Transgrid

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Infrastructure Systems Renewal and Maintenance Strategy

AMS Asset Class Strategy

2021/22

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Table 1 Change from previous version

Revision no	Approved by	Amendment
3	A. McAlpine – A/Head of Asset Management	New document template Review and update to deliver the 2021/22 Network Asset Strategy.
2	L. Wee – Head of Asset Management	Review and update to deliver the 2020/21 Network Asset Strategy
1	L. Wee – Head of Asset Management	New document structure. Review and update to deliver the 2019/20 AM Strategy and Objectives.

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Executive Summary

Transgrid's infrastructure systems facilitate the unmanned operation of over 100 electricity transmission sites. The technological changes affecting the asset base and increasing renewals required to provide further value to the consumers and business are presenting ongoing challenges. Stakeholder requirements are being refined and improvements in risk methodologies are assisting in investment decisions

Asset Review

Transgrid's infrastructure systems portfolio covers over 100 sites and all their associated systems which coordinate the independent systems within a site. These assets are a combination of many different technologies, approaches and applicable standards.

The infrastructure systems portfolio can be summarised as those components and philosophies which directly impact the overall coordination of the unmanned control, monitoring and protection of our electricity network assets to provide a secure and reliable energy system.

During FY2020/21 infrastructure systems assets underwent the following developments:

- Development and deployment of new standards.

- Development of efficient system deployments

It has been established that the maintenance of our current solutions is in line with industry best practice as stipulated by our NER requirements. Any significant improvements in maintenance will require changes in philosophy.

One new site has been added to the prescribed network.

Achievements

In FY2020/21 Infrastructure Systems achieved significant goals including:

- Continued efficient delivery of our asset renewal programs.
- Development of a new Special Protection Scheme standard design.
- Design phase of new Asset Monitoring System

Challenges

- Achieving cost reductions and efficiencies within a minimal portfolio of expenditure.
- Identifying areas for improvement in philosophical approaches and continued review of fitness for purpose of current philosophies.
- IEC61850 functionality issues.

Initiatives

- Review of technology capabilities to improve asset monitoring and defect response.
- Review of agreed approaches to tackle historical deployments that are no longer fit for purpose.
- Early stakeholder engagement for the next refresh or renewal of our SCADA control room system

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1. Foreword

1.1. Foreword

Due to the complexity and interconnectivity of Digital Infrastructure Systems, there is a need for a holistic vision and strategic direction for these systems which span multiple sub-classifications. This document defines the renewal and maintenance strategies for Transgrid's Infrastructure 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 Infrastructure Systems holistically, 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 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 ten year period from July 2022.

1.2. Overview

We have reviewed the historical technical performance and capital and operating expenditure for Infrastructure Systems within the network and we have determined that our current initiatives to date are in need of further investigation and investment to deliver value to our business.

The key initiative surrounding modernisation of the systems as a whole has led to greater confidence in the performance of our assets with increases in issue detection and pre-emptive corrections. This indicates that we are no longer relying as heavily on preventative maintenance to identify failed components of the network.

Overall performance between FY2016/2017 and FY2020/21 has seen:

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

A review of currently available infrastructure systems has identified a need for investment initiatives to modernise, standardise and consolidate deployed systems to facilitate our Strategic Objectives, these initiatives are estimated to cost:

- A base $3.4 million in operating expenditure over the next ten years
- Estimate is comprised of various identified research and development and improvement initiatives

The proposed operating expenditure will assist in:

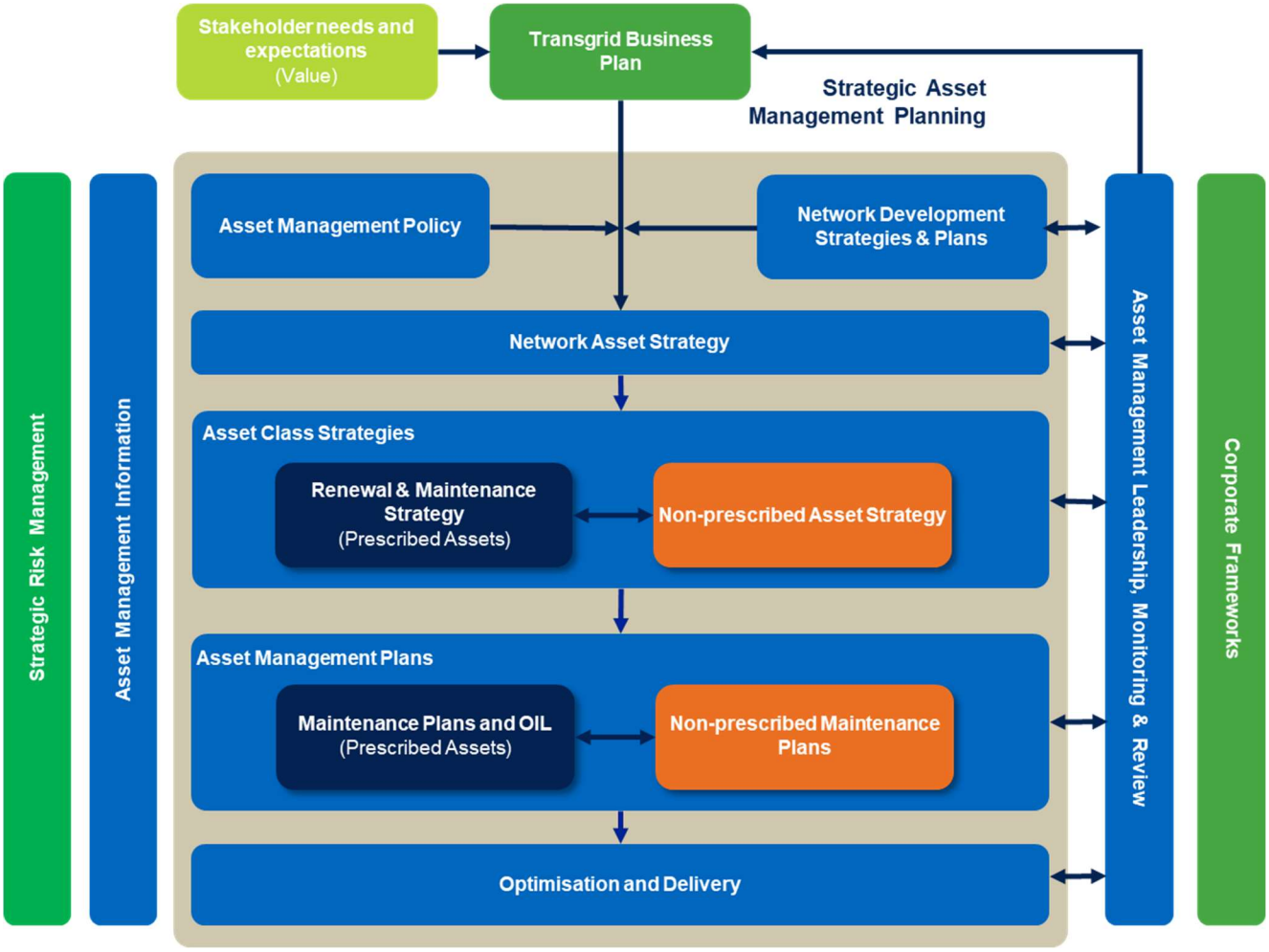
- Minimise outage impacts for maintenance – which will provide efficiencies in project delivery and incentive schemes
- Limit number of components in any system – effectively reducing lifecycle costs
- Continual improvements in asset data and analysis – which will increase efficiency and minimise impacts of works generated
- Leverage latest technologies to deliver intelligent integration of multiple systems into a summary of asset conditions

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.

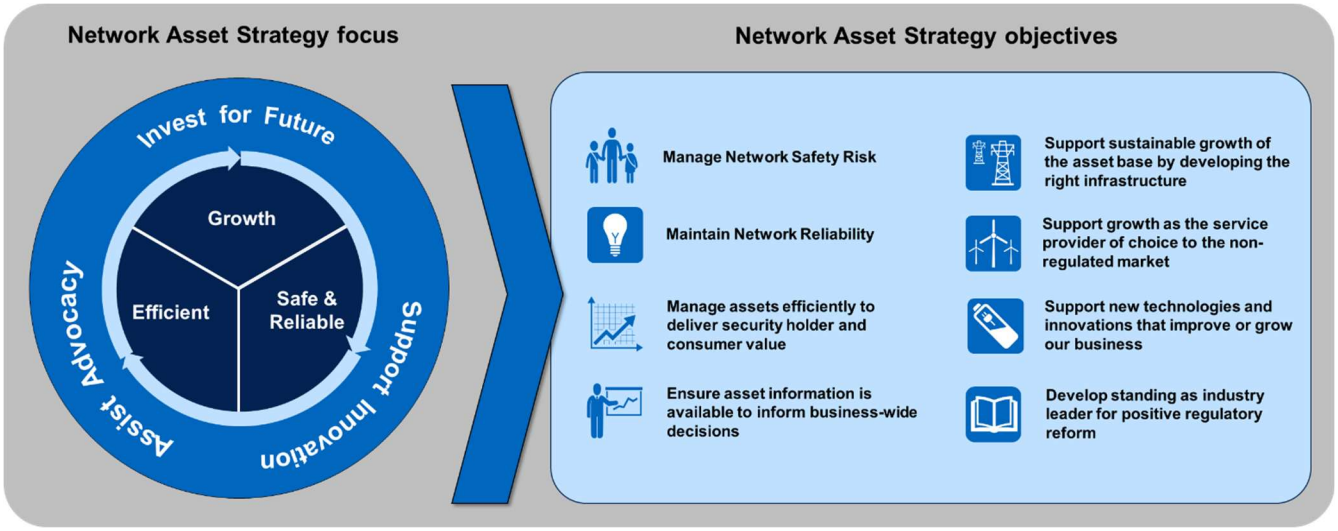
Figure 1 Asset Management System Hierarchy



