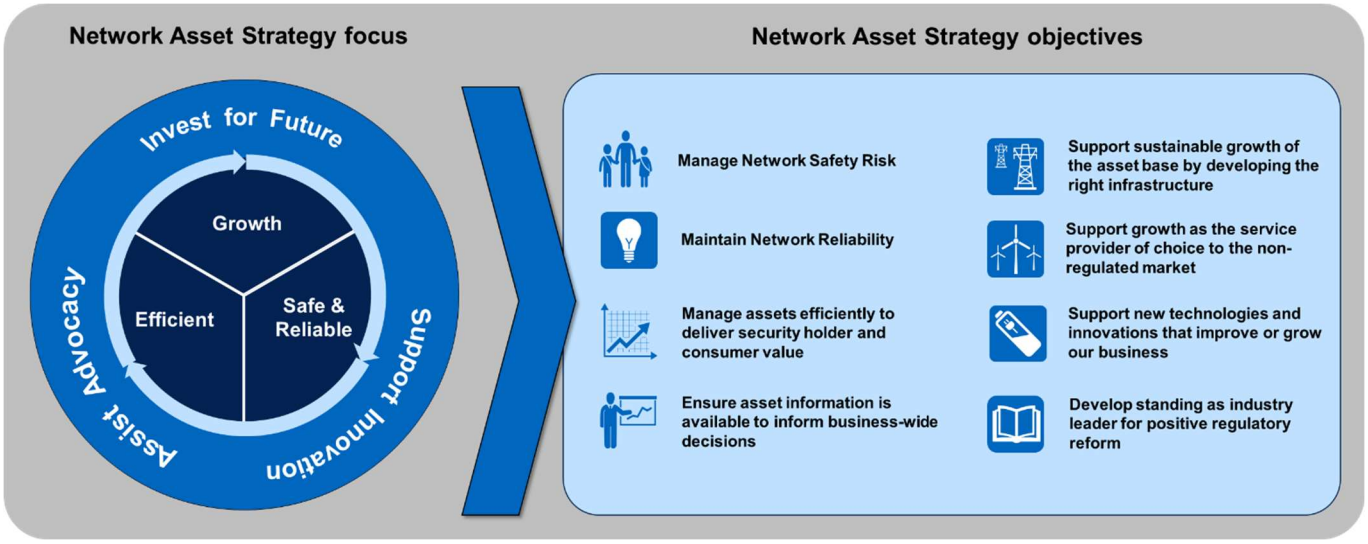
Figure 1 Asset Management System Hierarchy



2.2. Asset Management Line of Sight

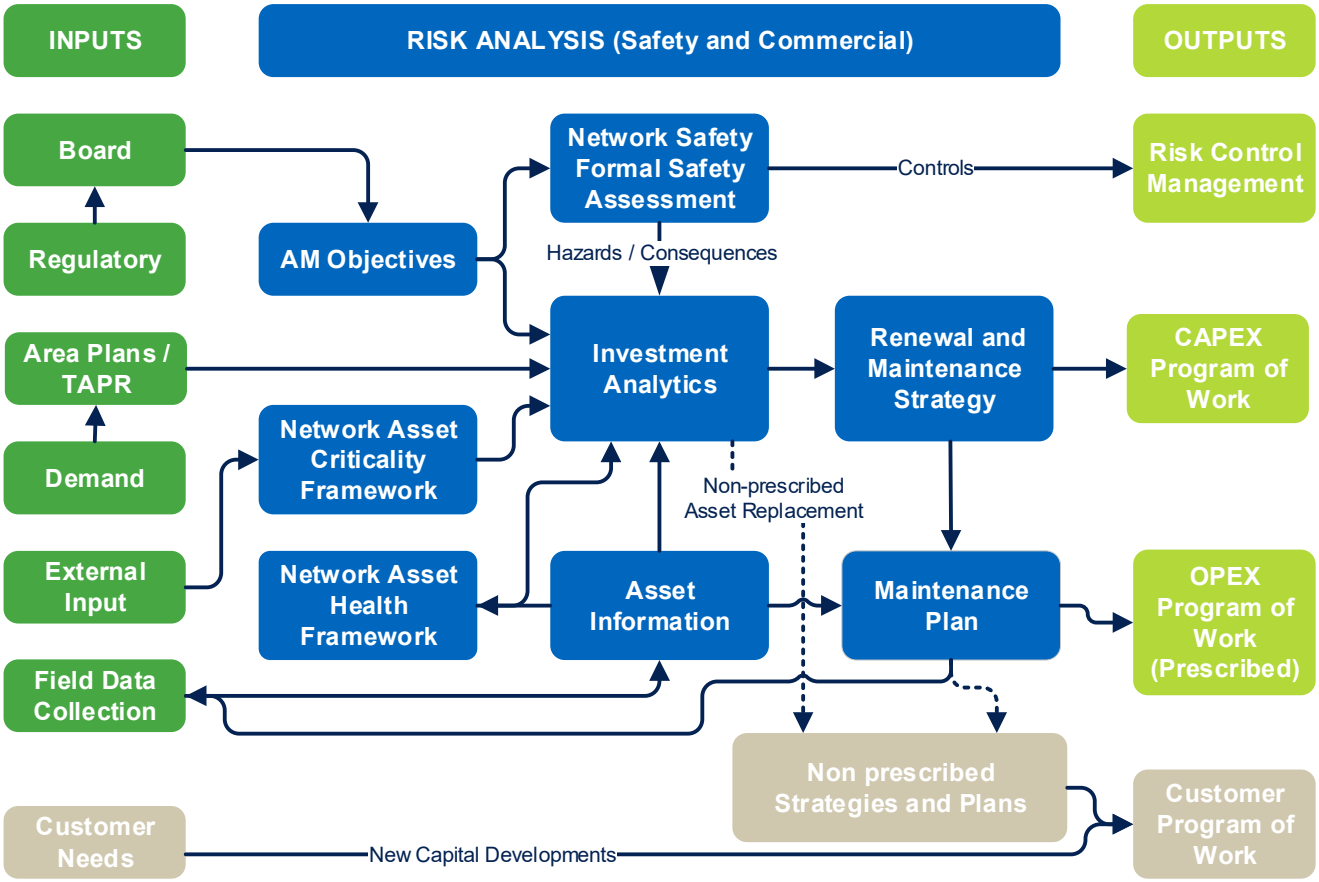
The renewal and maintenance strategic initiatives set out in this document support the achievement of the strategies set out in the Asset Management Strategy document. The strategic alignment of the initiatives in this document to the Asset Management Strategy document is based on meeting its strategic themes.

Figure 2 Network Asset Strategy Key Themes



2.3. Renewal and Maintenance Process Overview

Figure 3 Investment Development Framework



2.4. Asset Overview

2.4.1. Scope of Assets

The following Telecommunications assets are within the scope of this strategy. This totals over 1800 assets providing telecommunications services in this category:

- Terminal Equipment
  - Power Line Carrier (PLC) Systems
  - Microwave Systems
  - Multiplexer Systems
  - Very High Frequency (VHF) Systems
  - Communications Monitoring Systems
  - Operational Telephony Network (OTN)
- DC Supply Systems - 50V and 12V DC
- Radio Towers – Limited scope
- Fibre Optic Cables – Limited scope

The following assets are outside the scope of this strategy:

- Buildings
- Land and Property Assets
- Market Metering Modems
- Control System Network Assets
- Secure Substation Zone (SSZ) Network Assets

2.4.2. Terminal Equipment Asset Base

Terminal Equipment are those end-point assets utilised for the sending and receiving of data over a transmission medium. The assets are comprised of five categories with estimated technical life of 15 years for each as outlined below:

- PLC Systems
- Microwave Systems
- Multiplexer Systems
- VHF Systems
- Monitoring Systems
- OTN systems

Terminal equipment assets serve our business as well as a variety of connected customers including Distributors, Generators and large commercial customers. These assets are utilised by AEMO and our Control Room to monitor and control the Network.

Table 2 Terminal Equipment Asset Base

Terminal Equipment Type	Quantity	Description
PLC	195	These installations are currently based on microprocessor circuits to generate signals and is frequency agile. The assets are capable of supporting voice as well as protection signalling functions. More modern versions based on digital transmission are capable of functioning with multiple signals transmitted over a single unit. The use of these systems is gradually reducing as increasing route diverse high bandwidth communications paths are established.
Microwave	132	These installations have traditionally been utilised to provide high bandwidth communications links prior to the proliferation of fibre optic medium. The systems are based on microprocessor circuitry and comprised of higher capacity “trunk” SDH systems and lower capacity “tributary” SDH systems. These systems are inclusive of all equipment required to convert an electrical signal to a microwave signal.

Terminal Equipment Type	Quantity	Description
Multiplexers	558	These installations are utilised to combine smaller bandwidth signals into higher bandwidth packets to maximise the utilisation of the connected communication medium. These assets are all microprocessor based circuitry. These systems can be separated into standard low-order, special purpose low-order and fibre SDH multiplexers.
VHF	512	This type of installation is utilised throughout Transgrid's network. Due to the remote nature of many of the organisation's assets, they provide a reliable communications interface for field staff. An additional function of the VHF network is a reliable communications link for the coordination of a "Black Start" event where the network requires a restart following a black out.
Monitoring	156	These types of installations are in service throughout all Transgrid communications sites. These systems comprise a Communications Alarm System (CAS) and a Backup Alarm System (BAS), and essentially monitor and report on the performance of all communications assets with a capacity for monitoring. The BAS is additionally used for very basic alarming of all critical systems at any Transgrid site. However, the BAS systems are gradually becoming obsolete due to the deployment of route diverse communications links and added redundancy in SCADA connection systems at sites.
OTN	99	This installation provides the critical communications link between each substation, DNSP, TNSP, AEMO and our Control Room. It provides the critical communications link to allow our Control Room, as the System Operator, to manage network contingencies and communicate switching requirements as required.

2.4.3. DC Supply Asset Base

DC batteries and chargers provide the sustained DC supply required for the operation of all telecommunications systems within Transgrid sites. The assets additionally provide backup to continue remote operation of the network during a catastrophic loss of auxiliary supply at a site.

DC Supply assets include the following categories of assets with an estimated technical life of 20 years:

Table 3 DC Supplies Asset Base

DC Supply Type	Quantity	Description
50V DC NiCd Batteries	39	These installations are an older standard utilising Nickel Cadmium battery systems to provide uninterrupted DC supply to our communications systems. Due to the nature of NiCd, they require specially designed battery rooms.
50V DC NiCd Chargers	56	These installations are an older standard utilising Nickel Cadmium battery systems to provide uninterrupted DC supply to our communications systems.

DC Supply Type	Quantity	Description
50V DC VRLA	203	Based on the latest design standards, these are maintenance free installations that can be installed in any location and do not require any special designs to manage gas release.
12V DC VHF	144	Standard DC supply installation for VHF radio systems. Due to the long timeframes for sustained supply required during black start events, these have traditionally been deployed as a standalone supply.

It is of note that the data for DC Supply is currently under transition to new data rules and quantities provided in the table above are indicative only.

2.4.4. Radio Tower Asset Base

Transgrid is responsible for Radio Communications structures at repeater sites where we are the Site Controller, and at substations where microwave radio is used to provide telecommunications links. Radio communication towers are comprised of four categories and have an estimated life of 40 – 60 years depending on the type.

Table 4 Radio Tower Asset Base

Radio Tower Type	Quantity	Description
Steel Lattice	79	These installations are generally used where an antenna height of greater than 30m is desirable, where high-availability is required, or where several microwave radio links may come together.
Concrete Pole	42	These installations are generally used at substations or at repeater sites close to the terminal Transgrid substations.
Wood Pole	8	These installations are only used for VHF installations.
Guyed Mast	3	These installations are only used for VHF installations.

Quantities provided in the table above are prescribed only as all radio towers are currently owned by the prescribed business. However, ownership of 12 radio towers is under consideration and likely to be transitioned to Business Growth.

2.4.5. Fibre Optic Cable Asset Base

Transgrid has a substantial optical fibre network providing high speed high bandwidth data communication links throughout the HV network. Fibre optic technology additionally provides advantages in negating electromagnetic interference and path profile issues typically associated with PLC and Microwave based systems. It is current policy to include OPGW in all new HV augmentations and any significant reconstruction works. The fibre optic cable assets have an estimated technical life of 50 years.

Table 5 Fibre Optic Cable Asset Base

Fibre Optic Asset	Quantity	Description
Optical Power Ground Wire (OPGW)	3440 km	Optical fibre built into the earth wire of transmission lines. These assets form the majority of the main telecommunications network.

Fibre Optic Asset	Quantity	Description
Underground Fibre Optic (UGFO)	770 km	Underground fibre optic cable is a valuable asset to include in any underground HV cable project to provide communications between the terminal stations. UGFO is also a very useful means of extending optical fibre communications to a site where OPGW or microwave radio is not suitable.
Microduct	3.5 km	This technology permits installation of a system similar to UGFO that may be readily expanded to many times the original number of installed fibres, and the original fibre cable may be replaced if it becomes faulty or if a different configuration becomes desirable. It is currently installed between Holroyd and Rookwood Road substations, and is under evaluation for other uses.
OPGW Joint Box	417	These assets are used to join lengths of OPGW to form continuous optical fibre between terminal stations. They have been specifically isolated as an asset class due to the potential for a type fault identified in 2002 to cause fibre failure. This fault requires ongoing monitoring.

It is of note that the data is currently being collected for fibre optic cable assets and quantities provided in the table above are indicative only.

2.5. Spares

Current strategy for spares is to maintain holdings which are proportional to the installed quantities in the network as per practices specified in the Digital Infrastructure Spares Policy. Additionally, we monitor the support availability for the different assets and a scale is applied as support is diminished.

When notification is received for the withdrawal of support for a particular asset, a review of that asset's historical performance, age profile and population size is carried out. Based on this review we may decide to renew the assets with a modern replacement or purchase sufficient spares to support the assets towards the end of their technical lives.

3. Current Performance

3.1. Review of Previous Renewal, Disposal and Maintenance Strategies

This section discusses the performance of the current prescribed asset base.

3.1.1. Historical Expenditure

Historical expenditure has been analysed from Transgrid's RIN submissions between 2016/17 and 2020/21.