2.2. Asset Management Line of Sight

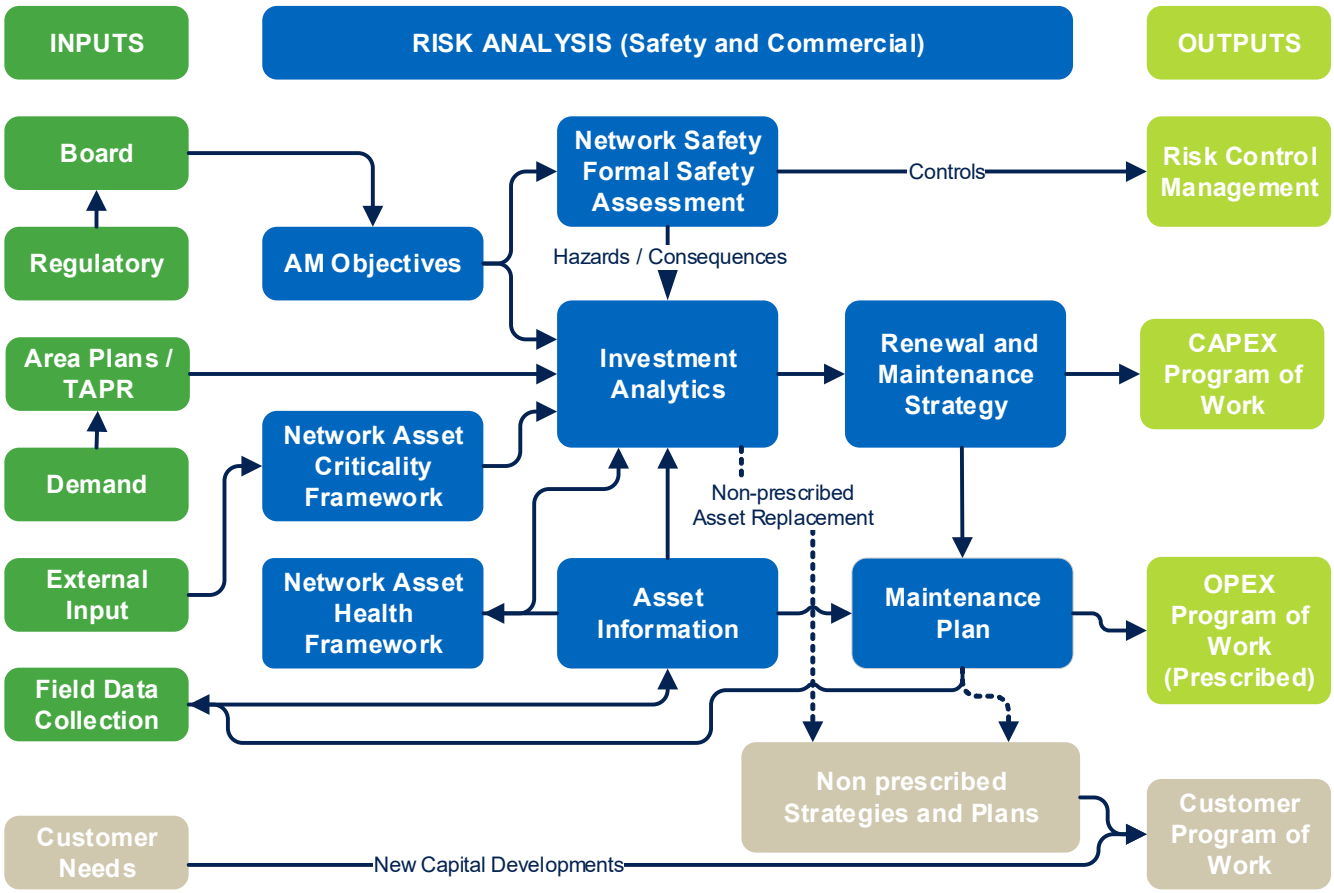
The renewal and maintenance strategic initiatives set out in this document support the achievement of the strategies set out in the Asset Management Strategy document. The strategic alignment of the initiatives in this document to the Asset Management Strategy document is based on meeting its strategic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

Figure 2 Network Asset Strategy Key Themes



2.3. Renewal and Maintenance Process Overview

Figure 3 REPEX Investment Framework



2.4. Asset Overview

2.4.1. Scope of Assets

The following Infrastructure systems are within the scope of this strategy:

- Automation System Architecture
- Asset Monitoring Systems
- AC Distribution Systems
- Intelligence Systems
- Supervisory and Control Systems
- Special Protection Schemes
- Network Infrastructure
- Configuration and Standards Management Systems

The following assets are outside the scope of this strategy:

- Individual Assets – covered in their appropriate Strategy.

2.4.2. Automation System Architecture

System architecture refers the specific type of control conceptual model implemented within Transgrid substations throughout the network. Several sites contain an overlap of design philosophies such as discrete controller and centralised controller or centralised controller with some dedicated HV service bay controllers. The technology utilised in each type of architecture differs significantly, and although is reflective of industry standards at the time maintaining and augmenting such assets in the present represents enormous challenges.

Five such generations of system architectures have been designed and installed throughout the years and are listed below.

Table 2 Automation System Architecture Asset Base

Architecture	Quantity	Description
Discrete Control	16	These installations utilised discrete relays to carry out basic control functionality including synch-check and auto-reclose. These types of installations provide no visibility of the site to the control room. This type of installation does not facilitate remote monitoring or operation of plant. This type of installation is typical for substations built prior to 1990.
Single Controller	19	This equipment utilises microprocessors to carry out control operations and calculations within one unit, thus eliminating many auxiliary component requirements. This type of installation generally connects several, if not all, HV services within the site to a single controller. This philosophy uses an obsolete system and as such, any replacements require a complete redesign of the control database to install even a “like for like” unit. This type of installation is typical for substations built between 1990 and the early 2000’s.
Dedicated HV Service Controller	75	This design philosophy utilises an individual microprocessor based controller for each HV service at a site. These controllers incorporate auto-reclose functionality and the panels are equipped with transducers, power meters and synchronising check relays. This type of installation is typical for substations built after the early 2000’s.
Combined Protection and Control (CPC)	6	This is the current design philosophy which utilises microprocessors with combined protection and control functions, eliminating the need for independent control schemes. This type of installation is typical for substations built from late 2010’s and is our current default solution.
IEC-61850 Protection and Control	2	This type of installation adopts the IEC61850 standard which defines a common protocol that facilitates interoperability and communication among intelligent electronic devices (IED) in substations. This solution is in early stages of development with only a single deployed installation completed in 2018. This solution is evaluated on a case by case basis

2.4.3. Asset Monitoring Systems

The Digital Infrastructure Asset Manager has recently been appointed responsibility for the management of these type of assets. There are four distinct systems with very different functionality that have currently

been identified. Information regarding requirements from the different system owners, configurations and systems deployed are being collated to facilitate a short term renewal and maintenance strategy. This strategy will cover the medium to long term strategic direction for these assets.

These Monitoring Systems provide insights into the performance and surrounding conditions of the associated assets, allowing accountable users to make decisions on the appropriate actions to meet Asset Management requirements for the associated assets. There are several types of Monitoring Systems.

Table 3 Asset Monitoring Systems Asset Base

System	Quantity	Description
Protection Monitoring	28	These systems are known as the "Tarigma" system. The deployments monitor the status of connected protection schemes and centralise extraction of fault records. There is additionally high level infrastructure components to connect the site based system which is deployed on our Substation Network to our Corporate Data Network. These systems comprise of: • Licensed software deployment • Up to date driver packages for each relay model
Substation Monitoring	55	These systems were historically named "Online Monitoring Systems" (OLCM). These systems have been deployed for the purpose of providing a centralised access point for the evaluation and trending of asset performance and facilitate the Asset Manager to develop appropriate risk mitigation measures to address trends. The deployments throughout the network have very limited information available regarding installed components. There are high level infrastructure components to connect the site based system which is deployed on our Substation Network to our Corporate Data Network. A typical deployment consists of: • Binary output devices • Analogue 4-20mA devices • Data aggregation and analysis devices • Protocol conversion devices • Standalone PCs –operating on an obsolete OS • Licensed SCADA software deployments – operating on an obsolete software package
HV Conductor Monitoring	58	These systems are historically named "Dynamic Line Rating" (DLR) systems. These systems have been deployed for the purpose of providing network operators the ability to set a conductor's rating based on the physical parameters surrounding that conductor at any point in time. The deployments throughout the network have very limited information available regarding installed components. Age profile, and associated system configurations. A typical deployment consists of: • Various weather stations • Base station

HV Cable Monitoring	4	These systems monitor and report any abnormal conditions surrounding our underground HV cables. These systems have been deployed to assist in the early detection of cable issues and any surrounding works that may have an impact on the cable.
Cable Tunnel Monitoring	4	These systems monitor the conditions of our HV cable tunnels. These systems are deployed to ensure the safety of our Transmission Cable and Tunnel staff as they work in the high risk areas associated with our cable tunnels. These system ensure that our tunnels can be treated as a standard area of operation and not classify the as a confined space.

2.4.4. AC Distribution Systems

AC distribution provides supplies throughout a site that facilitate the connection of maintenance equipment as we as provide energy sources to certain HV plant. These can effectively be broken down to three components.

Table 4 AC Distribution Systems Asset Base

Component	Quantity	Description
Distribution Rings	10	Unsegregated Cables - These installations have the AC cable installed in the cable trench alongside all other control cabling i.e. no segregation. This was the standard installation approach historically and ceased to be the standard in the 1990's.
	91	Segregated Cables - These installations have the AC cabling segregated from the control cabling either externally from the trench or utilising armoured cable. This is our current installation standard and has been in effect at sites and upgrades from the late 1990's to early 2000's.
Termination Boxes and Kiosks	NA	These comprise the end points within a switchyard and provide access and connectivity to the AC supply rings and facilitate the ring being a modular installation that allows upgrades and modifications to occur. This component has two installation methodologies in service within our network: • Unsegregated Terminations – These installations house the AC supply termination points in a shared box/kiosk with other control terminations. This was the standard installation approach historically and ceased to be the standard in the 1990's. • Segregated Terminations – These installation house the AC supply terminations segregated from control cabling in a separate box/kiosk. This is our current installation standard and has been in effect at sites and upgrades from the late 1990's to early 2000's.
Fault Protection Systems	NA	These comprise the installation of safety systems to protect equipment and staff at the 400V levels: • Main Board Circuit Breakers – These breakers perform two key functions involving the protection of equipment during a

Component	Quantity	Description
		fault and the limitation of Arc Flash energy. These are installed at all our sites • Residual Current Devices – these perform the key function of protecting personnel during activities from leakage currents. We do not currently have accessible data on the install base for the type of main breakers, RCDs and boxes installed.