3.1.1.1. Capital Expenditure

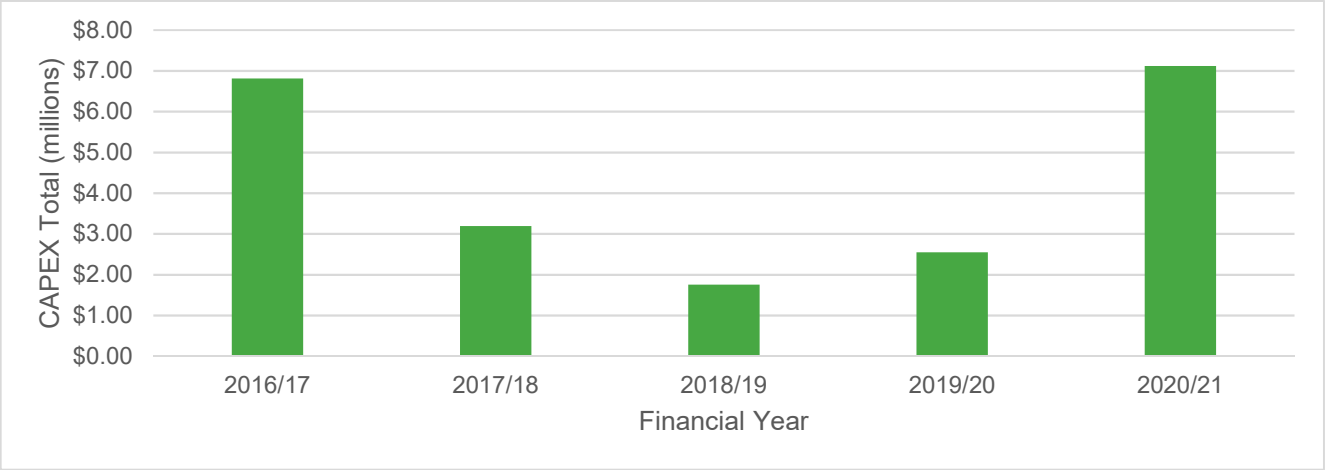
Previous initiatives had identified a general move for Telecommunications Systems to a run to fail based approach. This was applied to most telecommunications systems utilising modern principles and standards.

A few sites, that required significant effort to be upgraded to current standards, were invested in through capital expenditure.

There has been a shift in this strategy over previous years to address the withdrawal of manufacturer support for several assets within our installed asset base. This withdrawal, coupled with changes in technology have driven renewed investment to upgrade our telecommunications backbone.

Telecommunications is the backbone supporting the remote operation of our network. The capital expenditure had steadily declined for telecommunications assets from 2016/17 in alignment with the last few year's strategic objective. It is noted that expenditure in 2020/21 was considerably higher than previous years due to completion of Fibre Optic cables as part of our on-going Fibre rollout initiative.

Figure 4 Total Historical CAPEX



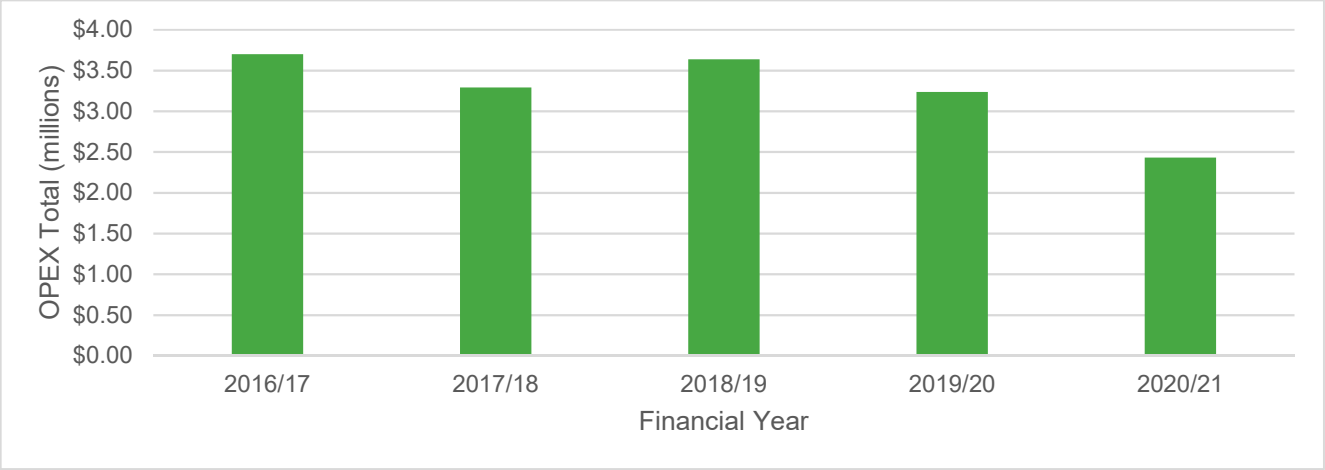
Capital expenditure has been targeted towards critical components for the last three years covering:

- 50V DC Supplies Renewals
- Multi-Protocol Layer Switching (MPLS) replacement of Multiplexers
- OPGW Rollout

3.1.1.2. Operating Expenditure

Previous initiatives had targeted a reduction in overall operating expenditure of the AMPOW. These reductions have been achieved through efficiency gains in maintenance delivery to reduce overall costs and a move to maintenance free operation of all capable assets. These have been targeted through a review of maintenance activities and their benefits. This has resulted in an overall historical downward trend of Operating Expenditure over the last four years.

Figure 5 Total Historical OPEX



The reductions in total expenditure highlighted above are a result of several factors. 2016/17 introduced a significant reduction in planned maintenance activities which resulted in defect only responses to equipment failures. Further efficiencies were achieved in 2020/21 through reduction in maintenance frequency of Nickel Cadmium based DC Supplies and merging the standalone preventative maintenance task for Dehydrator assets into site inspections.

A review of maintenance performance, actual versus budget costs, for 2020/21 is shown in Table 6 below.

Table 6 Telecommunications Maintenance Expenditure 2020/21

	Actual $	Budget $	Variance $
Routine Maintenance	384,342	441,801	-57,459
Condition	12,340	27,000	-14,660
Defect	1,160,210	798,000	362,210
TOTAL	1,556,892	1,266,801	290,091

Higher than budgeted corrective maintenance is often expected for the telecommunications asset fleet and is reflective of limited capital investment in recent years. Furthermore, our overall strategic direction is for defect only maintenance for most of the telecommunication assets. It is also noted that factors contributing to negative variances included early completion of some forecast works (2019/20), bundling efficiencies, COVID-19 and overall pressures on the AMWP budget resulting in deferral of works.

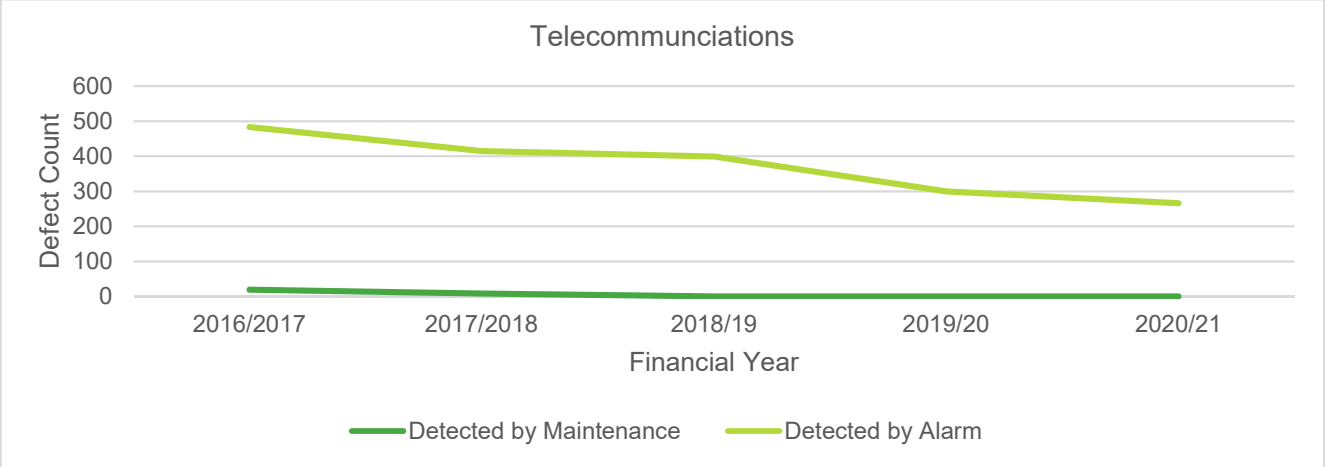
3.1.2. Review of Renewal and Maintenance Initiatives

Delivery of the existing Renewal and Maintenance Initiatives has continued to target the strategic objectives of Transgrid where the investment:

- can be shown to be in the best interest of consumers
- is required to add or maintain value to our stakeholders
- protects network performance and maintains our license
- supports future value and creates further opportunity

The historical investment in modern technology, particularly self-checking components, has allowed us to move away from a reliance on preventative maintenance to identify issues. New assets offer a higher availability of diagnostics and real time notification of issues.

Figure 6 Historical Telecommunications Issue Detection



As can be seen, issues detected during preventative maintenance activities has reduced throughout the last five years. As more assets are upgraded to modern technologies and standards, we are no longer waiting for a maintenance interval to discover issues with the assets. This means there is higher confidence in the availability of our telecommunications assets within the network.

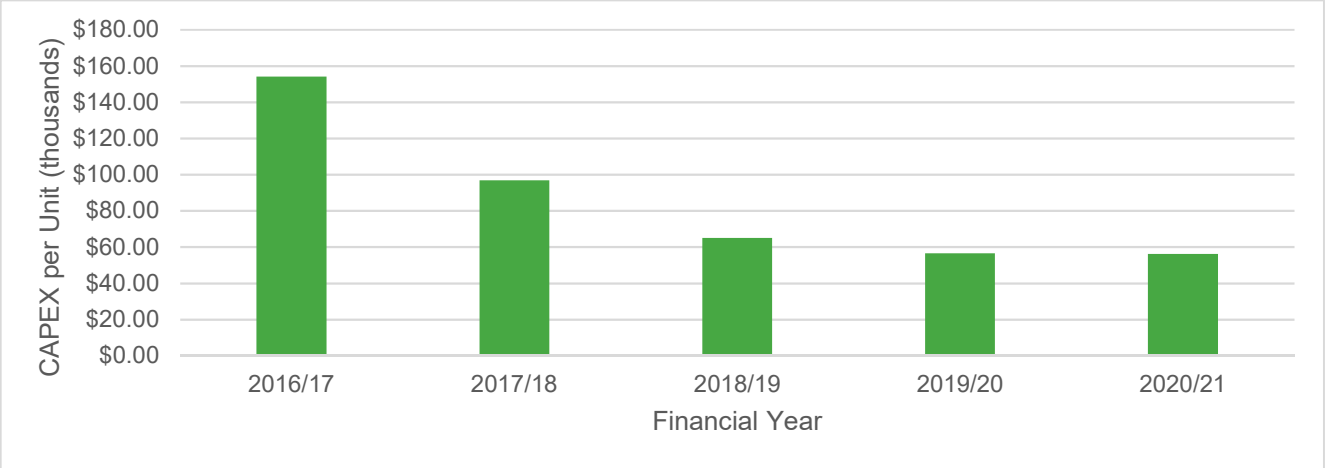
3.1.2.1. Capital Expenditure

When assessing the capital costs on a per unit basis, trends are decreasing for telecommunications systems which is expected due to the complexities of updating old technologies to modern standards having been addressed mainly by 2016/17. While recent initiatives in the development of new standards and freedom given to design teams to identify opportunities to deliver the greatest value to the organisation while meeting strategic objectives in collaboration with the Asset Management team has resulted in reductions in expenditure.

As we have moved to modern technologies, telecommunications see a unique advantage in the Digital Infrastructure suite of assets in benefiting from standardised connectivity (fibre optic and Ethernet) which are industry wide standards with no deviations. This has subsequently resulted in significant reductions in unit costs as complexity around wiring redesign and implementation have effectively been eliminated.

The higher unit costs in earlier years are directly attributable to significant OPGW infrastructure delivery these assets require significant capital due to the remote location of works and significant labour involved.

Figure 7 Unitised Historical CAPEX



Overall telecommunications unit expenditure has reduced and generally this can be attributed to a single major contributor: That being the replacement of modern technology is believed to be quicker due to modular design and industry wide standardised wiring and configurations being readily available

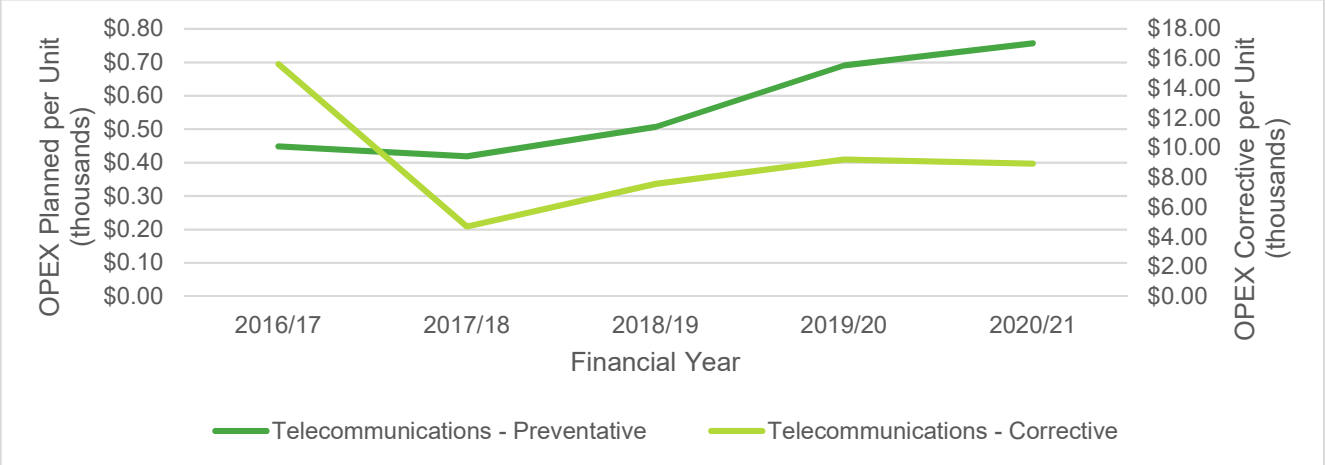
3.1.2.2. Operating Expenditure

Operating expenditure target reductions from the previous Strategy and Objectives have been met through the existing maintenance initiatives. This has been a result of several factors:

- Efficiencies in the delivery of maintenance tasks to maximise value from the assets
- Corrective maintenance cost reductions due to new technologies resulting in a faster and more cost effective return to service.