2.4.5. Intelligence Systems

Intelligence systems are a new addition to our fleet of support systems potentially providing efficiencies in our operational activities and assisting our investment decisions in yielding optimal results for all our stakeholders.

We currently have a single intelligence system deployed within the network, this being the AMC AMIP system leveraging PI Historian to link various asset systems and provide a centralised view of our asset's performance and trends that can be analysed by Asset Managers, Network Operators and anyone that needs access to make asset based decisions.

We are investigating the potential to leverage the new system to apply intelligence to mitigate maintenance activities.

2.4.6. Control Room SCADA System

There are two Operational Control Rooms in operation within our network, these are located at the Sydney West (primary control room) and Newcastle regional centres.

This system is currently under renewal and has been deployed with a like for like system providing the same functionality of allowing Network Operators to monitor and control the status of the network. No additional functionality or value is being derived from this renewal.

2.4.7. Special Protection Schemes

These schemes are deployed throughout the network where we identify system reliability risks when certain combinations of contingent events occur. These systems have become more common with the recent deployment of Wind Farms and Solar Farms throughout the network.

We currently do not have a complete view of system deployments within our network.

Table 5 Special Protection Schemes Asset Base

Scheme	Quantity	Description
Runback Schemes	2	To enable the generation to generate at its full capacity, a runback is required is to reduce the generator output when line overload is detected due to either changed system conditions, or line contingencies. As well as duplication required to ensure reliability of the run-back scheme at the generation, it should also be equipped with generator tripped off at point of connection to cater for the overloading of the 5 minute line ratings.

Scheme	Quantity	Description
Transfer Tripping Schemes	7	Generation transfer trip scheme is required to protect the power system against island conditions, voltage stability, and extreme voltage fluctuations due to the combined effect of network contingencies and the connected generation.
Load Shedding Schemes	18	Load shedding schemes are installed to improve voltages in those areas in the event of line trip contingencies during high load.

2.4.8. Network Infrastructure

These systems provide the required interconnectivity of various assets at multiple levels:

- Substation connections
- Inter-site connections
- Inter-functional connections
  - Operational Network(s)
  - Corporate Network(s)

The current established solution utilises spanning tree with a variety of devices and multiple points of failure. This places a burden on corrective maintenance costs as any failure requires rectification.

It has been identified that we need a network wide direction to manage these components. A solution has been investigated and is currently in the final design phase, ready for deployment in in train Secondary System Renewal projects.

2.4.9. Configuration and Standards Management Systems

These systems cover the management of our asset configurations and applicable standards for revision, review and renewal. There are various configurations and standards that require management:

- Protection Settings
- Communications Settings
- Control Settings
- Network Settings
- Panel Design Standards
- Schematic Design Standards
- Architecture Design Standards

2.5. Spares

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

This approach to spares management has provided some challenges due to the sporadic nature of the installed systems covered under this strategy. It is the strategic direction of the Asset Manager to consolidate and standardise our systems to allow for the manageable holdings of limited spares.

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

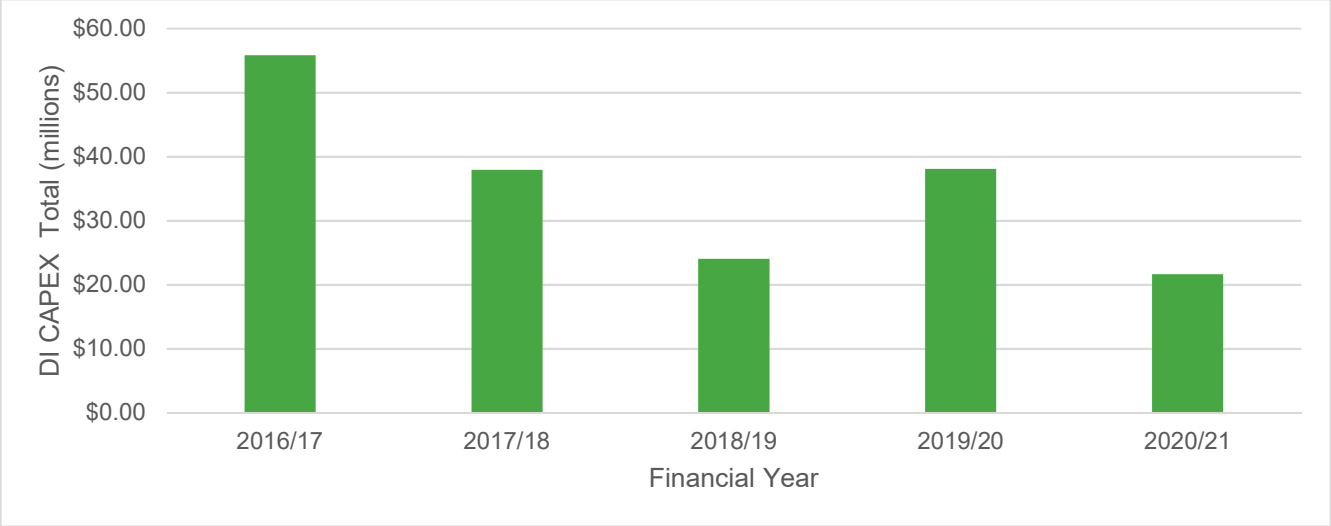
Historical expenditure has been analysed from Transgrid's RIN submissions between FY2016/2017 and FY2020/2021.

3.1.1.1. Capital Expenditure

Previous initiatives had identified the need to upgrade underlying infrastructure. We have not historically targeted the majority of systems under this strategy. These infrastructure style initiatives were only started recently and their costs have therefore only been capitalised in the last couple of years.

Overall, capital expenditure has levelled for Digital Infrastructure the last few years. This is mainly attributed to the strategic direction towards site wide renewals, targeted at upgrading the Automation Systems Architecture at our sites to align with the latest standards, resulting in longer project delivery schedules. . It is noted that due to longer project delivery timelines and the capitalisation method of RIN data, many of the projects in progress are delivering value while not having achieved completion and recording of capitalised expenditure. It is anticipated that these will see an increase in the last two years of the regulatory control period.

Figure 4 Total Historical CAPEX

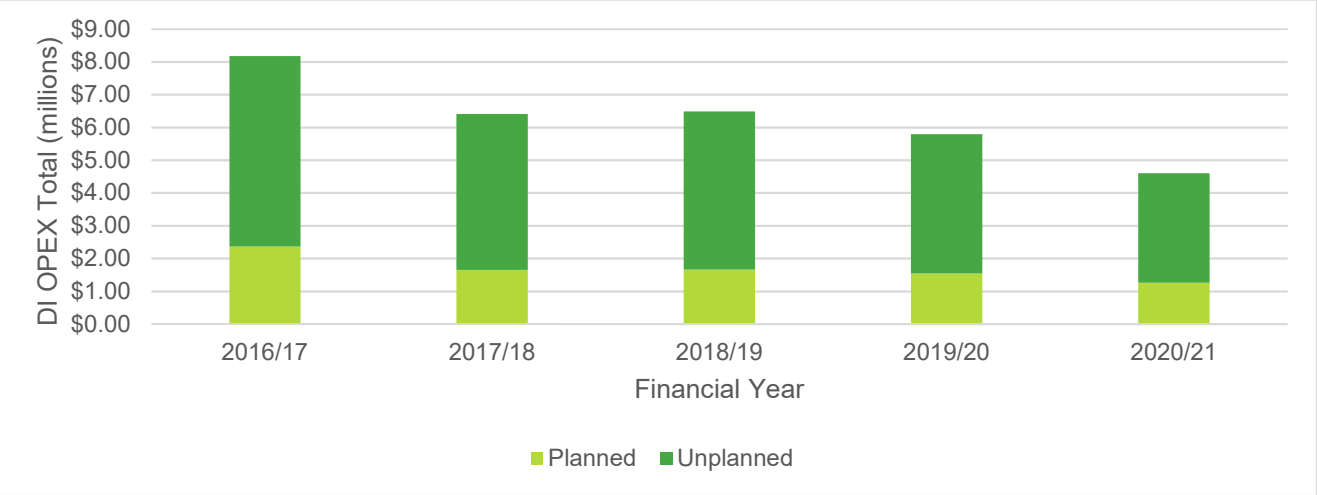


3.1.1.2. Operating Expenditure

Previous initiatives had targeted a reduction in overall operating expenditure of the AMPOW. These reductions have been achieved through several fronts:

- Efficiency gains in maintenance delivery to reduce overall costs. These have been targeted through a review of maintenance activities and their frequencies. This has resulted in the historical downward trend of Operating Expenditure over the last four years.
- Upgrade of architecture and utilisation of Monitoring Systems has facilitated reductions in planned maintenance activities and a general reduction in unplanned maintenance activities due to the modernisation of all components in a site.

Figure 5 Total Historical OPEX



The reductions in total expenditure highlighted above are a result of several factors. Due to the penetration of modern technologies over the past 2-3 years, FY2017/2018 introduced in-service protection maintenance for all feeder and busbar protection schemes, resulting in a reduction of effort and outages required to deliver maintenance while ensuring that our protection schemes are capable of performing their stated function in meeting NER critical clearance times and maintaining the reliability and security of the network.

A review of maintenance performance, actual versus budget costs, for 2021/22 is shown in Table 6 below.

Table 6 Digital Infrastructure maintenance expenditure FY2021

	Actual $	Budget $	Variance $
Routine Maintenance	$1,735,475	$2,864,382	-$1,128,906
Inspections	$19,278	$27,537	-$8,259
Condition	$417,657	$502,000	-$84,343
Defect	$2,053,130	$1,750,222	$302,908
TOTAL	**$4,225,541**	**$5,144,140**	**-$918,599**

Overall expenditure across the Digital portfolio has varied in the previous financial year primarily due to the introduction of operating expenditure constraints, this has seen resulted in the targeted deferral of planned

maintenance activities to facilitate the critical expenditure required in defect response. While the Digital portfolio has resulted in a $900k underspend, these funds were reallocated to other asset class portfolios as required.