Telecommunications related maintenance activities have seen a significant decrease in unitised costs per maintenance task across corrective activities. 2018/19 and onwards, preventive activities have seen negligible increase. This is most likely attributable to increase in labour costs and type of assets targeted for maintenance.

Figure 8 Historical Unitised OPEX



3.1.3. Past Performance – Asset Management Performance Indicators

The KPIs that demonstrate the effectiveness of this Renewal and Maintenance strategy to mitigate the network related safety, reliability environment, financial, compliance and reputational risks in support of the achievement of the asset management targets and objectives are the number of Key Hazardous Events. These measures have been maintained at a low level historically, indicating the Renewal and Maintenance strategies have been effective at mitigating the risks and achieving the asset management objectives.

KPIs are represented across both prescribed and non-prescribed assets. Across all outage types excluding Transmission Line & Cable Fault Outage Rates, Digital infrastructure assets have performed below the five year average for this asset class.

Historical KPIs and objectives are shown in Table 7 below. Updated Objectives and KPIs are shown in Section 4.

Table 7 Asset Management Objectives and Performance Indicators – Telecommunications Systems

Transgrid Strategic Theme	Asset Management Objective	Asset Management Performance Indicators
Deliver safe, reliable power	Manage Network Safety Risk	• Maintain Network Safety LTIs and Fire starts at zero *Achieved in FY2021.* • Maintain 5 year average level of Key Hazardous Events: - Uncontrolled discharge of electricity *Achieved in FY2021*
Deliver safe, reliable power	Manage Network Safety Risk	No red reports in key result indicators provided to BARC regarding Bushfire, Reliability and Public Safety *Achieved in FY2021.*
Deliver safe, reliable power	Maintain network reliability	Maintain 5 year average level of loss of supply events due to digital infrastructure asset faults *Achieved in FY2021 – see Section 3.1.3.*
Deliver safe, reliable power	Maintain network reliability	Achieve CY2021 STPIS result of $5.3m *STPIS performance for CY2021 is forecast to meet target.*
Create an efficient high performing business	Manage assets efficiently to deliver security holder and consumer value	• 7.8% reduction in AMPoW delivery FY2021 *AMWP budget outcome was met in FY2021. For asset class specific performance see* Table 6 *in Section 3.1.1.2.* • Achieve efficiency on regulated capital spend FY2021 *Targeted capital efficiency was achieved in FY2021 and reinvested into the business.*

3.1.3.1. System Minutes

No >0.05 system minute loss of supply events occurred in 2021 across the network, compared to the one event in 2020. However, telecommunications assets were not responsible for initiating any loss of supply events the past years.

Figure 9 ENS >0.05 System Minute Event Count

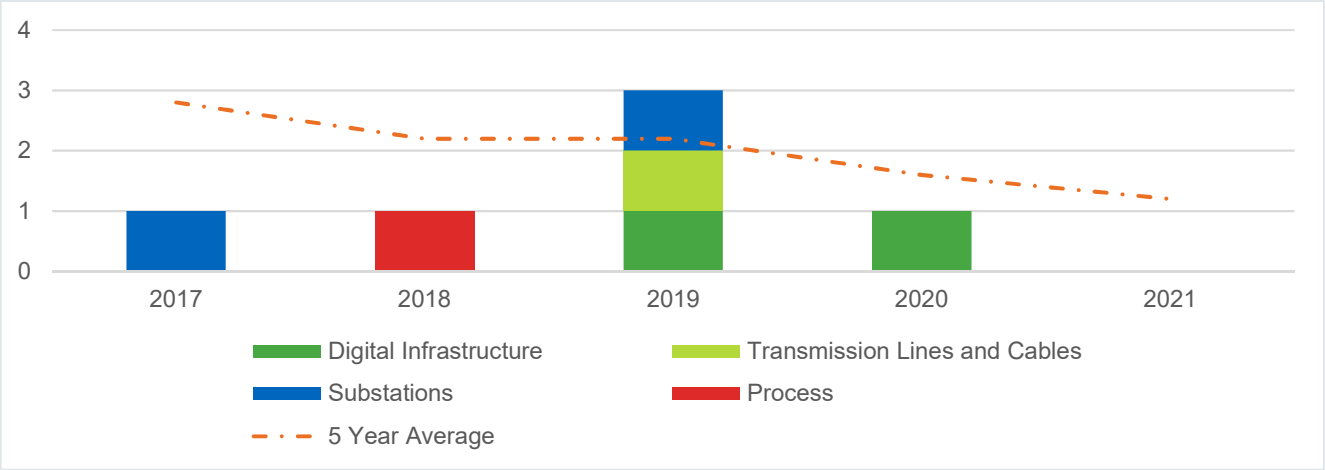
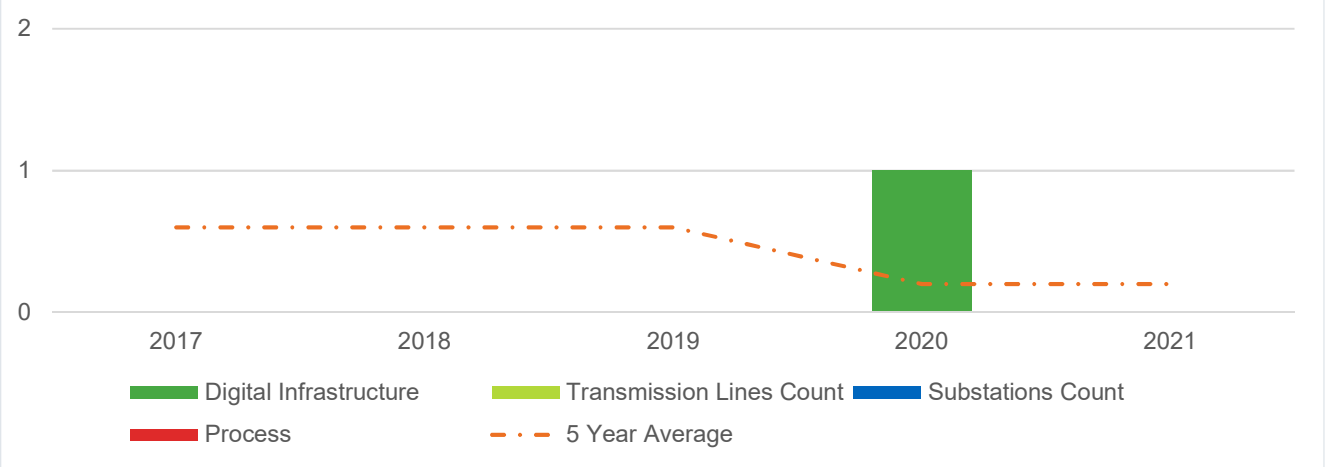


Figure 10 ENS >0.25 System Minute Event Count



3.2. Review of Strategic Initiatives

The status of relevant strategic initiatives from the Network Asset Strategy and other asset class specific strategic initiatives is provided in Table 8.

Table 8 Strategic Initiative Status

Network Asset Strategy Objectives	Initiatives / Reference	Status
Deliver safe reliable power		
Manage Network Safety Risk Maintain Network Reliability	Implement a technical authority framework supported by competency assessment processes.	Scope of activities covered by the Technical Authority Framework has been developed. Technical Design competency framework developed with assessment process development underway.
	Review and revise Risk Assessment Methodologies to ensure our ability to quantify risk is both appropriate and balanced defensibly.	Risk Assessment Methodology has been updated and is under continuous improvement. Asset Data collection has progressed to facilitate the development of a risk model for telecommunications assets.
	Implement Critical Control Management for key areas of the business.	Ongoing
	Minimise numbers of deployed systems that pose safety risk	Ongoing
Create an efficient high performing business		
Ensure accessible, relevant asset management information is available to inform business wide decisions	Update of Ellipse data rules.	Data rules awaiting approval.
	Continued collection of detailed asset condition data in AIM. Ready access to this data and integrating into the AAIT should empower the Asset Manager to make informed decisions. Improve asset performance monitoring through defect and AIM issue dashboards and analysis to inform asset strategies. Utilise newly implemented failure coding in AIM to allow better analysis and decision making.	Ongoing

Network Asset Strategy Objectives	Initiatives / Reference	Status
Manage assets efficiently to deliver security holder and consumer value.	Control Assurance Reviews (CAR's) to identify weakness and non-conformances in cable asset management practices.	Two CAR's completed in FY2020/21.
	Development of information dashboards that provide relevant information to stakeholders to ensure asset management performance is accessible	Strategic risk dashboards have been implemented across operational and Executive committee meetings with further measures to be included in future iterations.
Invest in Transmission to support the energy transition		
Support sustainable growth of the asset base by developing the right infrastructure	Supporting the development of the Integrated System Plan and Renewable Energy Zone projects.	Ongoing - providing trusted advice for the development, procurement and design of new assets to achieve lowest lifecycle cost. Review and update of standard design manuals and IUSA functional specifications.
Support growth in our unregulated business		
Support growth as the service provider of choice to the non-regulated market	Supporting the development of non-regulated projects.	Ongoing - providing trusted advice for the bid and development of non-regulated opportunities. Non-prescribed maintenance plan developed. Works in progress to develop a non-prescribed spares plan.

4. Strategy

4.1. Strategy and Objectives

All strategic initiatives with respect to Transgrid's prescribed Telecommunications assets are outlined in this section, including the renewal and maintenance initiatives that contribute to the asset management program of works. Further details can be found in the relevant Telecommunications Systems Maintenance Plan, and the referenced governance documents.

Table 9 Asset Management Objectives and Performance Indicators – Telecommunications Systems Asset Class

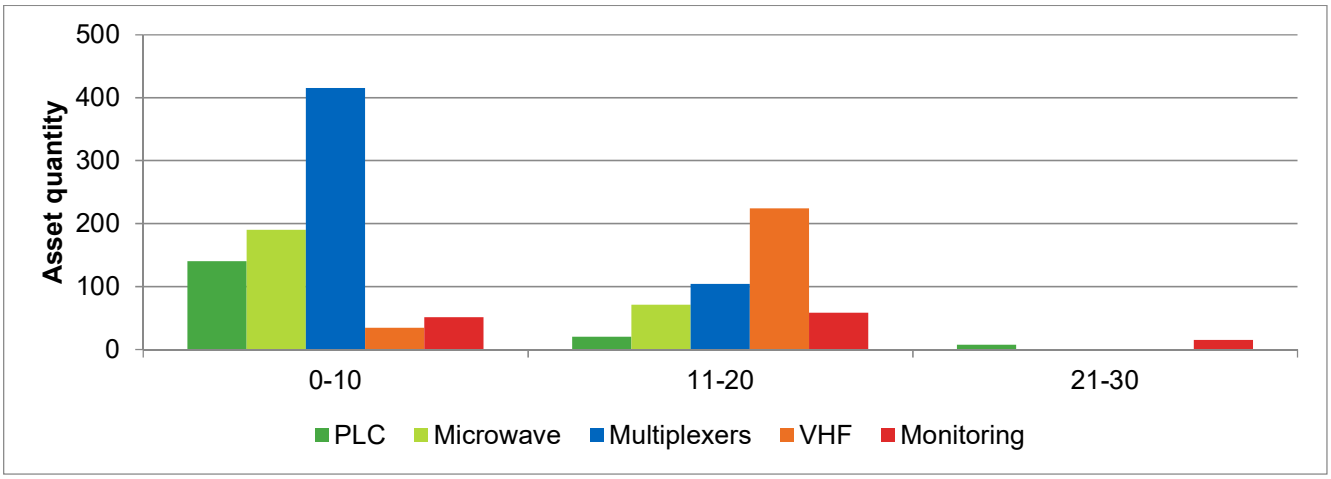
Transgrid Strategic Theme	Asset Management Objective	Asset Management Performance Indicators
Deliver safe, reliable and low cost power	Manage Network Safety Risk	• Maintain Network Safety LTIs and Fire starts at zero • Maintain 5 year average level of High Potential Incidents (HPI): - Uncontrolled discharge of electricity - Third Party Activity resulting in asset damage / public injury • No red reports in key result indicators regarding Bushfire, Reliability and Public Safety Principal Risk Dashboards
Deliver safe, reliable and low cost power	Manage Network Safety Risk	Maintain 5 year level of environmental incidents
Deliver safe, reliable and low cost power	Maintain network reliability	Maintain 5 year average level of loss of supply events
Deliver safe, reliable and low cost power	Maintain Network Reliability	Target improvements to performance of the STPIS measures
Create an efficient high performing business	Manage assets efficiently to deliver security holder and consumer value	Deliver AMPoW within +/- 5% Delivery Capital Program within +/-5% Target capital efficiency improvements

5. Renewal and Maintenance Initiatives

5.1. Telecommunications Terminal Equipment Assets Review

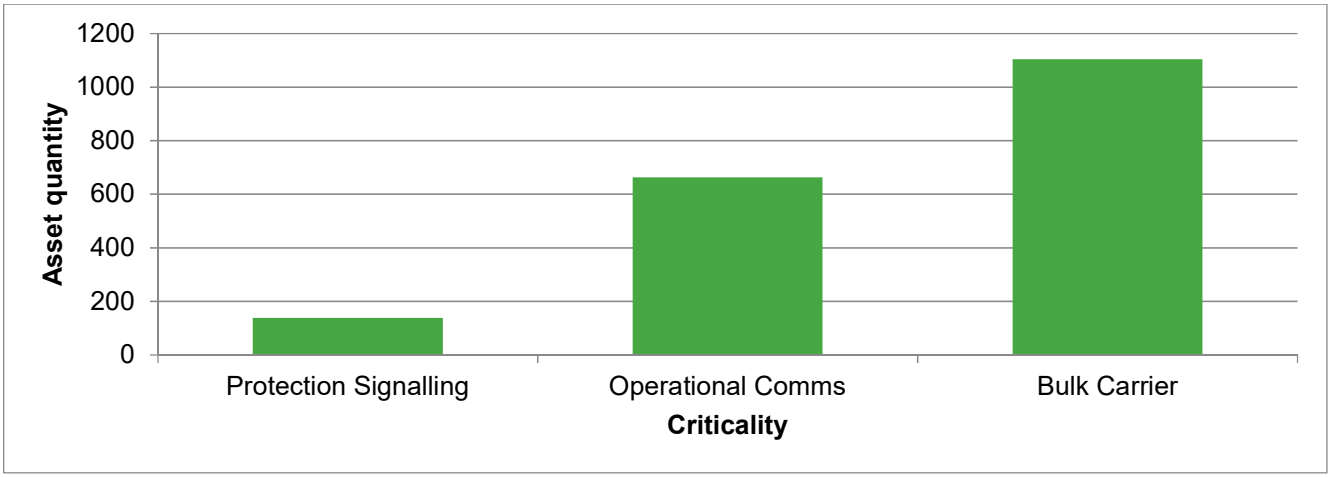
The current age profile of various terminal equipment when compared to their estimated technical lives, identify a reasonable number of assets that have exceeded their life. Some of these end of life assets have been identified for renewal.