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 and overall architecture, particularly integrating systems, has allowed us to move from a reliance on preventative maintenance to identify issues. New systems offer a higher availability of diagnostics and real time notification of issues.

As more assets are upgraded to modern technologies and standards, we are no longer waiting the length of a maintenance interval to discover issues with the assets. When bundled with the penetration of Protection Monitoring Systems, this leads to reduced issue response costs as majority of analytics can be successfully completed from the desktop.

In particular, since 2016/17 where we have seen the delivery of our architecture driven site wide upgrades there is a downward trend in defects in general as the entire site infrastructure has been upgraded and delivers a more reliable installation.

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 4.1.

Table 7 Asset management objectives and performance indicators – Infrastructure 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.*

Transgrid Strategic Theme	Asset Management Objective	Asset Management Performance Indicators
		• Maintain 5 year average level of Key Hazardous Events: - Uncontrolled discharge of electricity *Achieved in FY2021 – see Section 3.1.3.*
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 *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.* • Achieve efficiency on regulated capital spend FY2021 *Targeted capital efficiency was achieved in FY2021 and reinvested into the business.*

3.1.3.1. Fault Outage Rates

Digital infrastructure assets have met and exceeded the 5 year average for all Forced outages

Figure 6 Transmission Line & Cable Fault Outage Rate

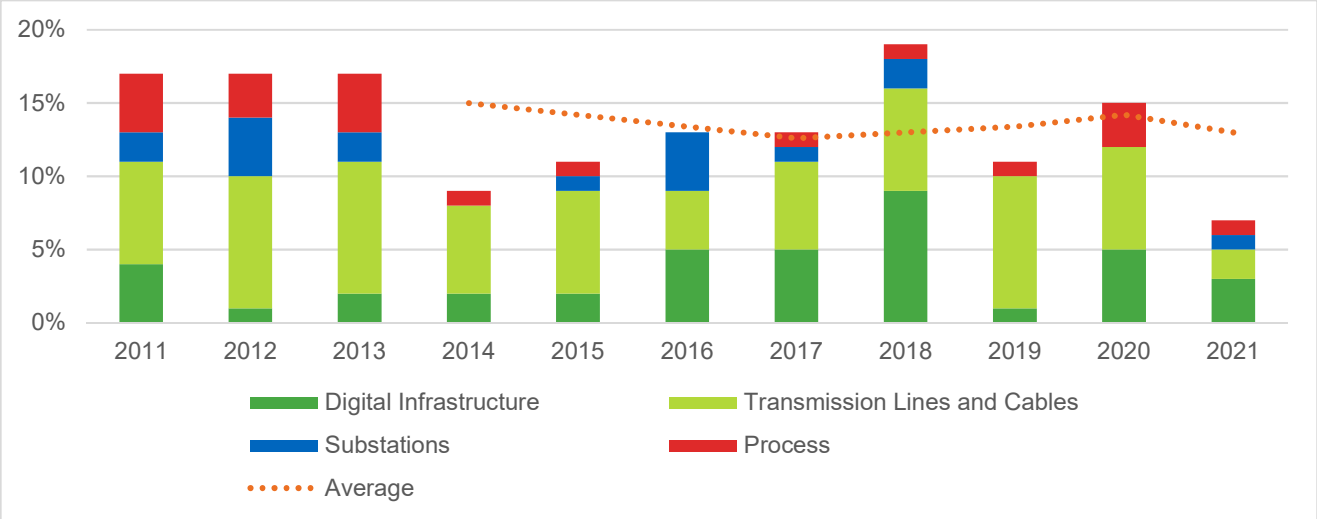


Figure 7 Transformer Fault Outage Rate

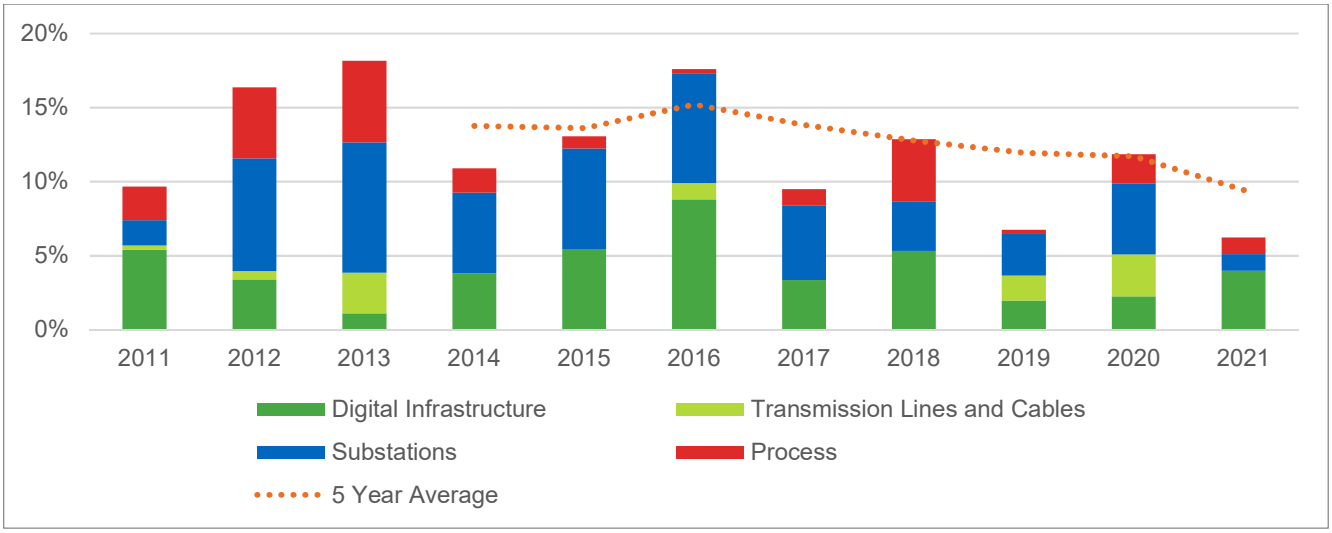
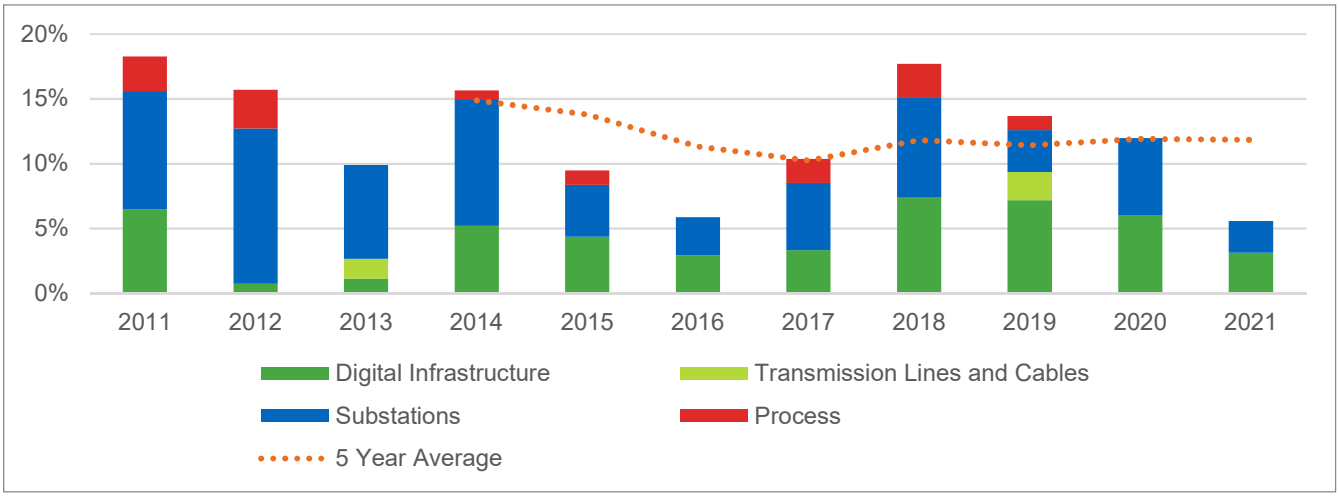


Figure 8 Reactive Plant Fault Outage Rate



3.1.3.2. Forced Outage Rates

Digital infrastructure assets have met and exceeded the 5 year average for all Forced outages.