Figure 11 Terminal Equipment Age Profile



Due to the nature of telecommunications systems, their criticality is scored against the function they provide across the network. Scoring is applied in accordance with brackets of function under Operational Communications, Protection Signalling and Bulk Carrier which has both functions.

Figure 12 Terminal Equipment Criticality



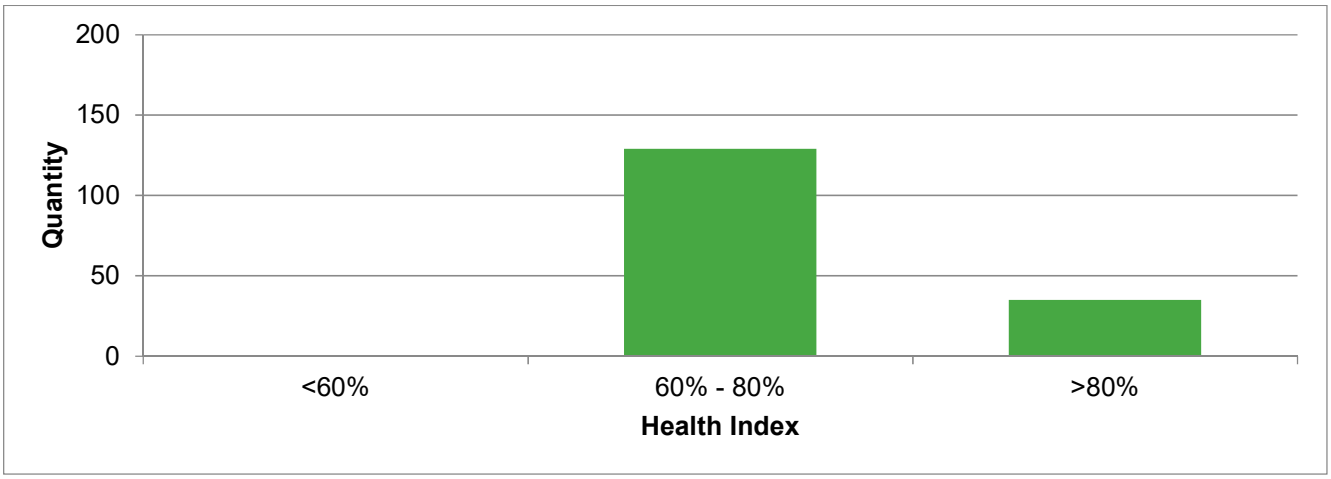
5.1.1. PLC Systems

The use of PLC systems is targeted for reduction as the availability of route diverse high bandwidth communications paths increases. This equipment is currently based on microprocessor circuits to generate signals and is frequency agile. The assets are capable of supporting voice as well as protection signalling functions.

More modern versions based on digital transmission are capable of functioning with multiple signals transmitted over a single unit. PLC systems face operational issues around the maintenance of frequencies and the need to minimise transmission crossover across different parts of the network.

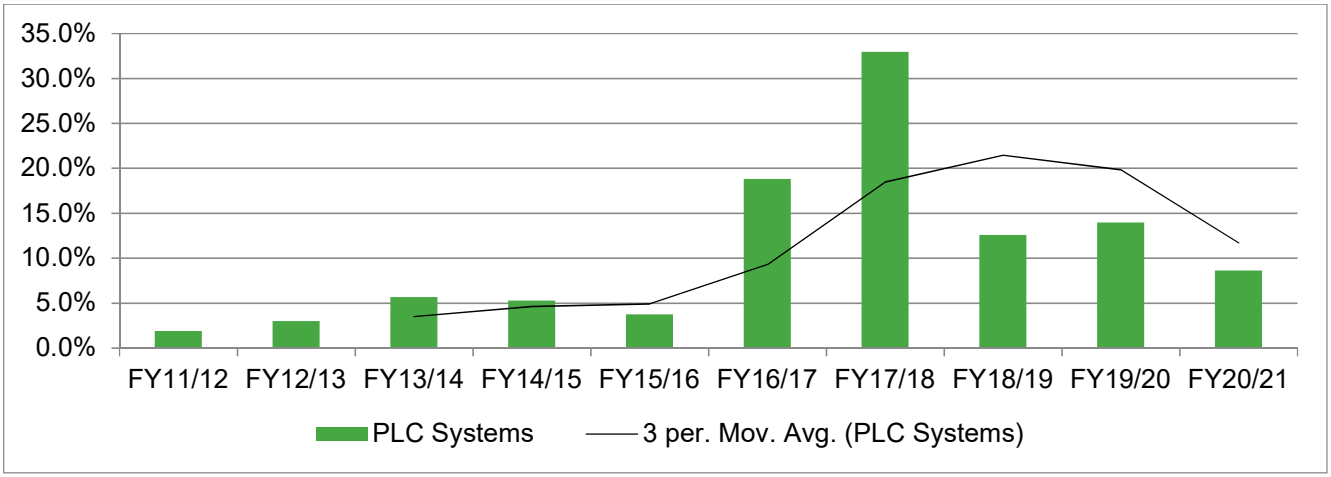
The health of these assets varies and is primarily dependant on manufacturer support, spares availability, forecast defect rates, age and the technical life of the assets. The health index has been used to identify the assets that require investigation for renewal through our Capital Investment Governance Process.

Figure 13 PLC Health Index



A review of historical defect rates highlighted an increasing trend in the previous years. Addressing these issues has been a priority for us to meet our strategic objectives and we have successfully managed to reduce the defect rates from 2019/20 to 2020/21.

Figure 14 PLC Historical Defect Rates (%)



5.1.2. Microwave Assets

Microwave systems have traditionally been utilised to provide high bandwidth communications links prior to the proliferation of fibre optic medium. The systems are based on microprocessor circuitry.

The population of microwave systems is gradually reducing as increasing route diverse high bandwidth communications paths are established. The systems are comprised of higher capacity “trunk” SDH systems and lower capacity “tributary” SDH systems.

This population review covers those assets that convert an electrical signal to a microwave signal and does not cover multiplexers as they are addressed as a separate asset type.

The health of these assets varies and is primarily dependant on manufacturer support, spares availability, forecast defect rates, age and the technical life of the assets. The health index has been used to identify the assets that require investigation for renewal through our Capital Investment Governance Process.

Figure 15 Microwave Health Index

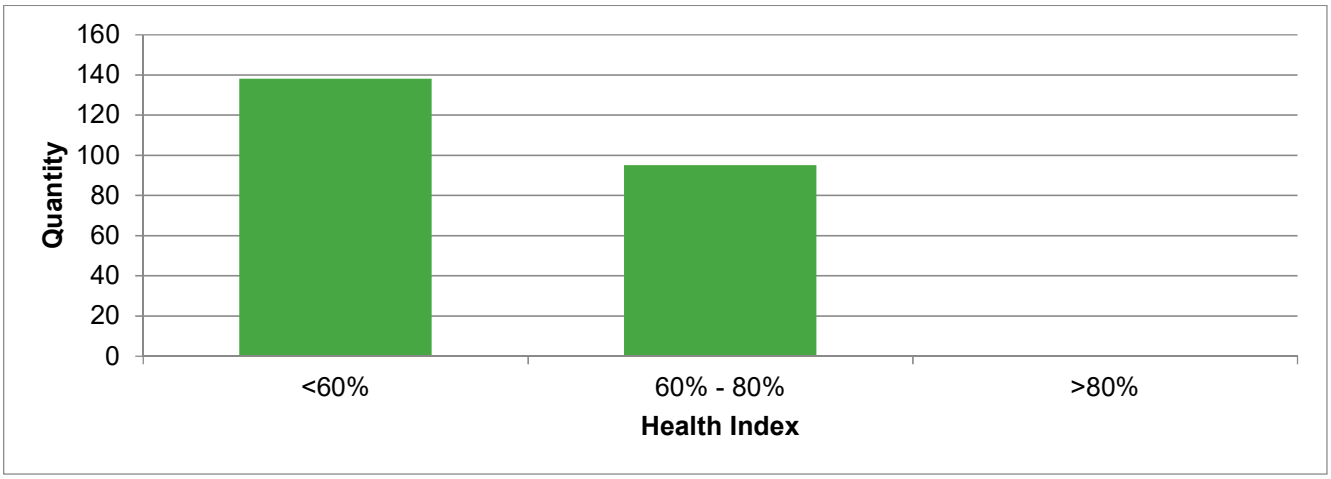
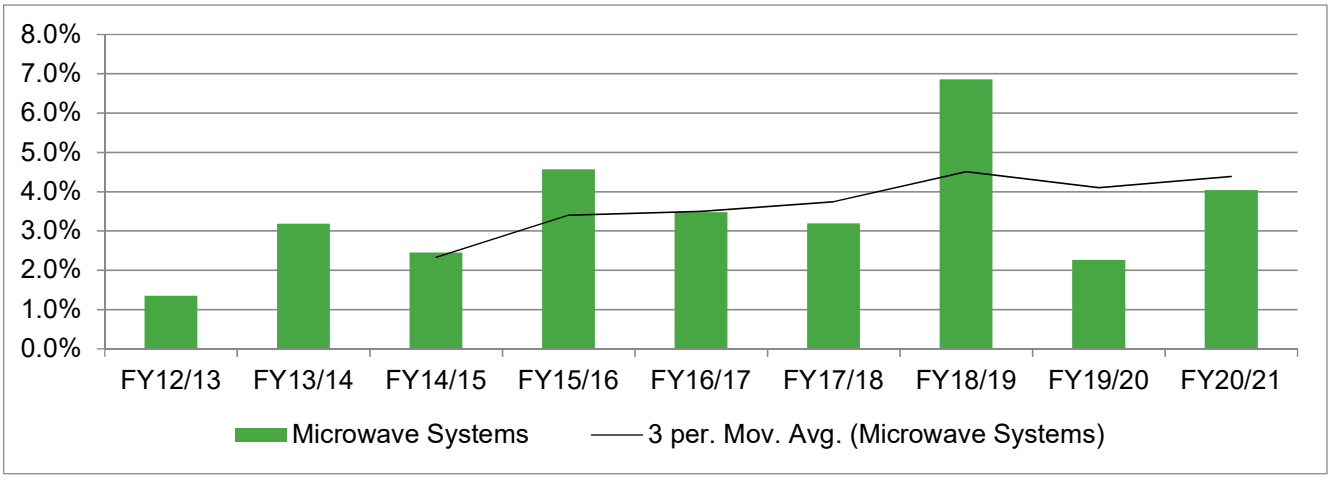


Figure 16 Microwave Historical Defect Rates (%)



2018/19 observed an increase in failure rates for microwave assets, whereby analysis attributed this in part to improved reporting practices regarding defects as well age based failures.

Low defect rates in 2019/20 and 2020/21 has strengthened earlier analysis of increases seen in 2018/19 defect rates due to improved reporting. Further analysis has indicated that the slight increase of defect rates in 2020/21 is primarily due to relatively old age of some asset. Though the analysis has not flagged any major concern to drive high priority works at this time, we would be targeting renewals of obsolete assets in the upcoming RP3.

5.1.3. Multiplexer Assets

Multiplexer systems are utilised to combine smaller bandwidth signals into higher bandwidth packets to maximise the utilisation of the connected communication medium. These assets are all microprocessor based circuitry.

These systems can be separated into standard low-order, special purpose low-order and fibre SDH multiplexers.

The low-order multiplexer is the basic building block that provides digital cross-connection functions for voice and data services other than those associated with the VoIP telephone networks and the CDN. The

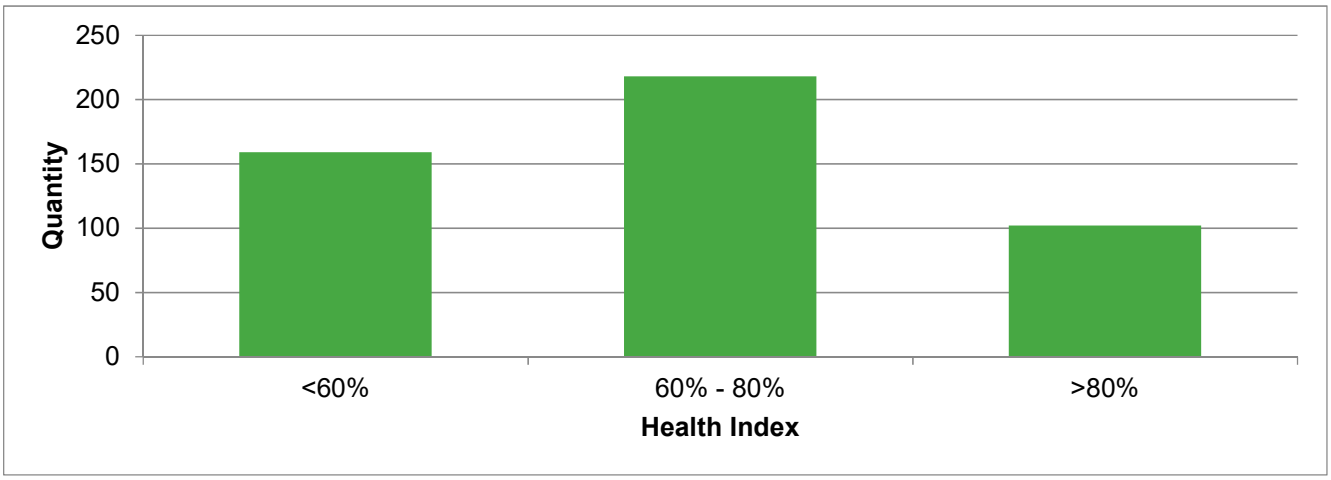
primary multiplex equipment does not connect below E1 level and a low-order multiplex unit is required to present individual G.703 64kbps channels, carry out protocol conversion for voice channels, PSTN interconnection, V.35 and V.24bps serial data.

The standard low-order multiplexer cannot accept the C37.94 optical fibre standard. This standard is in common use within DNSP telecommunications networks. C37.94-capable special purpose multiplexer equipment is used where necessary to interface with DNSP telecommunications networks to establish protection intertripping services at bulk supply points.

The primary fibre SDH multiplex equipment forms the backbone of the optical fibre network, and is the basic building block of the main telecommunications network. It is capable of being equipped to drive long distance optical fibre based links.

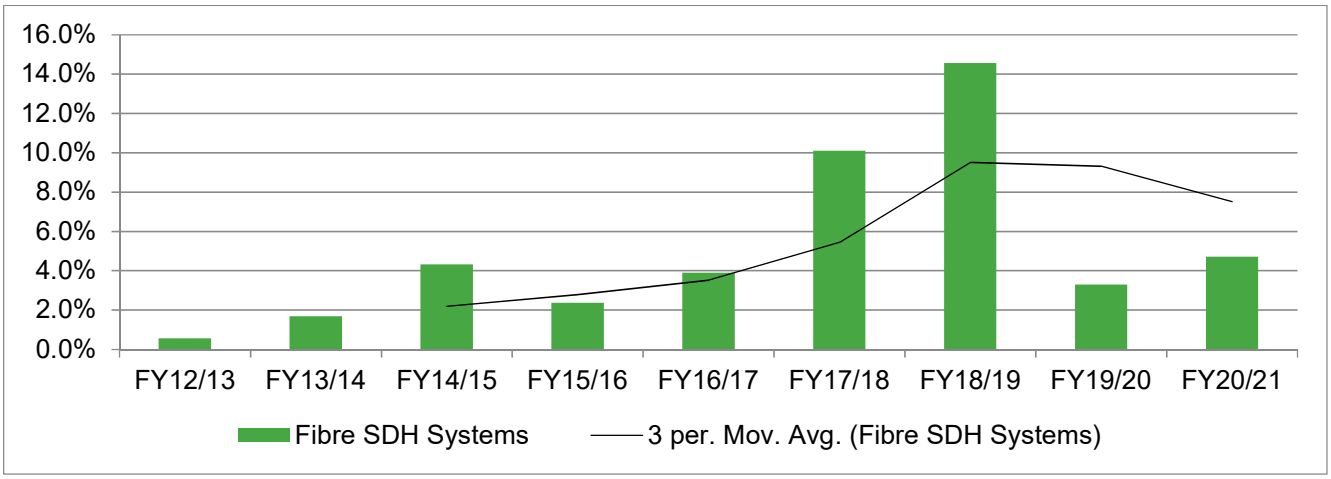
The health of these assets varies and is primarily dependant on manufacturer support, spares availability, forecast defect rates, age and the technical life of the assets. The health index has been used to identify the assets that require investigation for renewal through our Capital Investment Governance Process.

Figure 17 Multiplexer Health Index



Fibre SDH systems are seeing a downward trend in defect rates, this can be attributed to a relatively young age profile for these assets and the increasing number of installations that is effectively diluting the percentage rates for defects. However, 2018/19 observed an increase in failure rates for multiplexer assets, whereby analysis attributed this in part to improved reporting practices regarding defects.

Figure 18 Multiplexer Historical Defect Rates (%)



Low order systems are also seeing a downward trend in defect rates, this is primarily due to the relatively young age of these systems.

We have tested the market and initiated a move towards MPLS. This will facilitate a more complex network configuration which will provide efficiencies in deployments and connected asset lifecycles in the future.

5.1.4. VHF Radio Assets

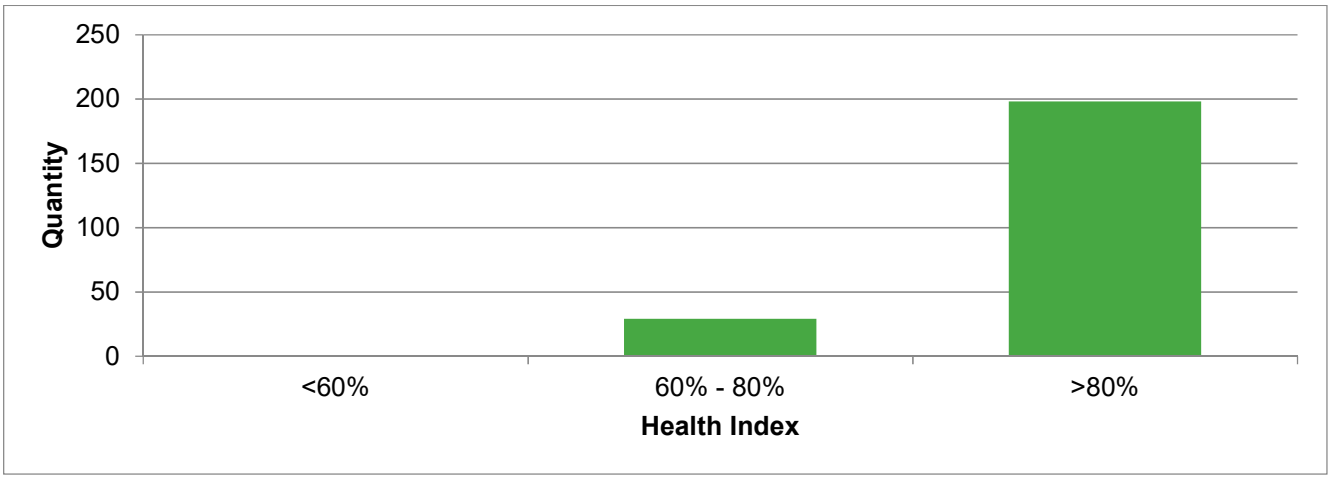
VHF Mobile Radio systems are utilised throughout Transgrid's network. Due to the remote nature of many of the organisation's assets, they traditionally provided a reliable communications interface for field staff. An additional function of the VHF network is a reliable communications link for the coordination of a "Black Start" event where the network requires a restart following a black out.

While improving mobile telephone coverage and the deployment of satellite phones may negate the need for field staff to use the VHF network, AEMO's system restart policy requirements require further consideration before moving away from the current philosophy of a VHF network. An active AEMO working group is also currently exploring feasibility with NEM participants for installation of a HF based radio system capable of interconnecting relevant parties for system restart coordination.

The system currently installed is at the end of its serviceable life and a technological transition is proposed for RP3 which can meet the core requirements and add value to our operations.

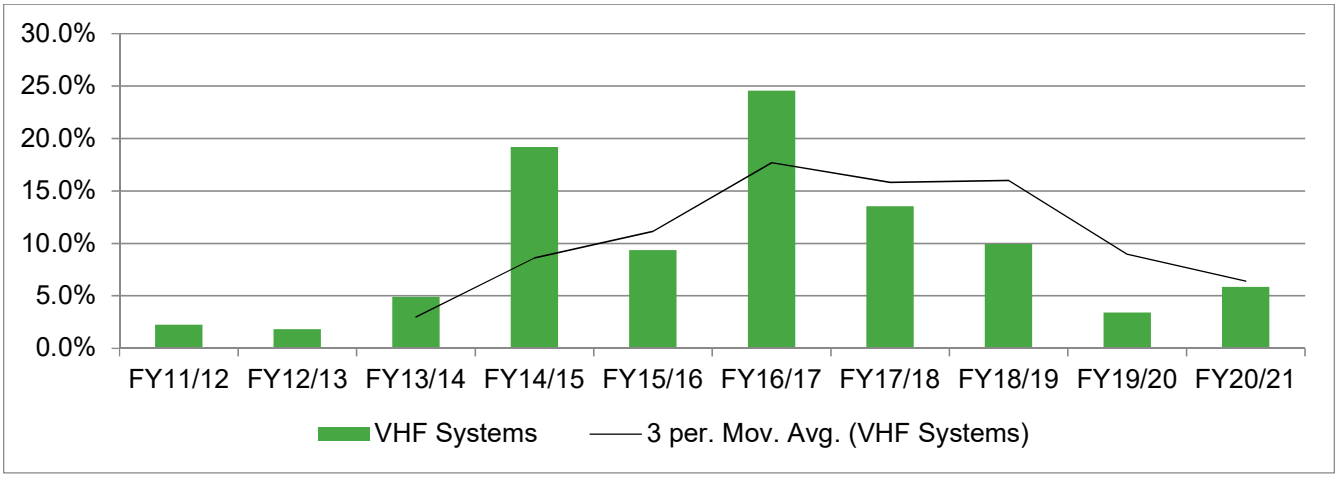
The health of these assets varies and is primarily dependant on manufacturer support, spares availability, forecast defect rates, age and the technical life of the assets. The health index has been used to identify the assets that require investigation for renewal through our Capital Investment Governance Process.

Figure 19 VHF Radio Health Index



VHF radio network had seen an increasing trend of defect rates in previous years, early analyses had identified that this is in part, due to improved reporting of defects over the past few years. We have additionally identified that the ageing of these assets is contributed to the previous increases. The assets in services are an obsolete technology with manufacturer support dwindling and require replacement. However, through effective management of these defects, we were able to realise significant reduction in the defect rates of specific models which showed high defects.

Figure 20 VHF Radio Historical Defect Rates (%)



5.1.5. Monitoring Assets

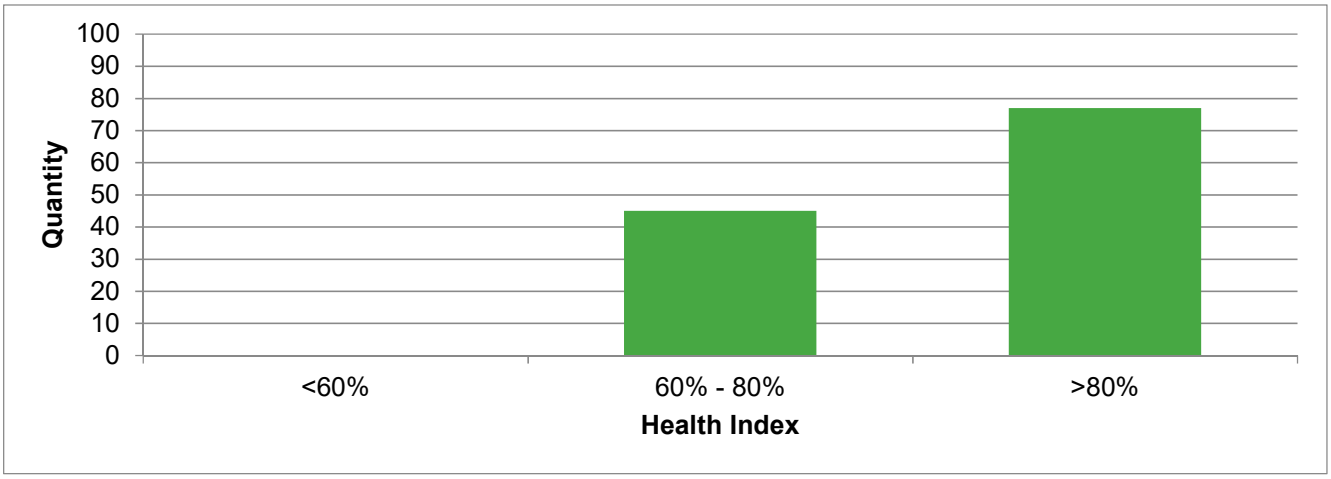
Monitoring Systems are in service throughout all Transgrid communications sites. These systems comprise a Communications Alarm System (CAS) and a Backup Alarm System (BAS) and essentially monitor and report on the performance of all communications assets with a capacity for monitoring. The BAS is additionally used for very basic alarming of all critical systems at any Transgrid site where there is a lack of redundancy in ensuring alarms arrive at the control room.

With the deployment of route diversity in the organisation's communications links and the added redundancy in SCADA connection systems at sites, the BAS systems are gradually becoming obsolete with only 25 sites identified as still requiring these systems.

It has recently been identified than the current deployment of CAS, which utilises an in-house developed Visual Basic piece of software, is inadequate to meet our monitoring requirements. Additionally the CAS system is deployed on a Windows based computer which then requires regular security patching and updating. As such, there is a requirement to investigate a replacement technology or deployment methodology. Our design team has been assisting with the development of more robust solution that follows our monitoring and alarming principles.

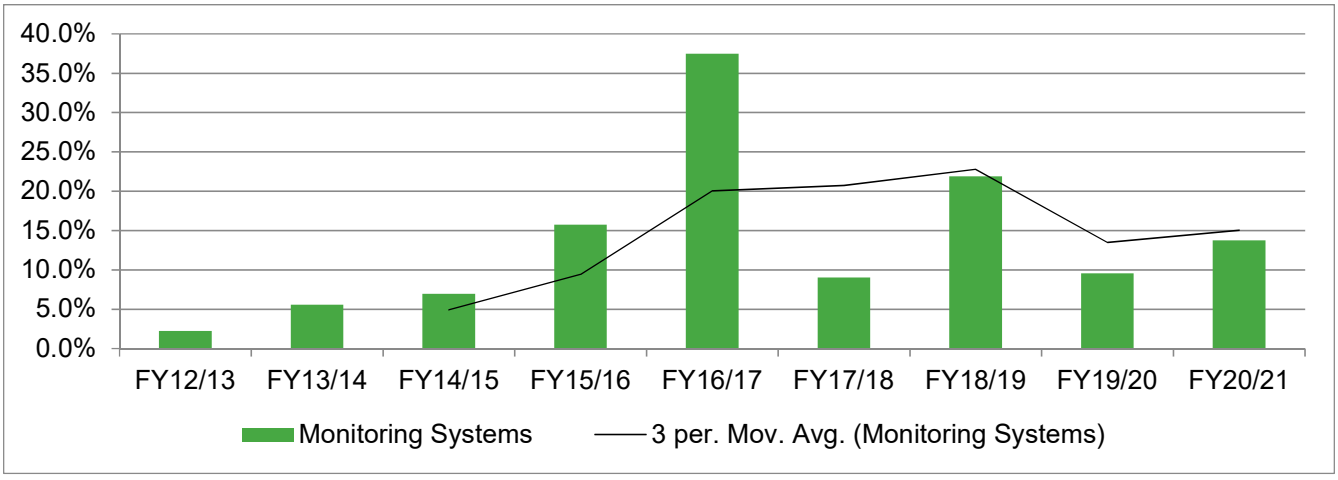
The health of these assets varies and is primarily dependant on manufacturer support, spares availability, forecast defect rates, age and the technical life of the assets. The health index has been used to identify the assets that require investigation for renewal through our Capital Investment Governance Process.