Figure 9 Transmission Line & Cable Forced Outage Rate

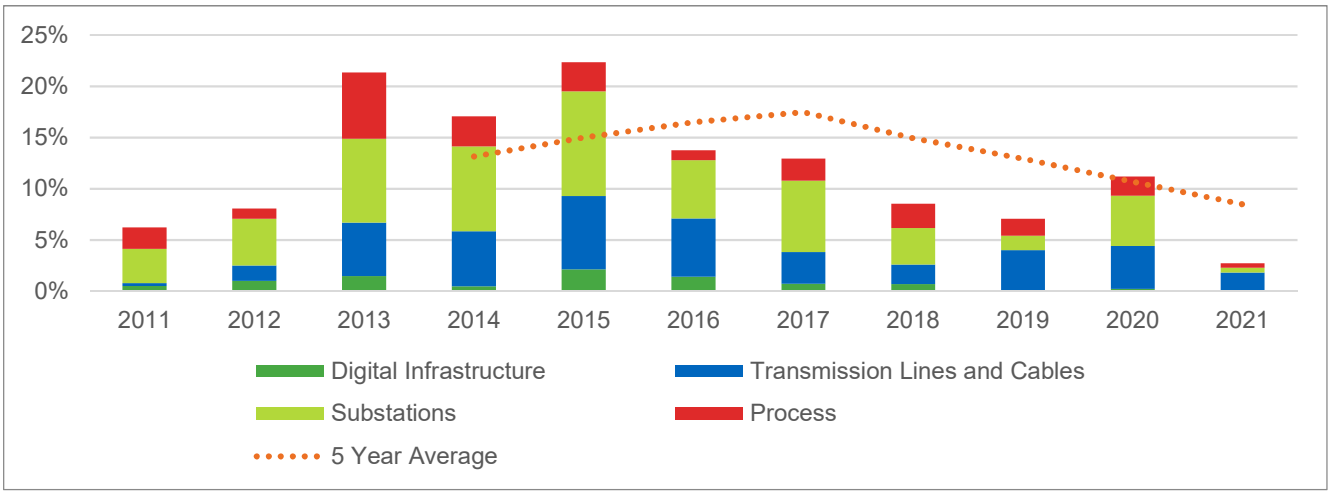


Figure 10 Transformer Forced Outage Rate

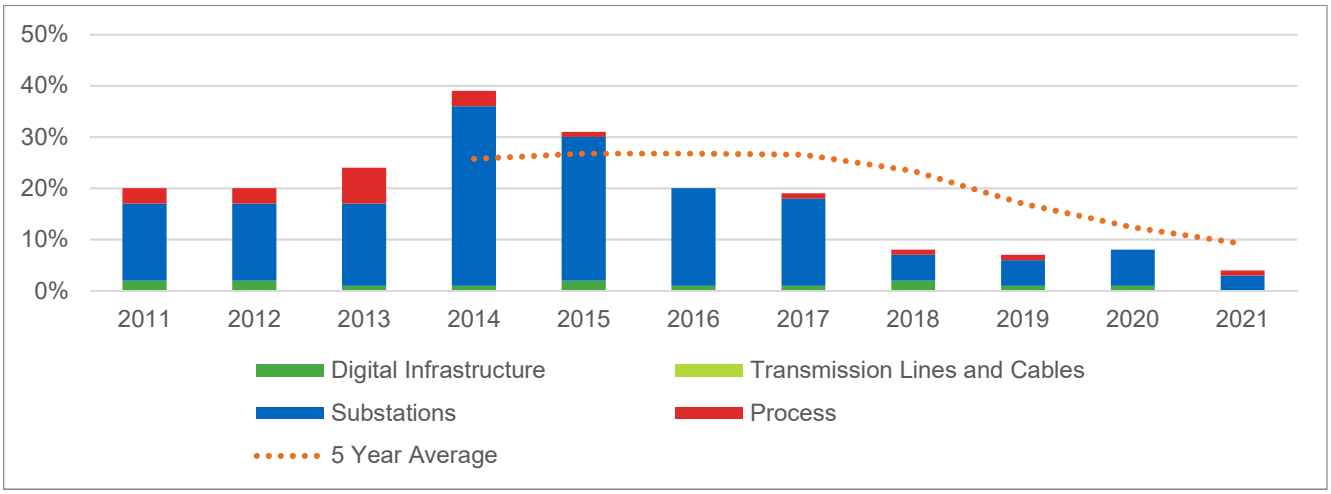
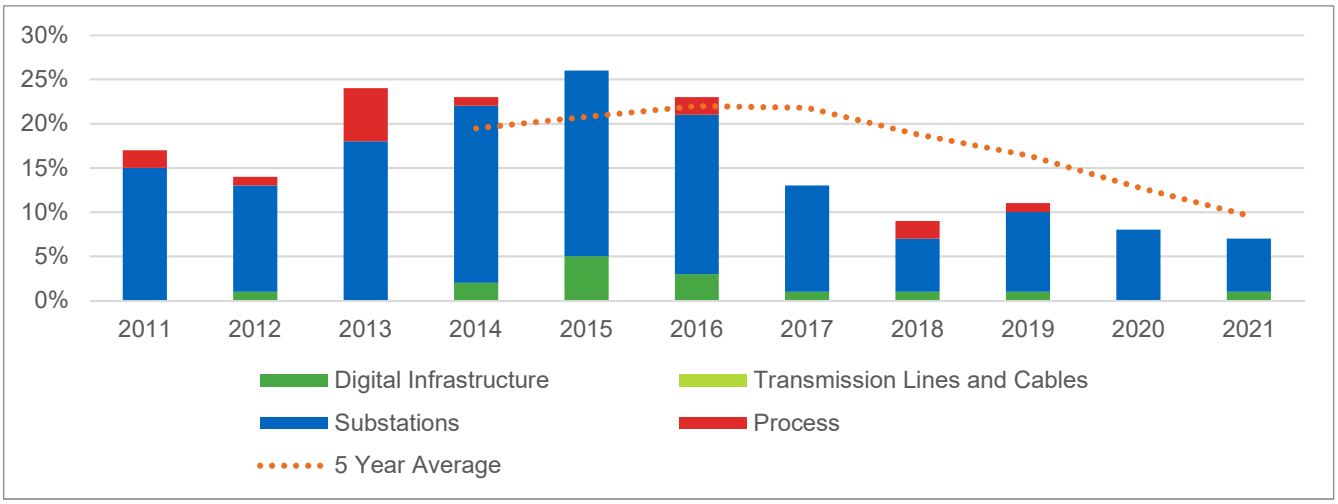


Figure 11 Reactive Plant Forced Outage Rate



3.1.3.3. System Minutes

Digital Infrastructure assets have not initiated any system minute events this past year.

Figure 12 ENS >0.05 System Minute Event Count

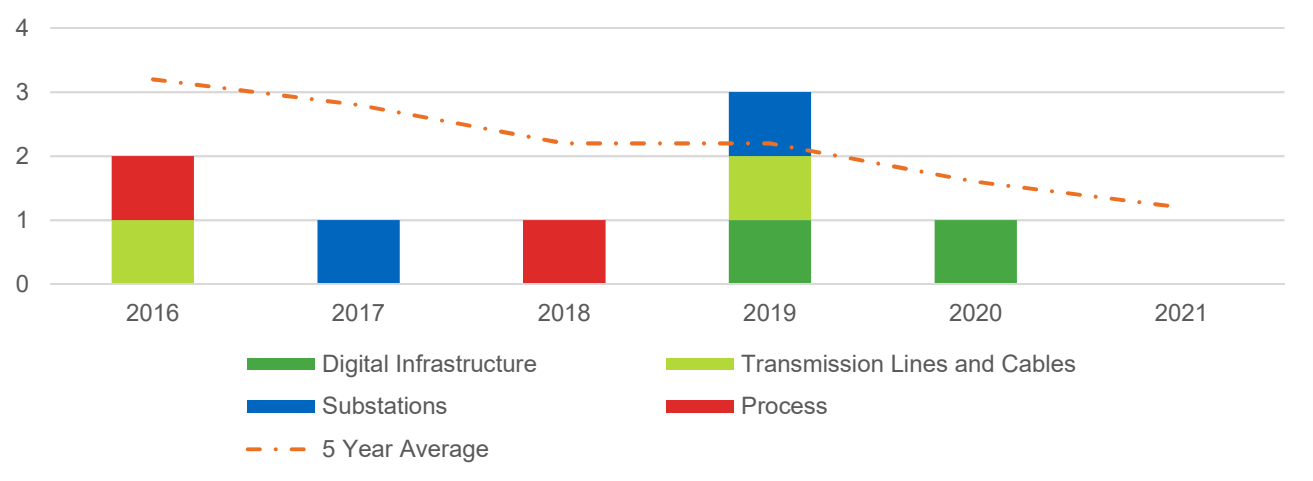
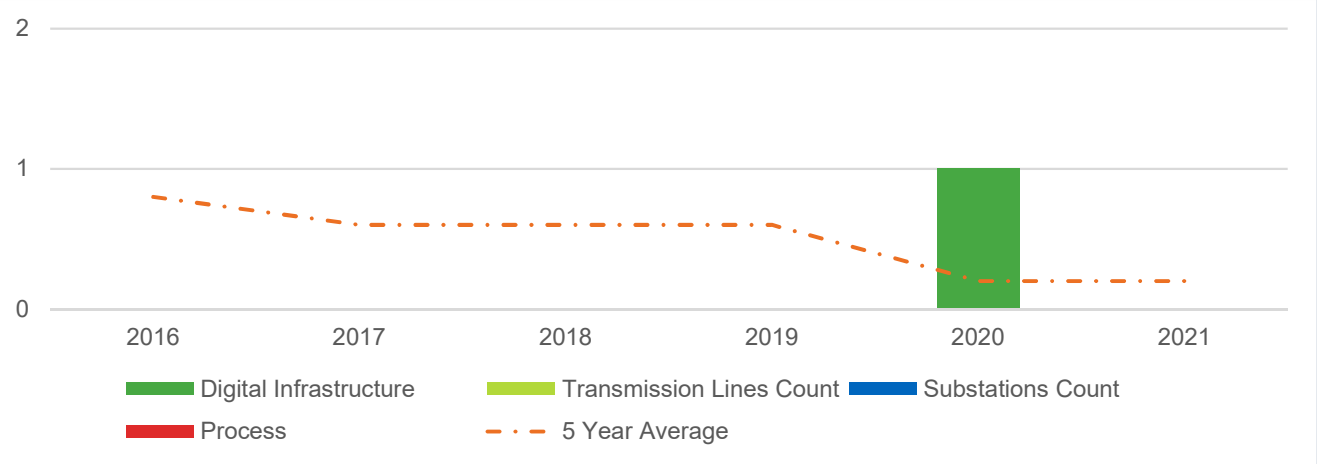


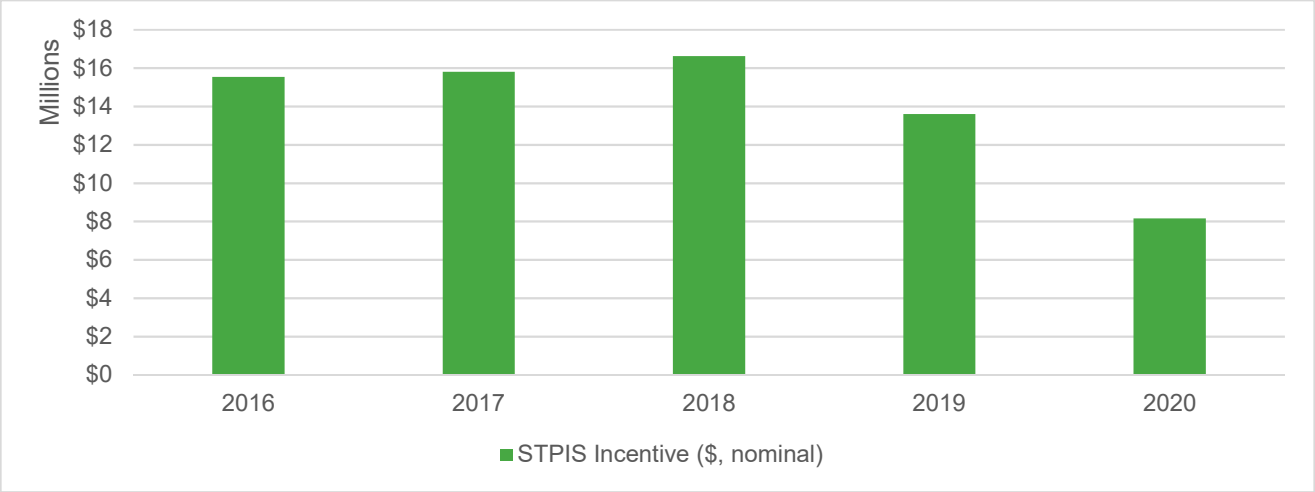
Figure 13 ENS >0.25 System Minute Event Count



3.1.4. STPIS Performance

Annual STPIS performance is summarised below.