Figure 21 Monitoring Systems Health Index



Defect trends indicates a sporadic frequency of failures in these assts. This is commensurate with the ageing population and the deployment of many of these systems on unsupported versions of Windows. To address this issue, we are targeting renewals of these assets in the upcoming RP3.

Figure 22 Monitoring Systems Historical Defect Rates (%)



5.1.6. Operational Telephony Assets

We currently own and operate a standalone Operational Telephony Network which is deployed to provide communications between the Control Room, all substations and third party control rooms in the network.

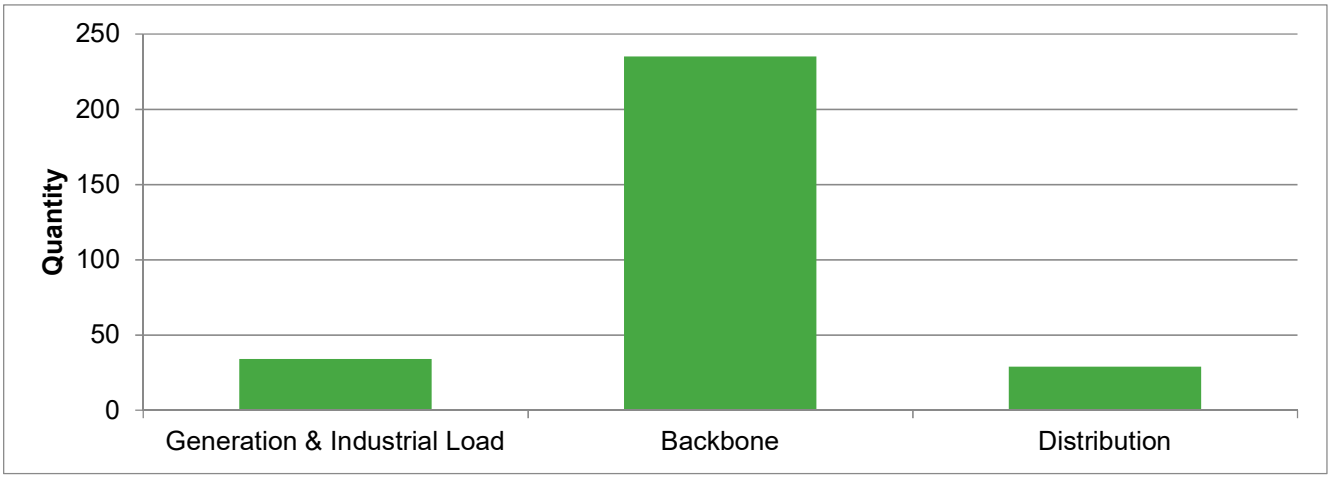
This system is quickly approaching the end of its serviceable life with an infrastructure that is still built on traditional copper telephony solution. The system is complex and heavily interconnected, it has been targeted for a renewal which will require the assistance of external telecommunications providers to develop and deploy a beneficial and robust solution to meet our requirements.

5.2. DC Supplies

DC supplies provide backup power to allow the control and protection systems at an unmanned substation or switching station continued operation. This is a critical component of the network to allow us to respond to network outages which may lose supply to the station affected. The communications facilities at a site carry several types of critical data to facilitate the unmanned operation of a substation.

Due to the need for DC Supply Systems to power all communication aspects of an unmanned high voltage electricity transmission station as well as bulk carrier functions passing through the site, criticality has been categorised on the purpose for the station which is being operated based on generation connector, transmission network backbone or Distributor connection point.

Figure 23 DC Supply Criticality



5.2.1. NiCd Batteries

NiCd batteries are utilised in arrays to meet load and capacity demands and differ for each site. Banks are installed in a duplicated fashion with each bank providing supply for each of the redundant telecommunications schemes at a site.

Our policy has been to phase out the use of NiCd batteries within communications functions and move to Sealed Lead Acid systems. These systems are preferred due to reduced maintenance requirements with comparable performance.

The health of these assets varies and is primarily dependant on manufacturer support, spares availability, forecast defect rates, age and the technical life of the assets. The health index has been used to identify the assets that require investigation for renewal through our Capital Investment Governance Process.

5.2.2. NiCd Chargers

NiCd Chargers are utilised wherever NiCd Batteries are installed, generally these are applied as one charger dedicated to each battery bank. There are some instances where a single charger may service

duplicated battery banks, this is very rare and is an interim step to full duplication of entire systems where it occurs within the network.

The health of these assets varies and is primarily dependant on manufacturer support, spares availability, forecast defect rates, age and the technical life of the assets. The health index has been used to identify the assets that require investigation for renewal through our Capital Investment Governance Process.

5.2.3. 50V Rack Power Supplies

Rack Power Supplies (RPS) are the current standard deployment for 50V communications supplies. These systems are the preferred solution due to a variety of factors including but not limited to:

- Lower lifecycle costs due to no planned maintenance requirements
- No requirement for battery rooms
- Simple gas ventilation solutions available
- Rapid in service deployment and repair capabilities

The health of these assets varies and is primarily dependant on manufacturer support, spares availability, forecast defect rates, age and the technical life of the assets. The health index has been used to identify the assets that require investigation for renewal through our Capital Investment Governance Process.

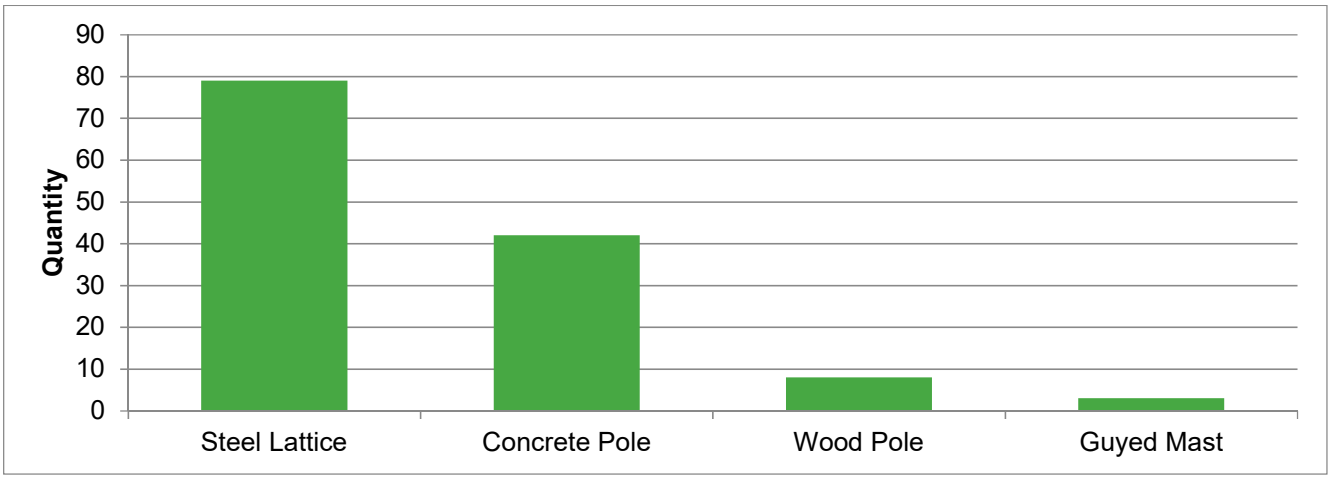
5.3. Radio Towers

Transgrid is responsible for the condition of Radio Communications structures at repeater sites where it is the Site Controller, and at substations where microwave radio is used for telecommunications. Radio Communications towers are broken into four main categories:

- Steel lattice towers are generally used where an antenna height of greater than around 30m is desirable, where high-availability is required, or where several microwave radio links may come together.
- Concrete poles are generally used at substations or at repeater sites close to the terminal Transgrid substations.
- Wood poles and guyed steel towers are only found in service within the VHF network.

There is no Health Index tracking for these assets at this time. Additionally there is no reasonable tracking of defect rates. We have a strategic initiative to establish a baseline of data records for these assets.

Figure 24 Radio Towers Population



It has been identified that several towers were displaying severe rust within core components and have been targeted for decommissioning and disposal. These issues have highlighted a gap in maintaining towers where we may have withdrawn our active telecommunications assets.

It is our strategic position to continue monitoring and inspecting these assets with a drive to the withdrawal of Radio services in the long term. In the short term it is our intention to refresh our asset recording requirements and improve lifecycle cost capture against these assets.

5.4. Fibre Optic Cable

Transgrid has a substantial optical fibre network. There is a current policy to include OPGW in all new HV augmentations and any significant reconstruction works. There is a current suite of projects to extend the optical fibre network by retrofitting OPGW to a number of transmission lines. The roll out of optical fibre provides high speed data communications links throughout the network while negating electromagnetic interference and path profile issues associated with PLC and Microwave.

There have been 14 defects, inclusive of OPGW Joint Box defects, across 3440km worth of fibre optic cable throughout the network, we are improving our health index and defect recording capacities for these assets to allow improved asset management practice. At this time it is deemed as a reasonable defect rate throughout the network. As we improve our data recording capacities, we will further our asset management practices in this area.

Overall, our strategic position is to deploy a mesh network of fibre optic assets to facilitate duplicated paths to all our sites. This direction reduces our ongoing lifecycle costs associated with the maintenance and renewal of radio repeater sites and associated terminal assets.

5.5. Emerging Issues and Renewal and Maintenance Initiatives

The emerging issues and renewal and maintenance initiatives to address them are summarised in Appendix A.

5.5.1. Microwave Assets

It has been identified that the microwave links are congested with bandwidth exhausted in parts of the network. Our strategic objective is to minimise reliance on microwave and replace them with OPGW links. However, the existing microwave assets are ageing and have no or very limited manufacturer support; and therefore, we have proposed a renewal program to target microwave systems approaching end of life.

Lack of route diversity and high utilisation of current capacity have also been identified in our communications network. To address this issue, we have proposed upgradation of these links in the upcoming RP3 to ensure bandwidth capacity is adequate for our network. The previously identified link westwards of Wagga Region with lack of route diversity has been withdrawn from RP2 and it is now part of the proposed RP3 program.

5.5.2. Multiplexer Assets

Most of these assets have reached obsolescence and manufacturer support is no longer available. We have initiated a network wide replacement initiative to migrate from obsolete systems to new technology standards. The migration targets “A” systems which gives us the opportunity to re-acquire spares to support “B” system in short to medium term. We have also proposed targeted renewal for “B” systems in RP3 which have reached end of life to ensure network reliability.

Moreover, the current deployment of Nokia 1646 SDH multiplexers has been impacted by a Force Majeure Notice. We have initiated works to investigate and test an alternative solution for these obsolete multiplexers within our A and B systems.

5.5.3. Monitoring Assets

A review of the current implementation of the monitoring assets has identified several improvements to meet Transgrid’s regulatory and changing operational requirements including:

- Greater visibility of issues to the SCADA Control Room (SCADA) and the AMC
- Withdrawal of Windows based PCs in substations to minimise Cybersecurity risk exposure and maintenance requirements
- Implementation into current Transgrid design and construction standards
- Safety in Design
- Standardisation of input

A renewal initiative has progressed to finalise the modern technologies and standard designs for these installations. Assets approaching end of life or with high health index are being targeted for renewal to maintain reliability of communications assets.

5.5.4. Operational Telephony

We have realised that the core justification of original deployments of these assets has changed. The assets are now obsolete and approaching end of life. These systems are in need of holistic renewal.

To address this issue we have established requirements of these systems with relevant stakeholders and subsequently, tested the market for available solution to deliver a state-wide renewal.

5.5.5. DC Supplies

It has been identified that the age and condition of DC supplies in our network are leading to high defect rates and we are currently in process of delivering targeted renewals of these assets where their age will exceed technical life by 2023.

We face a continuing challenge to minimise the maintenance requirements and delays after a failure. A policy change has been initiated which targets 50V NiCd batteries to be replaced with 50V RPS. These installations are not only maintenance free but also provide further cost savings as they do not require a separate battery room. In short term, we have reviewed the maintenance frequency of 50V NiCd batteries and optimised it to balance risk to network against cost savings.

5.5.6. Radio Towers

We have discovered gaps on various fronts for these installations. These include:

- Incomplete asset data
- Unavailability of asset health
- Non-regulated business interface with data systems incomplete
- Assets approaching end of life

To address these issues we have:

- Established Standard Design Guidelines for demarcation of anchoring points of mast type radio towers
- Developed AIM script for Radio Tower condition data collection

It is noted that Renewal of these assets was withdrawn from RP3 due to the inadequacy of asset condition data for health index modelling. We will be initiating the following activities to address the aforementioned gaps:

- Audit and update tower records
- Targeted renewal of ageing assets
- Establish data rules and interfaces with non-regulated business

5.5.7. Fibre Optic Cable

Optical Time-Domain Reflectometer (OTDR) tests have identified a section of OPGW on TL76 has degraded beyond acceptable limits. Further investigation has revealed that this OPGW is unable to meet minimum availability requirement for digital communications. We have initiated corrective works for the degraded section as part of our RP2 capital works program.

Furthermore, to pre-empt such issues in future, a review of network-wide OPGW installations is proposed to establish a renewal program based on the degradation rate of faulty fibre cables.

The performance of these assets is tested regularly, however, a gap was identified regarding the consistency of the data capture when testing is completed. We have effected changes in this area through the delivery of a maintenance program to ensure that testing is able to consistently report required parameters for the total length of fibre.

A review of the asset data has highlighted significant discrepancies and inconsistencies between disparate data systems. This will be addressed via initiatives to migrate asset data to a single source and its reconciliation with geospatial data system.

Challenges are currently being experienced through the increasing utilisation of regulated fibre cables by the non-regulated arm of the business. It is increasingly being noted as causing disruptions to regulated CAPEX and OPEX activities. The creation of a usage policy highlighting performance parameters for the regulated fibre network has been initiated.

Recently, we have also identified an increase in OPGW Joint Box defects where corrosion on these assets is causing degradation of the communication links traversing through the associated fibre cables. To address this issue, we are proposing to develop correlation between defect rates, age and environmental factors contributing to corrosion and degradation and establishing a renewal program as required.