Figure 14 Annual STPIS Outcome Trend



To meet the incentives certain initiatives have been undertaken by the Digital Infrastructure Asset Manager to maximise the availability of assets on the Network, we have not identified any issues with these initiatives over the last year and will maintain the previous direction.

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.
	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	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
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 Automation 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 Automation Systems Maintenance Plan, and the referenced governance documents.

Table 9 Asset management objectives and performance indicators – Digital Infrastructure 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. Overall Initiatives

Our overall direction regarding Infrastructure Systems is the move to holistic system renewals and away from individual asset renewals where feasible. Due to the nature of Digital Assets and the fast paced

evolutionary changes in technology and manufacturer support, it has been identified that we would benefit greatly from upgrading whole systems in a single body of work.

Implementation of a whole of system renewal strategy is expected to provide the following benefits:

- Single replacement projects
- Normalisation of system health-profiles
- Decreased operational and capital expenditure
- Minimisation of future capital write-off
- Platform commonality
- Enhanced features and operational benefits
- Reduction in individual asset counts
- Normalisation of system spares

5.2. Automation System Infrastructure

The current deployments of automation system infrastructure are leading to several issues in the deployment and maintenance of new assets. Of particular concern is the inter-connectivity of various infrastructure solutions, a component which has never been adequately covered in transitions.

Current deployments provide no integration between various technological changes and subsequently don't factor these differences in the selection of renewal solution. Another key issue being identified is the forced utilisation of sub-optimal solutions to facilitate backwards compatibility.

To provide some insight the following examples have been highlighted:

- IEC-61850 – Current design standards do not facilitate integrating IEC-61850 technology into an existing copper-based infrastructure philosophy. The design has been developed as a complete site solution only, and integration into an existing copper-based designed site would still require its independent network infrastructure installed in addition to that already existing.
- Combined Protection and Control – Minimises the redundant approach of wired connections for inter-device signalling. The design leverages communications based signalling to minimise cabling and cross device interconnection complexities. This cannot be deployed to deliver complete benefits at mixed technology sites due to the ad-hoc designs that would be required to facilitate such a change. Also, should a site be progressively renewed it would typically result in a sub-optimal outcome of running multiple SCADA links via disparate Data Concentrators.
- Dedicated HV Service Control – Has faced multiple variations in the standard design to facilitate integration with earlier technological approaches. This has led to the current position where sites can be mixed across 3-4 generational technologies. This forces the site to become a one-off design solution that is complex and subsequently expensive to upgrade on a device by device basis.

Current renewal initiatives involve the complete technological upgrade of a site's automation infrastructure and systems to modern standards. To date, Combined Protection and Control system has offered the greatest value for electricity consumers and our business.

To successfully maintain an effective technological renewal rate, we would have to target an approximate 25-30 sites per regulatory period to meet the typical 15-20 year asset life expected for modern digital assets. However, this may be forced to earlier timelines as these assets' renewal is often driven by manufacturer support and technological obsolescence.

5.3. Asset Monitoring Systems

These systems have been historically managed individually and without any holistic vison or direction across all components. One of the key differentiators of these systems is that access is required across the business. With various stakeholders having a vested interest into accessing the information they provide.

Current initiatives are investigating the potential for integration of all components into a single Asset Monitoring solution that can be applied across the portfolio of assets minimising training and upskilling requirements. This will effectively ensure that all stakeholder requirements are met and that the systems are maintainable by a broader range of available resources.

The minimum stakeholders for all these systems are:

- Asset Management
- Asset Monitoring Centre
- Maintenance Delivery

5.3.1. Protection Assets

The Tarigma system has significantly reduced defect response costs where they are deployed. As an operational assistance tool, it has facilitated the remote accessibility to protection device performance and extraction of fault records. This has facilitated savings in protection operation review response times and costs as we no longer need to send a technician to site for the sole purpose of fault record extraction.

The system is facing some difficulties with a reliance on Tarigma built drivers for every device/series included for monitoring. We are approximately 3 years into our latest protection standards and have just recently been notified of the availability drivers to allow connection of these devices. The vendor was engaged in 2019 regarding these issues and has made steps for the development of device drivers required by Transgrid, however the release of these remains pending.

As there are significant efficiencies in remote accessibility of protection device recorded data, we are currently investigating a new system leveraging our relationship with the supplier of our Gateway/HMI solution. The solution is capable of extracting device COMTRADE files and forwarding them as required akin to our existing Tarigma system.

5.3.2. Substation Assets

These systems have been deployed in an as needed basis and have had several components reach the end of their technical lives and end of the manufacturer support cycle.

In particular, the PCs, Operating Systems, Servers, Network Switches and Gateways, and actual monitoring software are no longer available or supported. This raises cybersecurity concerns whereby significant risks are introduced into Transgrid's high-security Operational Technology environment.

We have initiated a research and development activity to establish a feasible solution that can meet the Asset Monitoring Systems purpose and future direction for its lifecycle.

5.3.3. HV Conductor Assets

These systems have been deployed to assist Network Operations in establishing dynamic thermal limits to HV conductors dependent on ambient environmental conditions.

The systems were developed as a research and development initiative which has been subsequently rolled out to multiple locations throughout the network. There is currently limited information or direction on these systems. The current solution is treated as completely independent of our standard communications and monitoring infrastructure solutions. As such they are not subject to our current implementation of cybersecurity or strategic initiatives.

We are initiating a review of the current solution to determine the way forward to ensure that these systems integrate with our standard business practices.

5.3.4. HV Cable Assets

These systems monitor the condition of HV cables and provide early warning of degradation or damage. These systems are not currently under the remit of the Digital Infrastructure Asset Manager. It is however noted that as they currently reside on a separate standalone system there is benefit from integrating these systems into our current review of all Asset Monitoring Systems.

We are initiating a review of the current requirements from all relevant stakeholders to determine what value can be added from integration.

5.3.5. Cable Tunnel Assets

We have cable tunnel monitoring and management systems implemented that assist in the protection of cables and staff within the tunnels.

These systems were deployed as a designer supplied solution that is separate from all our currently established systems and designs. This leads to a condition where a specialised knowledge base is needed for their maintenance and renewal.

Additionally, these systems return to multiple interface points which force increased costs for investigations as often staff will attend the wrong interface location.

We have initiated discussion with relevant stakeholders to understand their requirements and to develop a renewal plan that meets our objectives.

5.4. AC Distribution Systems

5.4.1. Distribution Rings

LV AC cable distribution systems in Transgrid's network have traditionally had PVC cable installed within the cable trenches and without any form of segregation or separation from all other control cabling required for the operation of an unmanned transmission network substation. This methodology has historically led to cable fires at Sydney North in 2010 and Kemps Creek in 2004, both of these fires were found to be caused by LV AC cable failures.

The current philosophy to minimise risk of cable fires is to physically segregate the LV AC cabling from the control cabling by installing it outside the cable trench where feasible or installing a type of cabling that does not fuel a fire.

5.4.2. Termination Boxes and Kiosks

Historically, termination boxes and kiosks were deployed as a single installation per bay with all marshalling carried out. A recent LV safety audit has identified potential safety risks with exposed or live AC residing in the same box as DC circuits. The key driver or this safety concern is that the majority of callouts requiring access to these boxes involves fault finding or correction of the DC control circuits. The availability of live AC circuits in the same box leads to a risk for staff carrying out works inadvertently touching such circuits.

There are currently several maintenance and project based bodies of work to address these issues. The key renewal initiative in place is where a site's AC distribution is modified, we investigate the validity of moving to individual and separate AC and Control Boxes.

5.4.3. Fault Protection Systems

Historical deployments of Main 415V Breakers within the network have been identified with a flaw in their operation and installation. Specifically, they have been installed as isolator's without the speed of operation required to clear a fault in an effective time. This has led to potential risks regarding Arc Flash protection for staff at a site exposed to a faulted device.

As such Automation Design, in collaboration with Asset Management have taken steps to investigate initiatives for these assets:

- Development of a standardised method for arc flash calculations.
- Detailed reviews of each site during project initiations to highlight issues and assist in the early mitigation of any identification risks.
- The deployment of protection grade 400V AC monitoring and protection devices

Our current RCD deployment strategy has been flagged for review moving forward. The current approach is the deployment of RCDs on all 400V AC circuits. This applies to outlets in the buildings and switchyard including essential and non-essential circuits. This approach raises several difficulties from an operational maintenance perspective, particularly as statutory requirements are prescriptive regarding the maintenance requirements where RCDs are installed. The key difficulties faced are:

- Numbers of RCDs and maintenance costs associated. For switchyard outlets, current policy from Delivery is the use of portable RCDs is compulsory when performing work in the switchyard. As such, this effectively makes switchyard outlet RCDs as redundant. However as they are installed we face significant maintenance costs for obligatory testing of these units.
- Obtaining outages for essential circuits is notoriously difficult and therefore so too the ability to meet strict maintenance schedules.

Our current initiative is to meet with all relevant stakeholders and establish a direction moving forward. Our position at this time is to attempt to move to the installation of RCDs only on Mains, Power and Lighting on non-essential services within buildings and carparks only.

5.5. Intelligence Systems

Historical deployments as described in previous sections effectively exclude the ability for intelligence in analysis. We have traditionally deployed many non-standardised and individual systems that do not lend themselves to leveraging advancements in machine learning to provide more holistic analysis and reporting on the various parameters of our assets.