6. CAPEX Forecasts

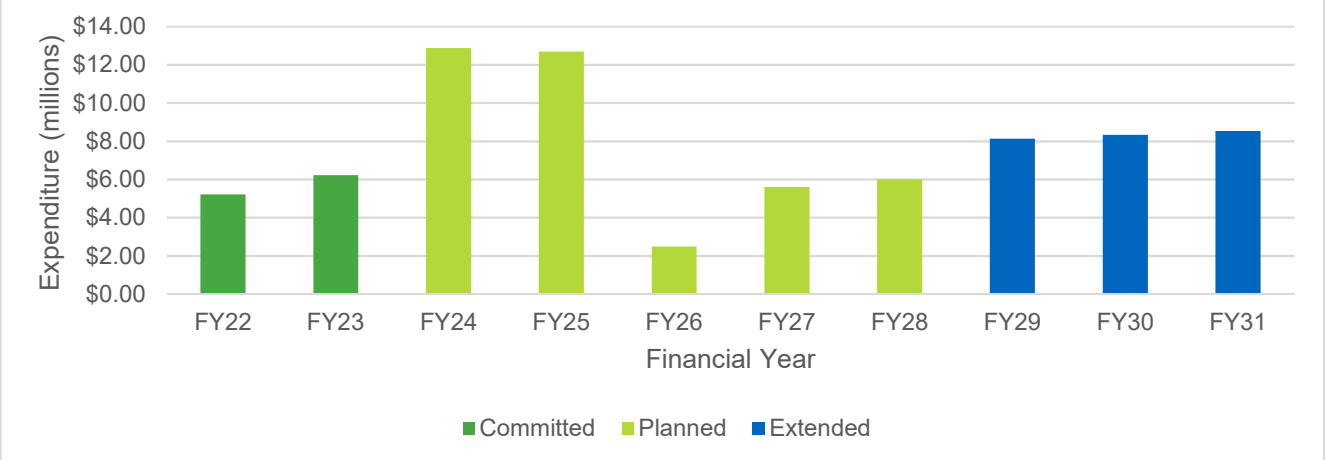
6.1. Ten Year CAPEX Profile

The projects within the digital infrastructure area of telecommunications systems have been reviewed and a strategic direction established within this document.

The figure below shows the estimated ten year CAPEX forecast which consists of committed, planned and estimated expenditure:

- The committed forecast (up to and including FY23) is a bottom up build of telecommunications systems capital expenditure currently in the Capital program of works.
- The planned forecast is based on the proposed Capital program of works for RP3 which is being submitted to the AER for review.
- The extended forecast (from FY29 onwards) is an estimation based on the forecasted expenditure in the preceding years. This forecast is indicative only and is subject to detailed cost estimation and feasibility studies.

Figure 25 Ten Year CAPEX Forecast



The data above represents a total proposed expenditure profile of $76 million over the next ten years to meet our overall strategic objectives. This value is driven by $11 million of committed and costed expenditure, $40 million of proposed expenditure for RP3 with the remainder of the forecast comprised of several estimated components:

- Telecommunications Terminal equipment assets renewal
- Fibre Optic Cable Rollout
- Communications alarm systems renewal
- Radio towers renewal
- DC Supplies renewal

6.2. Anticipated Changes to the Asset Base

The anticipated changes to the asset based have been illustrated in this section for two scenarios:

- All committed investments in the strategy proceeding
- No investments from this strategy proceeding

6.2.1. Terminal Equipment Assets

Figure 26 Terminal Equipment - Forecast Age Profile

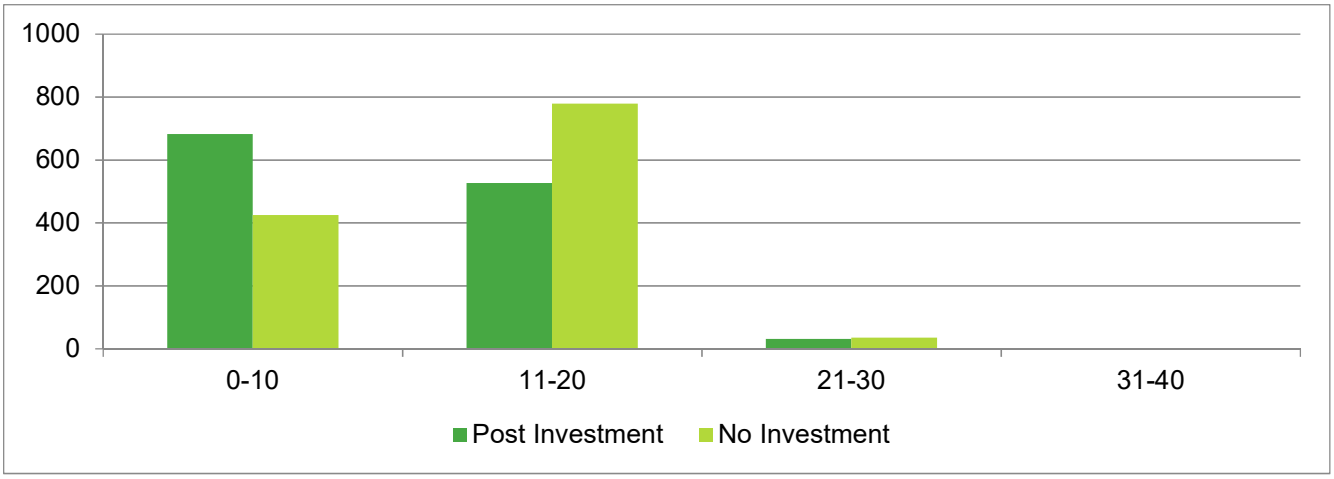
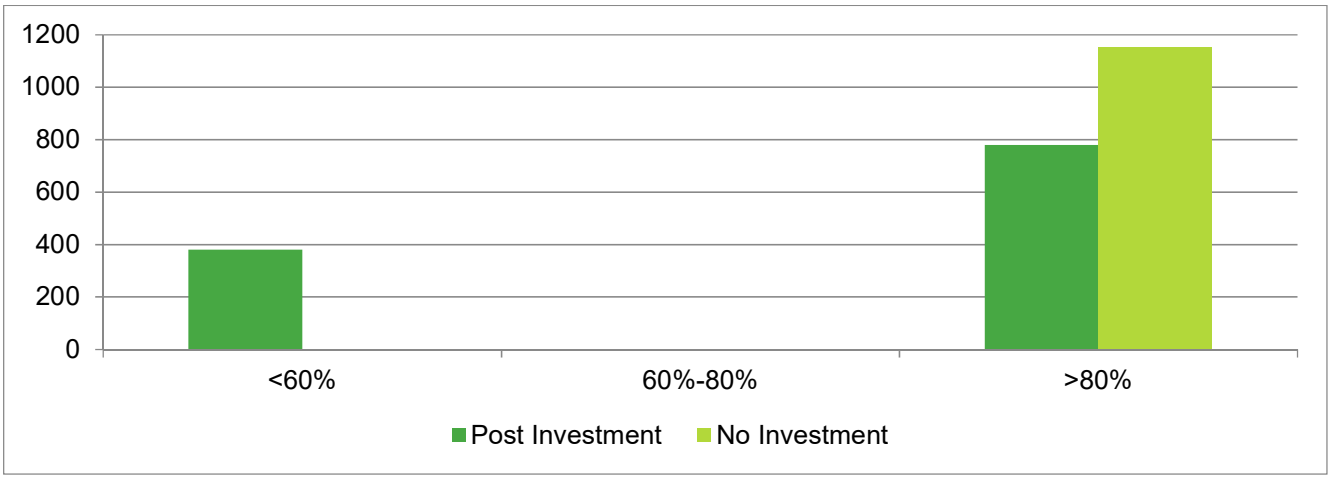


Figure 27 Terminal Equipment - Forecast Health Index



6.2.2. DC Supplies

Figure 28 DC Supplies - Forecast Age Profile

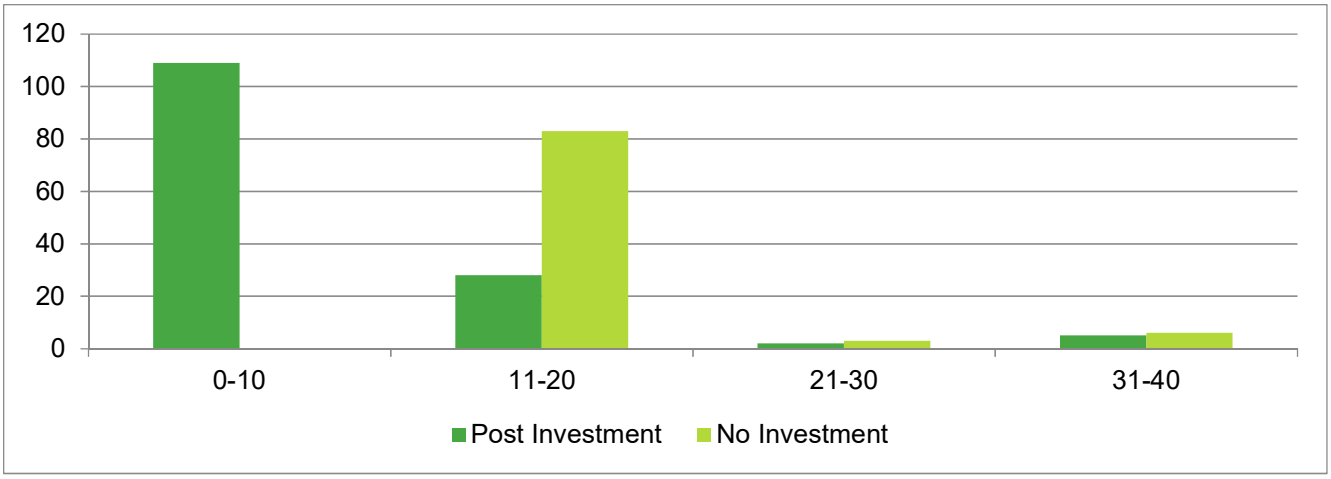
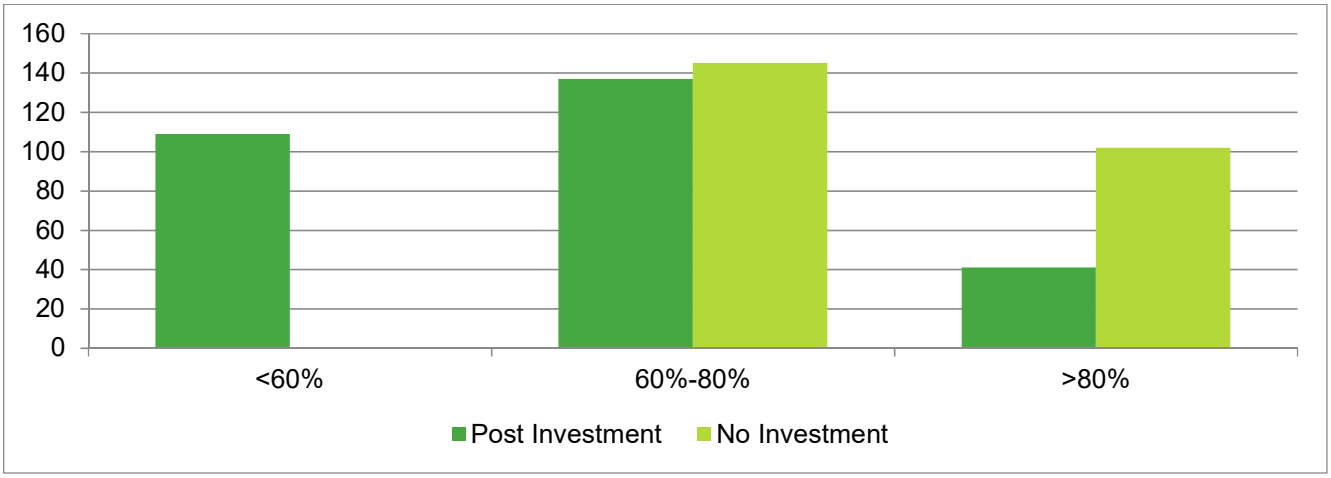


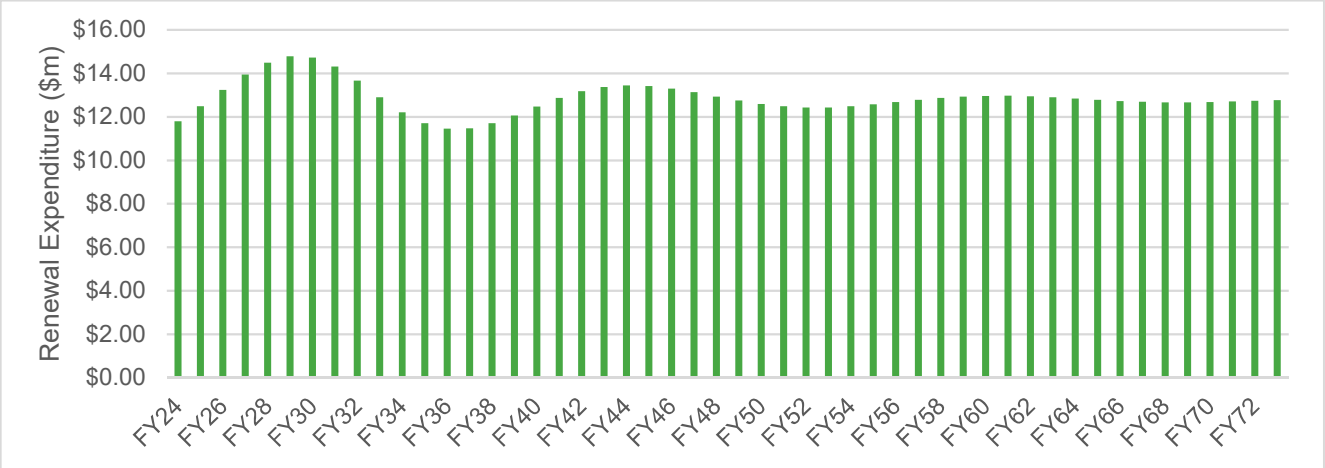
Figure 29 DC Supplies - Forecast Health Index



6.3. Long Term - REPEX Investment Framework

The 50 Year REPEX model is used by Transgrid to create a 50 year forecast, which is based on expected asset lives, standard deviations and unit costs. The assumptions within the model are based on industry standard information. This forecast includes REPEX volumes, costs and consequential average life profiles but no other consequential inputs/outputs (such as reliability and asset health). It also doesn't include augmentation expenditure. The following output is derived from the 2020/21 model.

Figure 30 Telecommunications Systems Long Term CAPEX



RP2 (2018/19 –2022/23) has been excluded as it is currently in an active system with committed works using a bottom up approach through our asset analytics tool using a number of financial and non-financial (risk) inputs.

7. OPEX Forecasts

7.1. Discussion of significant changes to Maintenance Plan

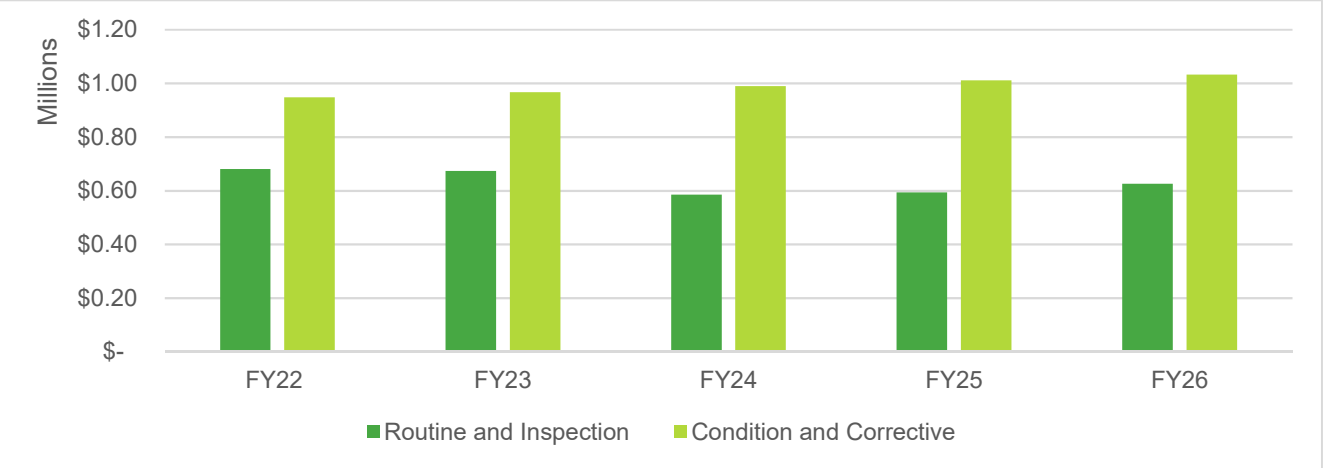
We are currently maintaining our telecommunications assets on a run to fail strategy. We have minimised our planned maintenance to include only planned inspections of those assets that cannot self-report failures. In essence this has driven our maintenance to site inspections surrounding infrastructure: towers, communications sites, and fibre optic DB loss trending. Our defect rates are reflective of a valid maintenance strategy with no concerning changes in issues identified that can be attributed to changing maintenance position.

The key initiative currently planned for the upcoming period is the extension of frequencies for communication site inspections. These activities cover a variety of non-self-checking functions such as VHF Radio compliance to frequency allocations, radio tower ground inspections, fan operation and dehydrator performance. Our aim is to move from 6 monthly to annual inspections with an interim step to 8 monthly to monitor impacts to the network. An 8 monthly frequency has been targeted to mitigate potential increases in defects due to the remote nature of radio sites.

7.2. Five Year OPEX Profile

The five year forecasted expenditure for routine and non-routine maintenance of telecommunications systems is shown below. Routine maintenance follows a non-liner pattern which is driven mainly by maintenance frequencies and their alignment with installation dates.

Figure 31 Telecommunications Systems Routine and Non-routine Maintenance Forecasts



7.3. Long term OPEX

The current initiatives are foreseen to maintain the long-term OPEX at a relatively consistent rate. It is expected that there will be minor peaks and troughs in expenditure, these fluctuations are the result of maintenance frequencies and convergence of various install dates.

The current and proposed initiatives are aimed at delivering efficiencies in OPEX expenditure through the removal of outage requirements. This will lead to a more predictable and consistent expenditure profile throughout the year and should minimise the probabilities of missed activities due to network constraints.

8. Implementing the Strategies

To implement the strategic renewal and maintenance initiatives stemming from this document, actions are to be established via the:

- Maintenance Plan –Telecommunications Systems Assets: The maintenance plan outlines the routine maintenance tasks and frequencies for each asset type.
- Capital Works Program – The capital works program outlines the approved asset renewal and disposal projects.

The Asset Manager is responsible for preparation of the maintenance plans and referring the renewal and disposal initiative to the network investment process. Delivery/Maintenance Programs is responsible for delivering the maintenance plans as per the Operating Model and Delivery/Infrastructure Development are responsible for delivering the renewal and disposal initiatives detailed in the approved capital works program.

9. Definitions

Table 10 Definitions

Term	Definition
Asset Management Objectives	• Specific and measurable outcomes required of the assets in order to achieve the Corporate Plan and objectives; and/or • Specific and measurable level of performance required of the assets; and/or • Specific and measurable level of the health or condition required of the assets; and/or • Specific and measurable outcomes or achievement required of the asset management system.
Key Hazardous Events	They events of most concern associated with the assets that prevent the achievement of the corporate and asset management objectives.
Emerging Issues	Newly identified issues with an asset that pose a risk to the achievement of the corporate and asset management objectives.
Fault Outage	AER defined term - Fault outages are unplanned outages (without notice) on the prescribed network from all causes including emergency events and extreme events.
Forced Outage	AER defined term - Forced outages are outages on the prescribed network where less than 24 hours notification was given to affected customers and/or AEMO (except where AEMO reschedules the outage after notification has been provided). Forced outages exclude fault outages.
Asset Management Plans	Documents specifying activities, resources, responsibilities and timescales for implementing the asset management strategy and delivering the asset management objectives.
RP2	Regulatory Period 2018/19 – 2022/23
RP3	Regulatory Period 2023/24 – 2027/28
Preventative Maintenance	Maintenance activities carried out to inspect and prevent assets from failing.
Corrective Maintenance	Maintenance activities carried out to address an asset condition that requires remediation.

10. Document Management

10.1. Monitoring and review

Implementation of the Strategy is monitored and reviewed by the Asset Manager, Head of Asset Management and Asset Management Committee.

This document will be reviewed in accordance with the requirements of the relevant document and records management procedure or when a material change occurs that requires its content to be updated.

10.2. Roles and Responsibilities to Develop this Asset Strategy

The roles and responsibilities of those responsible for the development of this asset strategy are as follows:

- The Head of Asset Management is responsible for the approval of this strategy.
- This document will be reviewed by the Asset Manager in accordance with the requirements of the relevant document and records management procedure or when a material change occurs that requires its content to be updated.

10.3. References

- Asset Management System Description
- Network Asset Strategy
- Prescribed Capital Investment Process
- Maintenance Plan – Telecommunications Systems
- Digital Infrastructure Spares Plan

Appendix A – Emerging Issues and Renewal and Maintenance Initiatives

Table 11 Emerging Issues and Renewal and Maintenance Initiatives

Assets	Network Asset Strategy Objective	Emerging Issues	Strategic Initiative	Progress (completion and expenditure)	Reference Documents
Terminal Equipment • Multiplexers	• Maintain network reliability • Manage assets efficiently without compromising security holder and customer value	• Obsolescence of deployed models may lead to issues in the network • Capital expenditure on an obsolete standard approach • Duplicated systems utilise the same piece of equipment. Manufacturer support has been withdrawn • Force Majeure Notice impacting current deployment of Nokia 1646 SDH multiplexers	Renewal • Ongoing replacement initiative to replace all “A” systems with new technology standard - Re-acquire spares from “A” system replacement to support “B” system in the short to medium term • Planned renewal project for targeted assets in “B” system • Investigate and test an alternative solution for the obsolete Nokia SDH multiplexers within our A and B systems.	• Ongoing – completion 2022/23 • Planned – completion 2027/28 • Ongoing completion 2021/22	Completion 2022/23 • Need 1365 Completion 2027/28 • Need N2441 Completion 2021/22 • IWR N2677
Communications Sites • All	• Manage assets efficiently without compromising security holder and customer value	• Efficient delivery of site inspections • Frequency of inspections deemed too high	Maintenance • Staged reduction in frequency of inspections with a view on corresponding defect rates • Aim is for yearly inspections 2022/23	• Ongoing – completion 2022/23	• Maintenance Plan – Telecommunications Systems

Assets	Network Asset Strategy Objective	Emerging Issues	Strategic Initiative	Progress (completion and expenditure)	Reference Documents
Monitoring Assets • All	• Maintain network reliability • Improve capability to support future energy system development	• Assets with high health index require addressing to maintain the reliability of communications assets • Assets are in breach of cybersecurity and Australian Signals Directorate recommendations, operating on obsolete and unsupported hardware and software	Renewal • Renewal initiative to finalise modern technologies and standard designs • Planned renewal project for targeted physical assets	• Ongoing – completion 2022/23 • Planned – completion 2027/28	Completion 2022/23 • AMI D0026 Completion 2027/28 • Need N2453
DC Supplies • NiCd • RPS	• Maintain network reliability • Manage assets efficiently without compromising security holder and customer value • Support sustainable growth of the asset base by providing the right infrastructure in the right place	• Battery age and condition leading to high defect rates • Due to the inability to store NiCd batteries there are at times long delays after a failure • RPS systems battery components are reaching end of life • RPS ventilation not correctly applied under original design standard. Ventilation revisited	Renewal • Renewal initiatives in place to target those batteries where their age will exceed technical life by 2023 • Renewal initiatives under review to target those batteries where their age will exceed technical life by 2028	• Ongoing – completion 2022/23 • Planned – completion 2027/28	Completion 2022/23 • Need 1360 • Need 1361 • Need 1362 Completion 2027/28 • Need N2486 • Need N2487
Fibre Optic Links	• Support growth of non-regulated income as service provider of choice to the non-regulated market • Maintain network reliability • Manage assets efficiently without compromising	• Utilisation of regulated fibres by the non-regulated arm of the business increasingly causing disruptions to regulated CAPEX and OPEX activities	Policy Review • Establish a usage policy that highlights performance parameters for the regulated fibre network	• Ongoing – completion 2021/22	Completion 2021/22 • New Policy

Assets	Network Asset Strategy Objective	Emerging Issues	Strategic Initiative	Progress (completion and expenditure)	Reference Documents
	security holder and customer value • Support sustainable growth of the asset base by providing the right infrastructure in the right place				
Fibre Optic Cables	• Maintain network reliability • Manage assets efficiently without compromising security holder and customer value • Support sustainable growth of the asset base by providing the right infrastructure in the right place	• Inconsistent asset data • Inconsistent data capture when testing is completed • Degradation beyond repair of OPGW on TL76 • Increasing defects on OPGW Joint Boxes due to corrosion	Policy Review • Reconciliation of data systems Renewal • Establish degradation rate of the faulty fibre cables and initiate targeted replacement • Review network-wide OPGW installations and establish a renewal program • Develop correlation between defect rates, age and environmental factors contributing to corrosion to establish a renewal program Maintenance • Set OTDR testing requirements for consistent and reportable results	• Planned – completion 2022/23 • Ongoing – completion 2022/23 • Planned – timing TBC • Planned – timing TBC • Ongoing – completion 2022/23	Completion 2022/23 • IWR to be issued • Need N2472 • Maintenance Plan – Telecommunications Systems Completion TBC • Needs to be issued Completion 2022/23 • Maintenance Plan – Telecommunications Systems

Assets	Network Asset Strategy Objective	Emerging Issues	Strategic Initiative	Progress (completion and expenditure)	Reference Documents
Communications Links • SCADA path duplication	• Maintain network reliability • Manage assets efficiently without compromising security holder and customer value	• SCADA path duplication missing in certain network areas	Installation and Design Review • Audit is required on affected installations • Design review to be provided on available communications paths at affected installations	• Planned – completion 2022/23	Completion 2022/23 • IWR to be issued
Microwave	• Maintain network reliability • Manage assets efficiently without compromising security holder and customer value	• Links are congested with bandwidth exhausted in parts of the network • No route diverse communication path westward of Wagga Region • Obsolescence and limited to no manufacturer support of deployed models may lead to issues in the network	Renewal • OPGW rollout to minimise reliance on microwave • Targeted renewal of ageing Microwave assets • Upgrade communications links to ensure bandwidth capacity is adequate	• Completed • Ongoing – completion 2022/23 • Planned – completion 2027/28	Completed 2020/21 • Need 2230 Completion 2022/23 • Need 699 Completion 2027/28 • Need N2442 • Need N2550
Radio Towers	• Manage Network Safety Risk • Manage assets efficiently without compromising security holder and customer value • Support growth of non-regulated income as service provider of choice to the non-regulated market • Support sustainable growth of the asset base by providing the right	• Asset data is incomplete • Asset health unavailable • Non-regulated business interface with data systems incomplete • EME Guides and Tower Elevation drawings are obsolete • No existing standard for demarcation of anchoring points and guy wires of mast	Policy review • Audit and update tower records • Establish asset health profile • Establish data rules and interfaces with non-regulated business • Firm enforcement of updating artefacts project closeout	• Ongoing – completion 2022/23	Completion 2022/23 • Multiple documents • IWR to be issued • Interface process to be issued • Data Rules awaiting approval

Assets	Network Asset Strategy Objective	Emerging Issues	Strategic Initiative	Progress (completion and expenditure)	Reference Documents
	infrastructure in the right place	type radio towers which pose a public safety risk • Assets are approaching end of life	• Standard design development for mast type radio tower guy wire visual identifiers and anchor point protective barriers Maintenance • Establish AIM script for Radio Tower condition data collection • Defect process initiated for updating obsolete EMEGs Renewal • Targeted renewal of ageing assets	• Completed • Completed • Withdrawn	Completed 2020/21 • IWR N2325 – Design guideline developed • AIM script issued. Withdrawn 2020/21 • Need N2549 withdrawn from RP3. • Update of asset and health data will be undertaken before initiation of targeted renewals.
Operational Communications • OTN	• Maintain network reliability • Manage Network Safety Risk • Manage assets efficiently without compromising security holder and customer value	• Assets are at end of life • Core justification for original deployment has changed • State-wide systems needing holistic renewal	Renewal • Establish stakeholder requirements • Test market for available solutions • Renewal delivery for the state	• Planned – completion 2027/28	Completion 2027/28 • Need N2020