One of the key areas we are trying to establish the utilisation of machine learning to establish overall whole of network performance analysis. This is currently not available as we currently rely on human intervention to investigate and report on any activity within the network.

We have initiated a high level investigation into the abilities and opportunities for the business in leveraging machine learning for the analysis of protection operations. We have commenced discussions with the relevant stakeholders and are preparing to put a proposal forward to fund research and development into a solution.

5.6. Control Room SCADA System

The control room SCADA system currently under deployment facilitates remote monitoring and control of our network assets with limited additional functionality from historical practices.

Due to the Server/Software nature of this system it has a relatively short lifecycle of no more than 10 years, typically driven by the Windows platform's support lifecycle and the significant cybersecurity requirements placed on us as a critical infrastructure provider.

We are preparing to establish stakeholder requirements with broader coverage than historically applied. There is potential for this system to be configured in a manner that meets a wider range of requirements than simply remote control and monitoring.

We have established a set of SCADA naming conventions to facilitate the standardisation of Data Point names from the device to the Workstation. This body of work will ensure that any system intelligence applied can work effectively.

We are in preliminary discussions with the SCADA group to establish user requirements such that a holistic solution can be designed for the next iteration of the SCADA renewal.

5.7. Special Protection Schemes

Historical deployments of these schemes have been treated in a per instance approach with no clear strategic direction. These schemes have not been deployed with a standard and have resulted in sub-optimal integration into other systems. For example, the modification of standard protection designs to facilitate special scheme tripping.

This lack of consistency has resulted in an overall risk to the network resulting from the potential or technicians to inadvertently operate a scheme through their standard day to day activities around a protection or control asset.

We have established a standardised approach to Special Protection Schemes whereby new installations treat these schemes as a standalone circuit. This approach mitigates the risks associated with preventative and corrective maintenance of associated assets. Furthermore we are initiating a review of installed

systems to normalise the quantities that exist at a single site and move towards a configuration based solution with a centralised intelligence unit.

5.8. Network Infrastructure

The network infrastructure associated with our digital assets has historically been deployed on a single function basis. This has resulted in multiple networks deployed throughout the network for individual asset groups or functions. This approach is no longer feasible as there is an increasing need for different systems to share information to allow for improved management of our network.

Currently, we have initiated stakeholder engagement to understand their requirements and establish a detailed, centralised and accessible network infrastructure. We have issued a project to establish a future state of this system and the staging required to migrate the existing infrastructure and deliver value for the network. This will reduce OPEX and investigation costs and lend itself to the deployment of further automation enhancements.

5.9. Configuration and Standards Management Systems

Historical management of system configurations has always been a factor within design groups to manage as they deemed necessary for the assets they deliver. This was a feasible approach to these types of systems in the past. Specifically, where assets did not change significantly over time.

However, with the current pace of technological development, system upgrades (firmware, hardware, setting files, drawings etc.) are a constant factor sometimes even resulting in the same project deploying multiple revisions of the same standards.

This level of configuration complexity requires a consistent approach to standards and configuration management that does not rely on individual staff member's recollections of what has been deployed or the reliance on a device by device audit.

Currently, we are initiating stakeholder engagement to understand their requirements to establish a detail, central and accessible policy on configuration and standards management. This will reduce OPEX and investigation costs and lend itself to the development of intelligence systems.

5.10. Emerging Issues and Renewal and Maintenance Initiatives

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

5.10.1. Automation Systems Infrastructure

We are currently facing certain challenges within the IEC-61850 architecture solution. We have further identified various issues with the technology, including but not limited to:

- Cyber security remains a concern with the source of parts of the current technological solution under formal assessment
- A lack of REF protection for transformers
- A type fault with selected network switches utilised

- IEC-61850 based NEM metering is not yet an approved solution under the NER.

We are working through these challenges to establish a scope of work for continuation of the technology.

5.10.2. Control Room SCADA

Due to the software based solution for our control room SCADA, we are commencing initial stakeholder engagements to understand their requirements from the system. The SCADA solution currently under deployment will reach the end of its supportable life within 6-8 years and so we are commencing the development of the next strategic deployment.

5.10.3. Special Protection Schemes

The lack of standardisation historically has led to several mal-operations of special protection schemes in recent years. Whilst this has primarily affected customer reliability on the non-prescribed network, there are potential risks against the Shared Network under particular failure scenarios. The recent development and deployment of standardised designs has effectively mitigated these risks for new installations.

We face the challenge of revisiting and correcting previously installed systems, this has its own unique challenge of determining the appropriate cost-allocations for these systems that are comprised of both prescribed and non-prescribed schemes and the subsequent requirements for ring fencing that this presents.

6. CAPEX Forecasts

6.1. Ten Year CAPEX Profile

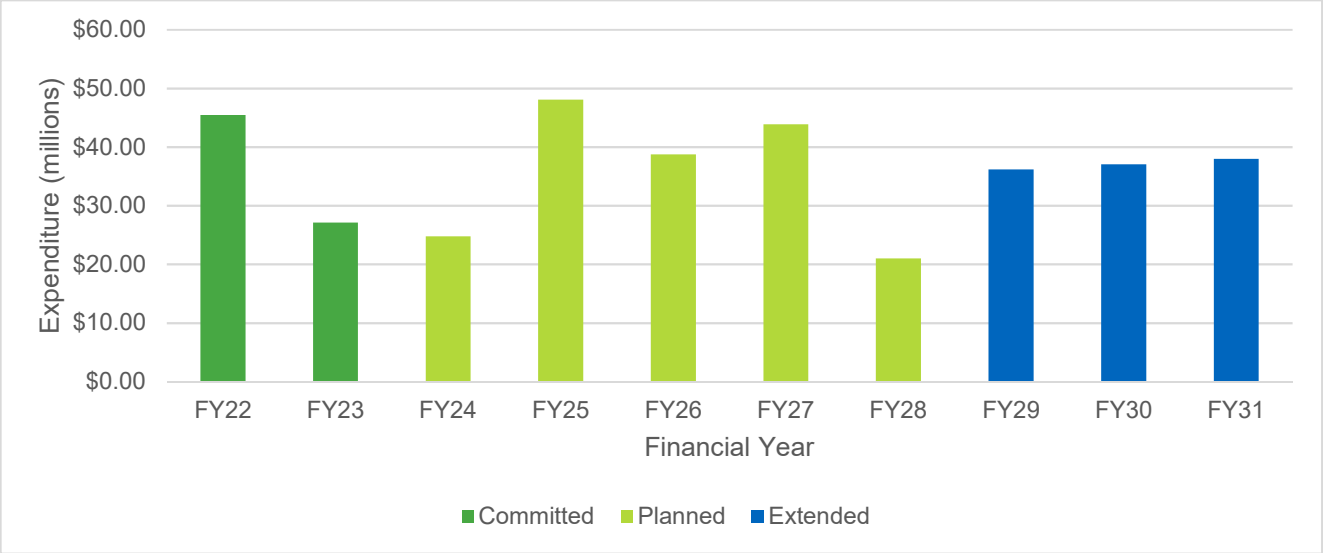
There has been a recent increase in projected capital expenditure due cost estimation updates and emerging issues. This has led to a CAPEX value exceeding our determination. The projects within the Digital Infrastructure area of control have been reviewed and a strategic direction established within this document.

Currently the ten year CAPEX profile covers all replacement expenditure forecast for all Digital Infrastructure sub-classes including:

- Automation Systems
- Telecommunications Systems
- Building Refurbishments

The committed forecast is a bottom up build of all capital expenditure currently in the Capital program of works. The planned forecast is a top down build of systems to be targeted that have not been progressed at this time. These use an average of project cost from current and historical projects. Architecture renewal projects have been based on the Combined Protection and Control concept as this has so far demonstrated the greatest value to consumers and the business. The below figure highlights committed and planned expenditure.

Figure 15 Ten Year CAPEX Forecast



The data above represents a total expenditure profile of $73 million for the remainder of RP2 to meet our strategic overall system objectives. A further $176 million has been proposed in site wide renewals for RP3 to deliver the goals and objectives of this strategy.

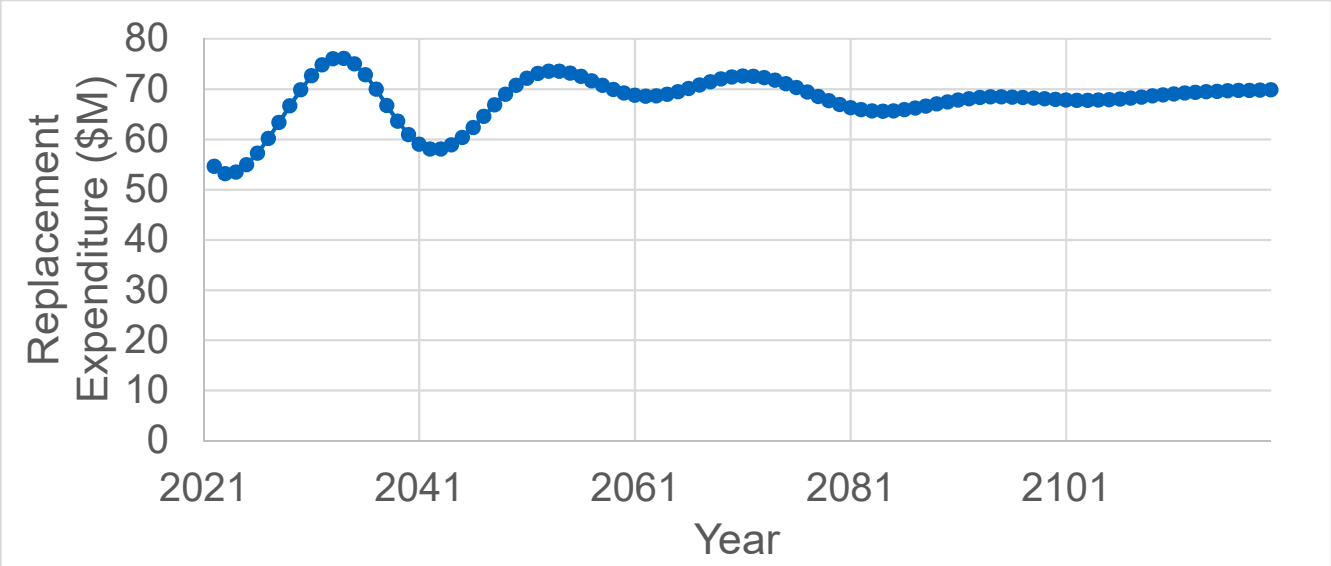
6.2. Anticipated Changes to the Asset Base

It is anticipated that the proposed expenditure profile above will result in a safer and more operationally efficient network. This expenditure represents the modernisation of otherwise obsolete and unsafe design and implementation methodologies that currently limit the potential for efficient work practices in design, installation, commissioning and maintenance activities.

6.3. Long Term - REPEX Investment Framework

The 100 Year REPEX model is used by Transgrid to create a 100 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.

Figure 16 Digital Infrastructure Long Term CAPEX



RP2 (FY2018/19 – FY2022/23) 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 assets as a leader in terms of frequencies. When comparing to Australian and International benchmarks (RIN and ITOMS), TNSPs are maintaining assets at a higher frequency to Transgrid. We are still reviewing and realising the benefits from recent initiatives and will continue to monitor effectiveness.

There are no planned changes to our maintenance plans at this time with most systems highlighted within this strategy covered under a run to fail philosophy.

Further development and deployment of the systems highlighted within this strategy will lead to more effective asset management and confidence in further reductions in portfolio wide preventative maintenance activities.

7.2. Five Year OPEX Profile

Currently the five year OPEX profile covers OPEX costs that are anticipated to meet the goals and objectives of this strategy. These values have reviewed historical OPEX research and development costs to establish a baseline estimate for future works. This profile does not cover actual renewal expenditure and covers the investigation and development costs required to normalise and standardise all our systems.

Research and development has been applied in a linear manner with end dates derived from the value the development will add to committed projects. An assumption of three R&D bodies of work every two years

has been taken in years without planned activities this is the anticipated expenditure to maintain the continual improvement of our systems to meet the latest demands.

Figure 17 Five Year OPEX Forecast

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, and the whole of system review and analysis of performance to facilitate predictive maintenance. This will lead to a more predictable and consistent expenditure profile throughout the year and should minimise the probabilities of missed or unexpected activities due to systemic issues.

8. Implementing the Strategies

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

- Asset Strategies – The detailed asset strategies outline the strategic initiatives of individual assets
- Maintenance Plans - 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.
RP1	Regulatory Period 2014/15 – 2017/18
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 Investment Review Committee annually.

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.
- The Asset Manager is responsible for the development and regular review of this strategy.

10.3. References

- Asset Management System Description
- Network Asset Strategy
- Prescribed Capital Investment Process
- Spares Policy All Streams

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
Automation Architecture • Discrete • Single Controller • Dedicated HV Controller	• Improve capability to support future energy system development	• Obsolete technologies and methodologies are deployed in the network • Cannot facilitate connection of new systems in an efficient manner • Cannot provide the functionality, visibility and operability required to monitor new installations and amendments. • Cannot provide the flexibility required for augmentation works and integration into modern systems and solutions	Renewal • Site wide renewals to modernise all digital assets and their associated infrastructure	• Ongoing –completion by 2022/23	• Refer Appendix B
				• Planned – completion by 2027/28	• Refer Appendix B
Asset Monitoring Systems • All	• Manage network safety risk	• There is no consolidation of asset monitoring systems. • The stakeholders that need access to these systems are limited in their availability • The various systems are reaching end of life and require an overhaul	Policy Review • Consolidate and standardise systems	• Ongoing – completion by 2022/23	• IWR N2656
Network Infrastructure • Inter-Site Connectivity	• Ensure accessible and relevant asset management information is available to inform business-wide decisions	• Provision of substation level data to the asset management team is difficult	Renewal • Refresh SSZ infrastructure to facilitate improved integration with other systems • Refresh Multiplexer network with MPLS based system providing	• Complete	• IWR N2264 • IWR N2282
Network Infrastructure • Substation Connectivity	• Improve capability to support future energy system development	• Control LAN deployments are expensive and limited in expandability • Systems used in the network limit expandability ad maintainability	Maintenance • Redesign Control LAN • Redesign gateway/HMI	• Complete	• IWR N2264 • IWR N2282
AC Distribution Systems • Unsegregated	• Manage network safety risk	• There is no segregation of high risk AC from lower risk control and DC cabling • There is a risk from older distribution boxes with combined and unprotected energy sources	Renewal • Segregate and secure AC distribution components to be clearly separated from other cabling and distribution components	• Ongoing –completion by 2022/23	• IWR N2066 • STD Designs Renewal • TBC (SYW and NEW 415V CB replacements)
AC Distribution Systems • Main circuit breakers	• Manage network safety risk	• There are historical design issues identified that cannot effectively provide fault protection • Arc Flash is a common design flaw in historical installations • Certain breakers are installed as disconnectors with no capability to break a fault	Design Review • Redesign installed systems that cannot break a fault • Redesign of AC distribution boards incorporating significant improvements in Fault and Arc Flash protection capabilities	• Ongoing –completion by 2022/23	• Designs in progress
Intelligence Systems	• Manage network safety risk	• We collect significant amounts of data and we rely on human analysis of individual instances.	Policy Review • Establish a Machine intelligence policy	• Ongoing –completion by 2024/25	• Requirements elicitation from stakeholders

Assets	Network Asset Strategy Objective	Emerging Issues	Strategic Initiative	Progress (completion and expenditure)	Reference Documents
		• We don't currently leverage machine learning/intelligence to establish patterns and trends	• Develop and deploy a trial system for testing		• Research and Development IWR to be issued
Control Room SCADA	• Leverage AM to support new technologies and innovations that improve or grow our business	• Current SCADA under deployment adds no new functionality to the Control Room • Current system under deployment already approaching the midlife of support cycle and requires planning for next iteration	Policy Review • Establish user requirements across all stakeholders • Invite the market to demonstrate capabilities and available technologies • Review and consolidate requirements and solutions to establish a direction	In progress • Establish position for costing of existing systems requiring upgrades	• Document a policy position • Requirements elicitation from stakeholders • Research and Development IWR to be issued
Special Protection Schemes	• Improve capability to support future energy system development	• Currently no standard approach to deployment and testing of SPS • Several older systems exist that impact new installations where needed, typically due to no documentation regarding their operation and design • Many systems not recorded accurately	Policy and Design Review • Establish a documented position regarding new SPS and existing systems • Establish user requirements across all stakeholders • Consolidate solutions into a design standard with standardised structure and equipment	• Ongoing – completion by 2022/23	• Document a policy position • Requirements elicitation from stakeholders • Deployment IWR to be issued
Configuration and Standards Management	• Ensure accessible and relevant asset management information is available to inform business-wide decisions	• There is no consistent record of asset configurations • Of particular concern is design standard version application	Policy and Design Review • Establish a documented position regarding new SPS and existing systems • Establish user requirements across all stakeholders • Consolidate requirements into a standard set of records across all assets	• Ongoing – completion by 2022/23	• Requirements elicitation from stakeholders • Deployment IWR to be issued

Appendix B – List of Site Wide Renewals

Table 12 Site Wide Renewals Committed in RP2

Capital Project	Reference Document
Liverpool Secondary Systems Renewal	NS-1599
Gadara Secondary Systems Renewal	NS-1260
Ingleburn Secondary Systems Renewal	NS-1255
Darlington Point Secondary Systems Renewal	NS-1253
Haymarket Secondary Systems Renewal	NS-1493
Muswellbrook Secondary Systems Renewal	NS-1247
Molong Secondary Systems Renewal	NS-1267
Marulan Secondary Systems Renewal	NS-1266
Tuggerah Secondary Systems Renewal	NS-1263
Broken Hill Secondary Systems Renewal	NS-1193
Coleambally Secondary Systems Renewal	NS-1196
Tamworth 330kV Secondary Systems Renewal	NS-1243
Deniliquin Secondary Systems Renewal	NS-1191

Table 13 Site Wide Renewals Planned for RP3

Capital Project	Reference Document
FY24-28 TTF Secondary Systems Renewal	NOSA-1194
FY24-28 YSN Secondary Systems Renewal	NOSA-N2211
FY24-28 SE1 Secondary Systems Renewal	NOSA-N2212
FY24-28 BER Secondary Systems Renewal	NOSA-N2213
FY24-28 ER0 Secondary Systems Renewal	NOSA-N2214
FY24-28 LT1 Secondary Systems Renewal	NOSA-N2405
FY24-28 GNS Secondary Systems Renewal	NOSA-N2406
FY24-28 BRD Secondary Systems Renewal	NOSA-N2407
FY24-28 AR1 Secondary Systems Renewal	NOSA-N2408
FY24-28 KS2 Secondary Systems Renewal	NOSA-N2409
FY24-28 FNY Secondary Systems Renewal	NOSA-N2410
FY24-28 WL1 Secondary Systems Renewal	NOSA-N2411
FY24-28 PMA Secondary Systems Renewal	NOSA-N2419
FY24-28 WW1 Secondary Systems Renewal	NOSA-N2426
FY24-28 RGV Secondary Systems Renewal	NOSA-N2427
FY24-28 CW2 Secondary Systems Renewal	NOSA-N2428
FY24-28 VP1 Secondary Systems Renewal	NOSA-N2429
FY24-28 FB2 Secondary Systems Renewal	NOSA-N2430
FY24-28 NAM Secondary Systems Renewal	NOSA-N2431
FY24-28 GN2 Secondary Systems Renewal	NOSA-N2432

Capital Project	Reference Document
FY24-28 TOM Secondary Systems Renewal	NOSA-N2433
FY24-28 LSM Secondary Systems Renewal	NOSA-N2434
FY24-28 NB2 Secondary Systems Renewal	NOSA-N2435
FY24-28 INV Secondary Systems Renewal	NOSA-N2436
FY24-28 COF Secondary Systems Renewal	NOSA-N2437
FY24-28 NEW Secondary Systems Renewal	NOSA-N2443
FY24-28 KCR Secondary Systems Renewal	NOSA-N2444
FY24-28 BRG Secondary Systems Renewal	NOSA-N2446
FY24-28 MPP Secondary Systems Renewal	NOSA-N2447
FY24-28 DMQ Secondary Systems Renewal	NOSA-N2448